The Dow Chemical Company
Midland, MI 48674

October 15, 2007

George Bruchmann, Chief
Waste and Hazardous Materials Division
State of Michigan Department of Environmental Quality
Constitution Hall
525 West Allegan Street
Lansing, MI 48909-7741

RE: Revised Midland Soils Remedial Investigation Work Plan

Enclosed please find The Dow Chemical Company's revised Remedial Investigation Work Plan (RIWP) for Midland Soils.

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Sincerely,

Ben Baker
Sr. Environmental Project Leader
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Midland, MI 48674

Enclosure(s)

Work Plan

Midland Area Soils Remedial Investigation

Submitted by

The Dow Chemical Company

Midland, Michigan

October 2007

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SECTION 1

Introduction

The Midland Area Soils Remedial Investigation (RI) Work Plan (RIWP) was prepared pursuant to Condition XI.B.5 of the Hazardous Waste Management Facility Operating License (License) issued by the Michigan Department of Environmental Quality (MDEQ) for The Dow Chemical Company (Dow) Midland Plant (Midland Plant) in Midland, Michigan (MDEQ, 2003). Background information, an overview of the RI objectives and approach, and summary of the RIWP organization and content are provided below.

This RIWP addresses work to be performed in offsite areas identified under Condition XI.B.2 of the License, known as the Midland Soils Study Area (Study Area). The Study Area for this RIWP is the portion of the city of Midland and the surrounding communities that may have been impacted by aerial releases of hazardous substances from the Midland Plant, including emissions from incinerators, open burning of wastes, wind blown dust, and emissions from production units and power plants. The Study Area encompasses residential, commercial, industrial, and undeveloped properties surrounding the Midland Plant, as shown on Figure 1-1. This initial area was defined in the *Sampling and Analysis Plan in Support of Bioavailability Study, Midland Area Soils* (Pre-RI Study) based on consideration of surface soil sample data from previous studies, and the predominant wind directions (CH2M HILL, 2006). The Study Area does not include the Tittabawassee River Study Area adjacent to and downstream of the Midland Plant, which is the subject of a separate RIWP. Offsite migration of hazardous substances from the Midland Plant via groundwater and other potential release pathways is being addressed by onsite corrective action activities, as detailed in Section 1.1.

This RIWP supersedes the revised *Scope of Work for Midland Area Soils Remedial Investigation* (SOW) that was developed and approved under the License (Dow, 2005a), and the Midland Area Soils RIWPs submitted to MDEQ in December 2005 (Dow, 2005b) and December 2006 (Dow, 2006). This RIWP has been updated to incorporate the results of the Pre-RI Study and other work performed in 2007. Table 1-1 lists the SOW requirements and identifies the section of the RIWP that addresses each requirement.

1.1 Objectives and Approach

This RIWP includes, but is not limited to, the following elements:

- A description of current conditions summarizing existing information on relevant Midland Plant history and the nature of the area to be investigated, as defined by the License.
- A preliminary conceptual site model (PCSM) integrating existing information on physical conditions, the distribution of hazardous substances in soil, environmental fate and transport, land use, and potential human and ecological receptors.

- A description of the process that will be used to complete the RI for the Study Area, including the human health and ecological risk assessments, activities to be conducted for the RI, and implementation schedule.

This RI has the following general objectives:

- Identify contaminants of potential concern (CoPCs) for human health and contaminants of potential ecological concern (COPECs) in the Study Area associated with Midland Plant operations
- Characterize the lateral and vertical distribution of CoPCs and COPECs in the Study Area, as needed to support remedial decision making
- Characterize fate and transport mechanisms that influence the distribution of CoPCs and COPECs
- Identify complete exposure pathways and assess risks to human health and the environment
- Collect information to support the preparation of a feasibility study (FS), if needed, and a remedial action plan

The RIWP activities will be coordinated with the onsite portions of the License, which require Dow to identify the potential for continuing sources. This will include coordination with work being done under License Conditions X.A through X.M, Environmental Monitoring Conditions; and XI.R, Source Control. No investigations are planned as part of the Midland Area Soils RI to investigate current or past potential releases from the Midland Plant via groundwater because groundwater is addressed by other elements of the License and is being managed by Dow's onsite project team.

The combination of onsite actions taken by Dow and monitoring activities required by the License are designed to address releases of contaminants via the groundwater transport pathway.

1.2 Report Organization

This RIWP includes 12 sections and seven appendixes. The main text is organized as follows:

- **Section 1—Introduction:** This section presents information regarding the objectives and approaches for the Midland Area Soils RI.
- **Section 2—Background**: This section summarizes the results of previous investigations and describes interim response activities (IRAs) that have been conducted in the Study Area.
- **Section 3—Current Conditions:** This section summarizes environmental information that is relevant to establishing the scope for the Midland Area Soils RI, including descriptions of the Study Area, potential sources of hazardous substances, and the distribution of dioxins and furans in soil based on available data.

- **Section 4—Preliminary Conceptual Site Model:** This section presents a PCSM that integrates information necessary to understand how hazardous substances move through the Study Area and come into contact with human and ecological receptors.
- **Section 5—Remedial Investigation Approach:** This section describes the phased approach that was developed to address the objectives of the RI.
- **Section 6—Human Health Risk Assessment:** This section describes the human heath risk assessment (HHRA) approach.
- **Section 7—Ecological Risk Assessment:** This section describes the ecological risk assessment (ERA) approach.
- **Section 8—Public Participation Plan:** This section outlines activities to inform residents of Dow's offsite corrective action activities.
- **Section 9—Implementation Schedule:** This section provides the schedule and planned deliverables for the RI.
- **Section 10—References:** This section lists the references that are cited in the RIWP. Section 10.1 provides references for Sections 1 through 5 and 7 through 9, and Section 10.2 provides references for Section 6.

Sections 11 and 12 provide a glossary and list of acronyms and abbreviations used in the RIWP, respectively. The appendixes provide supporting information for the RIWP, including summaries of the quality and usability of existing data for possible use in the RI (Appendix A), documentation of a remedial action performed to address localized soil contamination along a haul road adjacent to the Midland Plant (Appendix B), a map and table presenting dioxin data from previous offsite investigations (Appendix C), development of the target analyte list (TAL) for the RI (Appendix D), supporting documentation for the HHRA (Appendix E), supporting documentation for the site history (Appendix F), and the Pre-RI Study Report (Appendix G).

TABLE 1-1
Summary of Requirements in the Scope of Work
Midland Area Soils Remedial Investigation Work Plan

SOW page	Requirement	Where Requirement is Addressed
1	Be designed to address the factors described in R 299.5528(3) "as appropriate to the facility."[1]	See Table 1-2, Summary of Technical Requirements for the Remedial Investigation.
2	Summarize existing information in the current conditions section and determine whether there are continuing sources.	See Section 3 for current conditions; source control is addressed as part of the onsite corrective action program as described in Section 1.1.
2	Summarize relevant facility history in current conditions section.	Section 3.2.
2	Include a preliminary conceptual site model (PCSM), integrating existing information on physical conditions, nature and extent of contaminants, environmental fate and transport, land use, and potential receptors; in coordination with work being done onsite (facility shallow groundwater monitoring program, ambient air monitoring, soil monitoring, and source control).	See Section 4 for PCSM; coordination with onsite programs discussed in Section 1.1.
2	Discuss data quality objectives (DQOs). Types of questions will include: what are characteristics of soils within the city; what is the nature and extent of potential constituents of interest (PCOIs); do conditions in soils present a risk?	DQOs will be presented in the Phase II sampling and analysis plan (SAP) to be submitted to MDEQ after MDEQ approval of site-specific direct contact criteria.
2	Address collection of data to establish soil characteristics for use in the bioavailability study.	This work was performed in advance of the RI and is reported in the *Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils.*
2-3	Describe field sampling, which will be performed in at least two phases, with Phase I scheduled to begin in April 2006, and Phase II when appropriate site-specific or area-wide criteria have been established.	Section 5 describes the revised RI approach, which includes one phase of field sampling and analysis. This work will occur after site-specific direct contact criteria have been established. Section 9 provides the current implementation schedule.
3	Provide details regarding specific areas to be studied and propose analyte list in the sampling and analysis plan (SAP).	The Study Area is shown on Figure 1-1. The target analyte list (TAL) is discussed in detail in Appendix D. Additional areas of study and specific analytes, if different from the TAL, will be defined in the Phase II SAP as appropriate.
3	Include maps, figures, and standard operating procedures (SOPs) to describe protocols for the collection and evaluation of data.	Section 5.3.1: This information will be provided in the Phase II SAP to be submitted to MDEQ after MDEQ approval of site-specific direct contact criteria.
5	Include a work plan element for HHRA activities during the RI (the primary RI steps are illustrated on Figure 1.A of the SOW).	HHRA activities are described in Section 6.

[1] This rule sets forth the elements that a RIWP or RI must address (Table 1-2).

TABLE 1-1
Summary of Requirements in the Scope of Work
Midland Area Soils Remedial Investigation Work Plan

5	Include further identification of potential exposure pathways and DQOs related to the HHRA as appropriate.	Section 6.2 discusses exposure pathways; DQOs will be presented in a separate HHRA data collection SAP as appropriate.
5-6	Identify which potential exposure pathways will be addressed in the RI, including rationale for inclusion/exclusion.	Section 6.2.
5	HHRA component of RIWP:	Section 6:
	• Exposure pathway identification and refinements	• Sections 6.2.2, 6.4.1.
	• Exposure algorithm identification	• Section 6.4.3.
	• Exposure data needs	• Section 6.1.5.
	• Toxicity criteria identification/derivation	• Section 6.5.
	• Screening-level risk assessment	• Section 6.6.3.
	• Perform deterministic or probabilistic risk assessment and generate site-specific criteria	• Section 6.1.2 (direct contact criteria); Section 6.6.4 (probabilistic risk assessment).
	• Risk management decisions	• Sections 5.2.7, 5.3.4, 6.6.4.
	• Evaluation of all land uses allowed under current zoning; residential, agricultural, commercial, industrial, recreational	• Section 6.2.2.
	• Discuss exposure pathways. "Tentative" pathways include:	• Sections 6.2.2, 6.4.1.
	– ingestion of soil and dust (interior and exterior)	– Sections 6.2.2, 6.4.1.
	– ingestion of local vegetables and produce	– Section 6.2.2, 6.4.1.
	– ingestion of local fish and game	– Addressed in the Tittabawassee River and Floodplain RIWP.
	– ingestion of sediment and surface water (primarily recreational)	– Addressed in the Tittabawassee River and Floodplain RIWP.
	– inhalation of soil and dust (including agricultural dust)	– Sections 6.2.2, 6.4.1.
	– dermal exposure via soil, dusts, sediments and surface waters	– Sections 6.2.2, 6.4.1 (soil and dust); Tittabawassee River and Floodplain RIWP (sediments and surface water).
6	Ecological risk assessment (ERA); outline activities to evaluate the need for an ERA in the Study Area and determination made whether an ERA is needed.	Section 7.
6	Preliminary feasibility study planning; provide work plan element to include remedy considerations.	Section 5.2.6.
6	Public participation plan; submit a revised and consolidated plan as part of the RIWP, including incorporation of the "stakeholder" process.	Section 8

TABLE 1-1
Summary of Requirements in the Scope of Work
Midland Area Soils Remedial Investigation Work Plan

7	Provide a detailed implementation schedule for the RI (RI to commence within 45 days of MDEQ's approval of RIWP; Phase I RI Report submitted within 60 days of completion of work).	Section 9.

TABLE 1-2
Summary of Technical Requirements for the Remedial Investigation
Midland Area Soils Remedial Investigation Work Plan

R 299.5528 Section	Requirement	Where Requirement Will Be Addressed
(3)(a)	Define the nature and extent of contamination.	Section 3.3 of this RIWP describes the nature and extent of contamination based on existing data. Section 5 describes the approach for completing the definition of nature and extent. The updated results will be presented in the RI report.
(3)(b)	Identify risks to the public health, safety, and welfare; the environment; and natural resources including identification of any water wells and wellhead protection zones	Approaches for assessing human health and ecological risk are presented in Sections 6 and 7 of the RIWP. Findings will be presented in the RI report.
(3)(c)	Define relevant exposure pathways.	Section 6.2 discusses the current understanding of human health exposure pathways. Ecological pathways and receptors will be identified as part of the screening level ecological risk assessment (SLERA) described in Section 7.2.2. The RI report will refine this understanding and present an updated conceptual site model (CSM).
(3)(d)	Identify the following with respect to hazardous substances that are present: (I) amount, (ii) concentration; (iii) hazardous properties; (iv) environmental fate; (v) bioaccumulative properties, (vi) persistence, (vii) mobility, and (viii) physical state.	The amount and concentration of hazardous substances based on existing data is summarized in Section 3.3. Information on fate and transport parameters for potential constituents of interest (PCOIs) is provided in Section 4.3. Section 5 addresses additional data collection to supplement this information. A refined discussion will be included in the RI report.
(3)(e)	Define the following with respect to the physical setting of the facility: (I) geology, (ii) hydrology, (iii) hydrogeology, (iv) depth to saturated zone, (v) hydrologic gradients, (vi) proximity to aquifers, (vii) proximity to surface water, (viii) proximity to floodplains, and (ix) proximity to wetlands.	Section 3 describes the physical setting of the site and addresses these elements as applicable. The RI report will incorporate new information found during the implementation of this RIWP into the description of the site setting.
(3)(f)	Identify current and potential groundwater use.	Groundwater in the study area is being evaluated as part of the onsite corrective action work.
(3)(g)	Identify and evaluate the source.	Section 3.2 summarizes existing information about potential sources of contamination. Any new information obtained during the implementation of this RIWP will be included in the RI report.
(3)(h)	Evaluate whether hazardous substances at the facility can be reused or recycled.	This pertains to onsite Midland Plant operations and is being evaluated as part of the onsite corrective action work.
(3)(i)	Identify the likelihood of future releases if the hazardous substances remain at the facility.	This pertains to onsite Midland Plant operations and is being evaluated as part of the onsite corrective action work.
(3)(j)	Define the extent to which natural or human-made barriers currently contain the hazardous substances and the adequacy of the barriers.	This element is not applicable to Midland area soils with the exception of interim soil cover associated with interim response activities (IRAs) as described in Section 2.2.

TABLE 1-2
Summary of Technical Requirements for the Remedial Investigation
Midland Area Soils Remedial Investigation Work Plan

R 299.5528 Section	Requirement	Where Requirement Will Be Addressed
(3)(k)	Identify the impact of any planned demolition activities on conditions at the facility.	This pertains to onsite Midland Plant operations and is being evaluated as part of the onsite corrective action work.
(3)(l)	Determine the extent to which hazardous substances have migrated or are expected to migrate from the area of release.	Section 3.3 describes the currently known extent of contamination. Section 4 and Appendix D present the current understanding of contaminant fate and transport. This information will be refined throughout implementation of the RIWP and included in the RI report.
(3)(m)	Evaluate injury to, destruction of, or loss of natural resources related to the release.	Section 7 address evaluating ecological risk in the Study Area due to releases from the Midland Plant. Impacts to natural resources will be addressed in the RI report.
(3)(n)	Determine the contribution of the hazardous substances at the facility to contamination of the air, land, or water.	Section 3.3 describes the nature and extent of contamination in the Study Area based on existing data. Section 5 presents the approach for further addressing this requirement. The results will be included in the RI report.
(3)(o)	Determine legally applicable or relevant and appropriate state and federal requirements.	Legally applicable or relevant and appropriate state and federal requirements will be identified in the remedial action plan for Midland area soils.
(3)(p)	Design sampling and provide rationale for parameter selection.	RI sampling, analysis, and data evaluation details will be provided in separate Sampling and Analysis Plans (SAPs) prior to implementation of RI field activities.
(3)(q)	Describe monitoring well construction.	Monitoring wells will not be installed during this investigation. Groundwater is addressed under onsite corrective action activities.
(3)(r)	Describe and present rationale for any geophysics techniques used in the investigation.	Geophysical techniques will not be used for this investigation.
(3)(s)	Define sample collection and preparation procedures.	RI sampling, analysis, and data evaluation details will be provided in separate SAPs prior to implementation of RI field activities.
(3)(t)	Identify laboratory or laboratories responsible for sample analysis.	RI sampling, analysis, and data evaluation details will be provided in separate SAPs prior to implementation of RI field activities.
(3)(u)	Select laboratory methods used to generate remedial investigation data.	Appendix D identifies laboratory methods to be used for target analyte list (TAL) constituents. Any other required laboratory methods will be specified in separate SAPs prior to implementation of RI field activities.
(3)(v)	Describe any statistical methods used to evaluate laboratory data relative to cleanup criteria.	RI sampling, analysis, and data evaluation details will be provided in separate SAPs prior to implementation of RI field activities.
(3)(w)	Expand on other matters appropriate to the facility in addition to those described above.	Additional information will be incorporated into the RI report as appropriate.

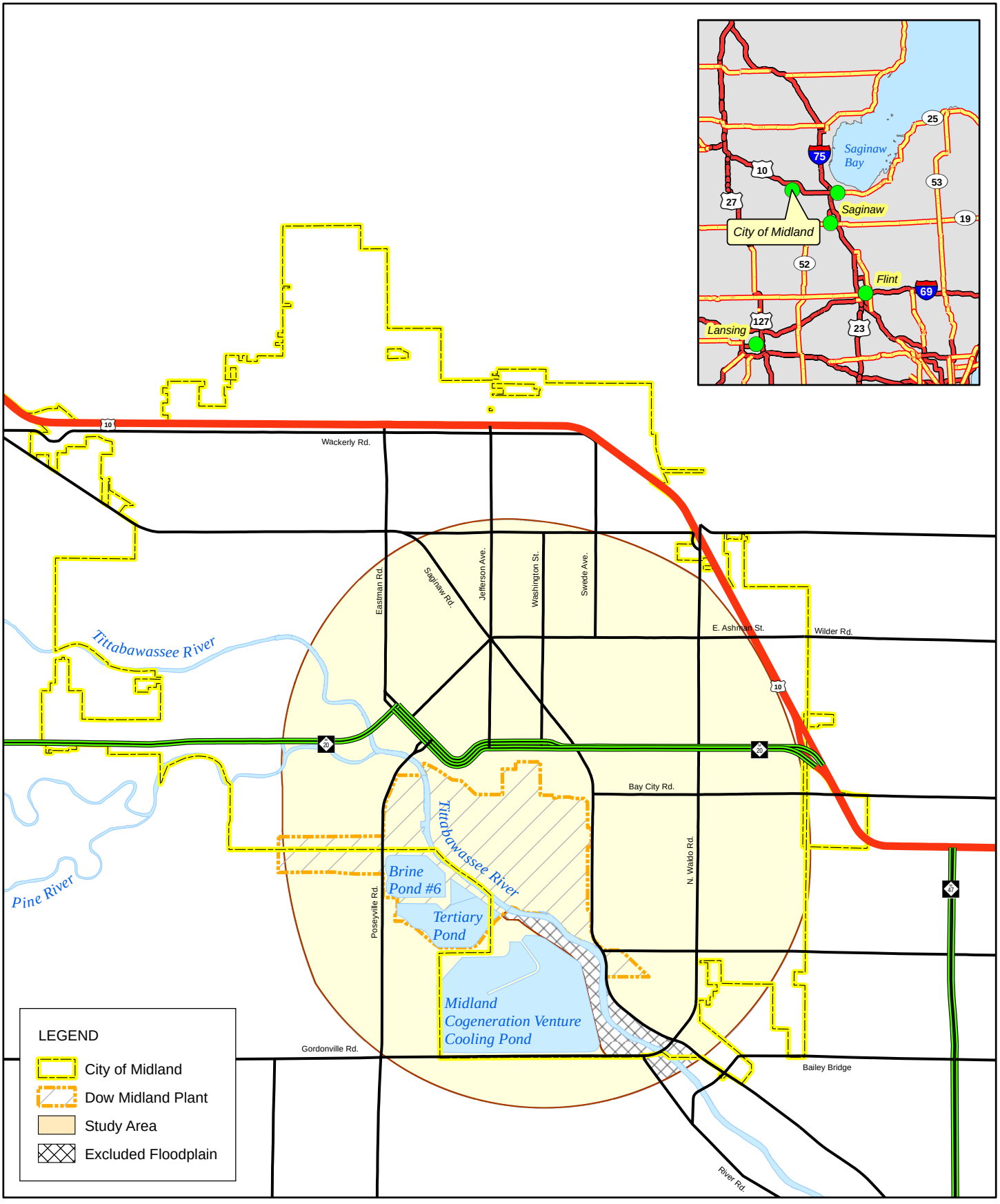


Figure 1-1
Midland Study Area
Midland Area Soils Remedial Investigation Work Plan

SECTION 2

Background

This section summarizes the results of previous investigations and describes IRAs that have been conducted in the Study Area.

2.1 Previous Investigations

The current understanding of hazardous substances in soil in the Study Area is based largely on studies conducted by Dow in 1984 (Agin et al., 1984) and 1998 (Dow, 2000), U.S. Environmental Protection Agency (USEPA) in 1983-1984 (USEPA, 1985), and MDEQ in 1996 (MDEQ, 1997). Although these studies focused primarily on dioxins and furans, the 1985 USEPA study also analyzed samples for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). More recent sampling results have been provided by the University of Michigan Dioxin Exposure Study (UMDES), and onsite soil sampling conducted by MDEQ at the Midland Plant in 2005 and 2006. Soil sampling for the Pre-RI Study was completed in 2006, although the exact sample locations associated with the results are not yet known because the samples were blinded to protect the anonymity of property owners using a procedure that was approved by the MDEQ (CH2M HILL, 2007). A study conducted by USEPA in 1987 provided limited data on concentrations of dioxins and furans in garden vegetables.

The studies conducted prior to 1996 by Dow, USEPA, and MDEQ focused on sampling and analysis for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as the main dioxin congener. More recent studies report dioxin and furan data as toxic equivalent (TEQ) concentrations. Dioxin and furan sample results from the laboratory are typically reported on an individual congener basis. TEQ concentrations are calculated according to a toxicity weighting scale. The measured concentration of each dioxin and furan congener is multiplied by a corresponding toxic equivalency factor (TEF), and the products are summed to determine the TEQ concentration, as shown in Equation 1:

$$\textit{Total TEQ}\ (\text{2,3,7,8-}\textit{TCDD equivalents}) = \Sigma\ (\textit{Congener-specific concentration} * \textit{Congener-specific TEF}) \qquad (1)$$

TEQ concentrations are typically reported in concentrations of parts per trillion (ppt). The mammalian TEFs developed by the World Health Organization (WHO) are provided in Table 2-1. TEFs are developed by the WHO based on the best available information at the time. The previous investigations cited in this RIWP utilized TEFs from pre-1998 and 1998. Dow has recalculated the TEQ concentrations based on the 2005 WHO TEFs so that TEQs can be directly compared (Appendix C). Table 2-1 provides both the 1998 and 2005 TEFs for comparative purposes.

Following are the objectives and conclusions of previous investigations in the offsite Study Area:

- **1984 Dow study—**The primary objective of the 1984 Dow study was to identify point sources of dioxins and furans at the Midland Plant (Agin et al., 1984). As part of the

study, 11 samples also were collected within the offsite Study Area. At the time this study was published, the Public Health Service Center for Disease Control had indicated that 2,3,7,8-TCDD concentrations below the concern level of 1 part per billion (ppb) were sufficiently low that there was "no medical reason to warrant concern or suggest remedial action" (Agin et al., 1984). Concentrations of 2,3,7,8-TCDD in the offsite samples ranged from 0.6 to 450 ppt. The study concluded that the levels of 2,3,7,8-TCDD were "significantly below the 1 ppb concern level established by the [Centers for Disease Control and Prevention] for residential areas" (Agin et al., 1984).

- **1985 USEPA study**—The primary objective of the 1985 USEPA study was to determine whether concentrations of dioxins and other hazardous substances present in the offsite Study Area might pose an unacceptable public health risk (USEPA, 1985). Approximately 40 samples were collected in the offsite Study Area and analyzed for 2,3,7,8-TCDD. Concentrations of 2,3,7,8-TCDD in the offsite samples ranged from 3 to 310 ppt. Thirteen samples also were analyzed for VOCs, SVOCs, pesticides, and PCBs. Several polynuclear aromatic hydrocarbons (PAHs), chlordane, and PCB-1254 were detected in this sample group. USEPA concluded that "data obtained from this study do not suggest widespread environmental contamination by 2,3,7,8-TCDD, and other PCDDs [polychlorinated dibenzo-p-dioxins] and PCDFs [polychlorinated dibenzofurans] at significant levels with respect to public health or adverse environmental impacts" and that other sampled hazardous substances "do not pose an unacceptable health risk" (USEPA, 1985).

- **1987 USEPA garden vegetable study**—In addition to the above studies, in 1987, USEPA Region 5 conducted preliminary screening of homegrown vegetables from two gardens in Midland and a control garden in Eagle, Michigan (USEPA, 1988). Fresh or frozen vegetables (carrots, beets, onions, and lettuce) and garden soil samples were collected and analyzed for dioxins and furans. Although dioxins and furans were present in the soils of both gardens, they were not detected in any vegetable tissue samples (USEPA, 1988).

- **1996 MDEQ study**—The objective of the 1996 MDEQ study was to evaluate the distribution of dioxin and furan concentrations in the Midland community and the Midland Plant and to compare these results to those of the 1984 Dow and 1985 USEPA studies (MDEQ, 1997). The study reported results for 17 individual dioxin and furan congeners, as well as calculated TEQs using pre-1998 TEFs. Approximately 35 samples were collected in the offsite Study Area. 2,3,7,8-TCDD concentrations in the sample group ranged from 3 to 288 ppt, and TEQ concentrations ranged from 9 to 602 ppt. The study concluded that "the 1996 data suggests a decline in the concentrations of 2,3,7,8-TCDD from the 1984 and 1985 results" (MDEQ, 1997).

- **1998 Dow study**—Approximately 45 soil samples were collected in the offsite Study Area during the 1998 Dow study (Dow, 2000). Most samples were collected from Dow property (Corporate Center area). The objective of this study was to determine descriptive statistics (mean, median, geometric mean, standard deviation, variance, and normality check) for sample groups from the Dow Corporate Center and Saginaw/Salzburg/Rockwell roads site. Concentrations of TEQs (based on 2005 TEFs) in the data set ranged from 8.8 to 2,000 ppt (Dow, 2000).

- **2006 UMDES**—The objective of the UMDES was to evaluate human exposure to the dioxins, furans, and dioxin-like PCBs in Midland and along the Tittabawassee River (University of Michigan, 2006). The scope of the study is summarized in Section 6.1.3. Soil and household dust samples were collected from 32 locations in the Midland area (referred to as the "Midland Plume") as well as in other areas. The sample locations remain confidential as part of the study design; however, summary statistics for soil and dust data from the "Midland Plume" are summarized in Table 2-2. Mean and median TEQ concentrations (based on 2005 TEFs and data for 17 dioxin and furan congeners) were lowest in household dust samples (32 and 27 ppt, respectively), and highest in soil samples collected from the perimeters of houses (approximately 110 and 58 ppt, respectively). TEQ concentrations in the data set ranged from 4.5 to 850 ppt.
- **2005 MDEQ samples**—MDEQ collected surface soil samples from eight locations within the Midland Plant in 2005. Samples were analyzed for dioxins and furans, PCBs, pesticides, VOCs, SVOCs, and metals. TEQ concentrations in the surface soil samples (based on 1998 TEFs) ranged from 2.3 to 1,800 ppt. Other chemicals were detected as well.
- **2006 MDEQ samples**—MDEQ collected additional surface soil samples from within the Midland Plant in 2006. These samples were also analyzed for dioxins and furans, PCBs, pesticides, VOCs, SVOCs, and metals. TEQ concentrations reported by Dow for 15 samples ranged from 8.5 to 53,000 ppt.
- **Pre-RI Study samples**—Soil samples were collected at 136 stations in October and November 2006. Subsets of samples were analyzed for dioxins and furans, additional chemicals (VOCs, SVOCs, metals, pesticides, and PCBs), and parameters that may influence the bioavailabilty of dioxins and furans. TEQ concentrations ranged from 2.4 to 950 ppt, which is consistent with results from previous studies in the city of Midland. Because of the sample blinding requirements of the study, it was not possible to evaluate the spatial extent of dioxin and furans. The Pre-RI Study is discussed further in Section 5.1.1.

As part of developing the RIWP, the soil sample data from each of the previous investigations were reviewed to determine the degree to which the data could be used in RI data evaluation activities. The results of this evaluation are documented in Appendix A.

2.2 Interim Response Activities

Two types of IRAs have been undertaken for the Midland area: one to address potential exposure to dioxins and furans in soil, and one to address risk communication. Properties located close to and downwind of the Midland Plant appear to have higher concentrations of dioxins and furans than properties upwind or farther away from the plant. These data further suggested that some properties proximal and downwind of the Midland Plant might have dioxin and furan TEQ concentrations exceeding the Agency for Toxic Substances and Disease Registry (ATSDR) action level of 1,000 ppt.

Actions were prioritized based upon exposure potential to dioxins and furans in soil. The highest priority for the IRA was residential use properties where TEQ concentrations in soil were known or presumed to exceed the ATSDR 1,000 ppt action level. Properties with

exposure potential similar to residential use (that is, schools, child care facilities, nursing homes, and adult day care facilities) also were considered a high priority for the IRA. Mitigation options were offered to the owners of these properties.

The IRA was implemented using the following procedure:

- Identified residential use properties and properties with similar exposure potential that were known or presumed to have dioxin and furan concentrations in soil exceeding the ATSDR 1,000 ppt TEQ action level
- Established the priority for mitigating potential exposure to dioxins and furans with an IRA
- Identified a range of mitigation options for specific land uses that could be implemented and were acceptable to the property owner, either presumptively or in light of property-specific conditions
- Implemented the mitigation option(s) agreed to by the property owner to limit or prevent exposure to contaminants

Figure 2-1 shows the areas where IRAs were performed. These areas include the following neighborhoods:

- Corning Lane area: This area consists of mixed residential and commercial/industrial land use bounded by Saginaw Road to the west, Bay City Road to the north, Bierlein Services Property to the east, and Mark Putnam Drive to the south.
- Wexford/Tibbs area: This area consists of mixed residential and commercial/industrial land use bounded by Lyon Street on the north and west, Tibbs Street to the east, and an abandoned railroad to the south.
- East of the facility: This area consists predominately of residential land use bounded by Bay City Road to the north, Bierlein Services Property to the west, Mark Putnam Drive to the south, and Sam Street to the east.

The following mitigation measures were offered to the property owner(s):

- Education and outreach (offered to all)
- Provide temporary cover material (for example, sod, soil, raised garden bed, raised area, paving, and mulch) for exposed or poorly covered areas used by the owner
- Provide paving or cover material at entryways to minimize track-in of contaminated soils
- House cleaning, including cleaning of carpeting, interior ductwork, and other surfaces where contaminated soil or dust particles may be located
- Monitoring, maintenance, and restoration of mitigated areas as necessary
- Other reasonable mitigation measures identified and accepted by owner(s) based on their property use

Table 2-3 summarizes the number of properties accepting each type of mitigation measure.

In addition to the IRA for soils, an IRA for risk communication was initiated. The objectives of the *IRA Work Plan: Communications* are to provide information on the potential risks associated with exposure to dioxins and furans, and practical measures that can be taken to mitigate those risks; provide information about Dow's offsite corrective action activities for Midland area soils and the Tittabawassee River Study Area; and provide for notification to the public about the potential presence of dioxin and furan impacted soils that may exist on their property (Dow and MDEQ, 2005). This IRA consisted of several elements, including:

- Community Information Centers: Dow set up and maintains a series of seven Community Information Centers (CICs). The CICs provide brochures and pamphlets with information on dioxins and furans and related public advisories, and are placed in public places such as libraries and township halls. One of the CICs is located at The Grace A. Dow Library, which is within the Study Area.
- Public Information Materials: This element of the IRA is for the preparation of public information materials that are easy-to-read, contain relevant educational information about dioxins and furans and the corrective action process, and provide straight-forward suggestions for limiting exposures. The materials were drafted by the Watershed Initiative Network (WIN) and modified by MDEQ prior to printing. Three brochures (*Reducing Exposure from Agricultural Activities*, *Health Questions*, and *Reducing Exposure at Home*) were produced and distributed to the CICs in February 2006.

A Public Participation Plan that outlines activities to inform residents of the Midland, Saginaw, and Bay City areas of Dow's offsite corrective actions is provided in Section 8.

TABLE 2-1
World Health Organization Mammalian Toxic Equivalency Factors
Midland Area Soils Remedial Investigation Work Plan

Congener	1998 TEF	2005 TEF
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	1	1
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01
OCDD	0.0001	0.0003
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	0.03
2,3,4,7,8-PeCDF	0.5	0.3
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.0001	0.0003

Sources: Van den Berg et al., 1998; Van den Berg et al., 2006

Notes:
PeCDD = pentachlorodibenzo-p-dioxin
HxCDD = hexachlorodibenzo-p-dioxin
HpCDD = heptachlorodibenzo-p-dioxin
OCDD = octachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzofuran
PeCDF = pentachlorodibenzofuran
HxCDF = hexachlorodibenzofuran
HpCDF = heptachlorodibenzofuran
OCDF = octachlorodibenzofuran

TABLE 2-2
Statistical Summary of Soil and Dust Sample Data for the Midland Area from the UMDES
Midland Area Soils Remedial Investigation Work Plan

Number of samples	Sample group	Minimum TEQ (ppt)	Maximum TEQ (ppt)	Mean TEQ (ppt)	Median TEQ (ppt)
32	House perimeter 0-1”	4.5	740	110	58
31	House perimeter 1-6”	6.8	850	100	56
24	Soil contact 0-6”	19	260	59	53
32	Dust	7.6	95	32	27

Soil and dust sample data obtained from http://www.sph.umich.edu/dioxin/handouts.html
TEQ values based on 2005 WHO TEFs and include 17 dioxin and furan congeners
House Perimeter - Up to four stations close to the residence; one station on each side where accessible soil is present
Soil Contact - Up to two stations, vegetable and flower garden samples
Dust - Household vacuum dust sample from two sampling locations

TABLE 2-3
Number of Parcels Accepting IRA Mitigation Measures
Midland Area Soils Remedial Investigation Work Plan

Mitigation Option	Number of Parcels
Carpet cleaning	80
Hard floor cleaning	69
Horizontal hard surface	68
Cleaning of heating system	67
Replacement of furnace filter	62
Landscaping	87
Doormat	18
Refused services	8

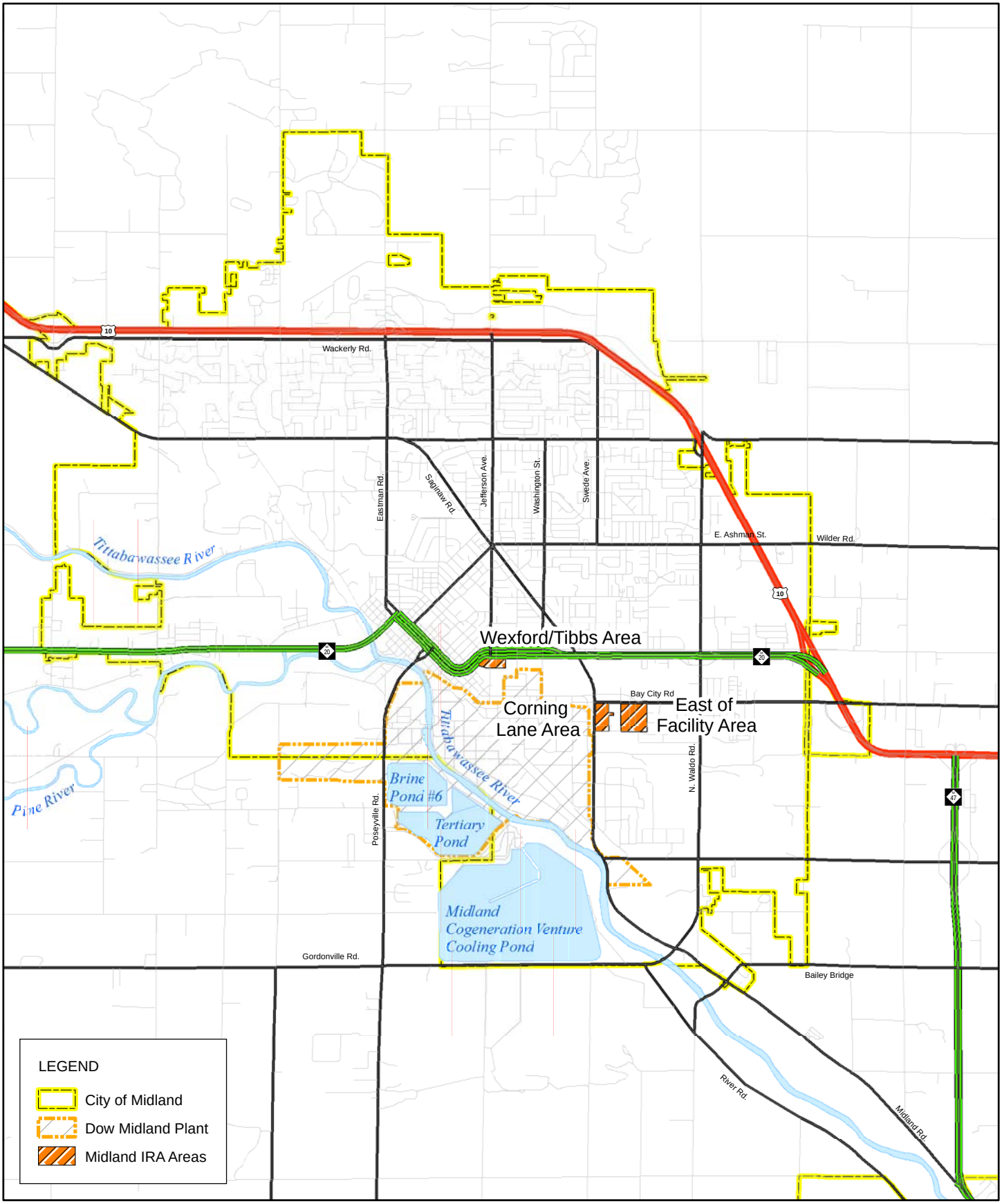


Figure 2-1
Midland IRA Areas
Midland Area Soils Remedial Investigation Work Plan

SECTION 3

Current Conditions

This section describes the current conditions in the Study Area. Based on historical information regarding surface soils, the primary source of hazardous substances, and the focus of this RIWP, is airborne deposition of particulates emitted from the Midland Plant (USEPA, 1985). Historical information indicates that some particulates may have been transported offsite via vehicle "track-out." Potential impacts of historical track-out will be addressed in the RI; however, the potential for track-out from present-day activities and other potential pathways for offsite migration are being addressed under other conditions of the License. This section presents information on the physical setting of the Study Area, historical plant operations relevant to airborne emissions, and the distribution of hazardous substances in soil based on previous studies.

3.1 Physical Setting

This section summarizes information on land development, climate and meteorology, hydrology and surface water, geomorphology and geology, hydrogeology, and ecology. This information will be used to provide context for understanding the lateral and vertical distribution of CoPCs and COPECs present in the Study Area when the RI data are available.

3.1.1 Land Development

In the early 1900s, the area surrounding the Midland Plant and the city of Midland was primarily composed of land used for agricultural and recreational purposes. Beginning in 1916, a marked increase in land development for residential and industrial purposes occurred. By the 1960s, residential properties were distributed throughout the Midland area and the rate of increase had stabilized; however, industrial and commercial land development continued to occur to the east, southeast, and southwest of Midland over the years. From the late 1800s to 2000, the population of the city increased from 1,160 to 41,685 (U.S. Department of Agriculture, 1997; Dee, 2005). The city currently encompasses approximately 28 square miles. As the size of the city has increased, surficial soils have been redistributed through grading, excavation, and backfilling.

The current land development within the Study Area was evaluated and assigned to one of six categories similar to those used by MDEQ for establishing cleanup criteria in Part 201 (Figure 3-1). Land development classifications were established primarily by reviewing aerial photographs and using secondary information and knowledge of local conditions. High-resolution aerial photographs taken in April 2004 were available for most of the Study Area and were the primary sources used. However, coverage was not available from the April 2004 aerial photographs for the southwest corner of the Study Area, so lower-resolution aerial photographs taken in 1998 were used for this area. Distinctions between some land development types—for example, Commercial II, III, and IV versus Industrial, or Residential versus Commercial I—were not always evident from aerial photographs. Other

sources of information, such as local knowledge and local zoning, were used as needed to help establish and refine the classifications. Detailed land use maps will be prepared as part of the Phase I RI report using more recent aerial photography from 2005 and field verification (Section 5.2.2).

Land development categories used for this analysis are defined as follows:

- **Residential:** This category includes properties used predominately for residential purposes. These include single-family homes, condominiums, apartment buildings, and mobile homes.
- **Recreational/Undeveloped:** This category includes developed parks, boat launches, picnic areas, athletic fields, golf courses, country clubs, undeveloped private property, undeveloped parkland, and wildlife areas. This category was created to designate properties intended for regular outdoor recreational activities and/or property that is primarily in a natural state.
- **Agricultural:** This category includes properties that are actively used for farming, including cropland, orchards, and grazing land.
- **Commercial I:** This category includes commercial or other properties such as schools, nursing homes, and hospitals.
- **Commercial II, III, and IV:** This category includes the MDEQ classifications for all other types of commercial properties, such as office buildings, retail, restaurants, banks, gas stations, car dealerships, and automotive repair shops. Land used for these purposes was combined into a single category.
- **Industrial:** This category includes properties that contain manufacturing and other industrial facilities. Land is typically highly disturbed and little surface soil is typically present. Examples of industrial land development include manufacturing facilities, power plants, and municipal wastewater treatment facilities. Waste disposal sites, including open or closed landfills, also were included in this land development category.

Figure 3-2 depicts City of Midland and Midland Township zoning in the Study Area. The commercial and industrial areas depicted on Figure 3-2 are a combination of several subcategories used by the city and surrounding townships. Land development and zoning were not verified for each parcel depicted on Figures 3-1 and 3-2. As noted above, land use will be mapped in detail and verified as part of the Phase I RI.

3.1.2 Climate and Meteorology

The Study Area is characterized by a continental climate regime, with winter temperatures cold enough to sustain stable snow cover and relatively warm summer temperatures. The mean temperature for the area is 47.8 degrees Fahrenheit (°F). The minimum average temperature is 22.1°F (January), and the maximum average temperature is 72.1°F (July). Between 1896 and 2002, the Midland area average monthly precipitation ranged between 1.4 inches (February) and 3.1 inches (September), with a monthly average of 2.3 inches and an annual average of 27 inches. Figure 3-3 shows precipitation changes throughout the year.

According to annual measurements recorded in Midland from 1950-1951 through 1979-1980, the average seasonal snowfall between October and April was 37 inches. During this period, 65 days per season averaged 1 inch or more of snow on the ground, but conditions varied greatly from season to season (Michigan State Climatologist's Office, 2005).

Wind direction is consistently from the west-southwest (that is, toward the east-northeast), regardless of season. Wind velocity peaks during February and March and is lowest during July. A wind rose depicting predominant wind direction and velocity for the Study Area is included as Figure 3-4. The data used to develop the wind rose were obtained for the years 1987 through 1991 from a meteorological station located at the Midland Plant.

3.1.3 Hydrology and Surface Water

The primary natural surface water feature in the Study Area is the Tittabawassee River, which drains approximately 2,600 square miles of land in the Saginaw River watershed (Michigan Department of Natural Resources [MDNR], 1988). The river begins in Roscommon and Ogemaw counties, which are approximately 26 miles north of the city of Midland and Saginaw County. The Tittabawassee River flows south and southeast for approximately 80 miles to its confluence with the Saginaw River, located approximately 22 miles southeast of Midland. Most of the Tittabawassee River watershed upstream of Midland is forested or agricultural land. The Pine and Chippewa rivers are tributaries to the Tittabawassee River and have similar drainage areas and flow contributions to the Tittabawassee River. Together, the Pine and Chippewa rivers contribute approximately 40 percent of the Tittabawassee River flow at Midland (MDNR, 1988).

Other secondary surface water features include small permanent and intermittent streams flowing into tributaries of the Tittabawassee River, small natural and constructed ponds, and constructed ditches used to store and convey stormwater from developed properties. These ditches discharge water to the Tittabawassee River and associated tributaries. The regional topography indicates that surficial drainage patterns in the Study Area are generally toward the Tittabawassee River. However, natural drainage patterns in developed portions of the Study Area have likely been altered and might direct surface water away from the Tittabawassee River, toward drainage basins and other stormwater collection units.

Natural watercourses remaining in the Study Area are concentrated northeast of the Midland Plant and the city. The flows from these creeks and drains enter the Tittabawassee River immediately upstream of the Midland Plant. A small tributary enters the Tittabawassee River downstream of the Midland Plant. Small, natural ponds (less than 5 acres) and constructed retention and detention ponds are scattered throughout the Study Area. Figure 3-5 depicts surface water bodies and the general topography in and around the Study Area.

3.1.4 Geomorphology and Geology

The Midland Plant lies in the Eastern Lowlands Physiographic Region of Michigan's Lower Peninsula. This region has very flat topography of lacustrine origin and is found along coastal areas in the southeastern part of the state, extending north from the Saginaw Bay area, along Lake Huron to the tip of the Lower Peninsula. Soil types in the Study Area are

typically derived from glacial and post-glacial fluvial processes and generally are composed of coarse-grained material deposited in ancient beach and near-shore environments and clay-rich lacustrine deposits (MDNR, 1988).

Because the offsite Study Area is urban, the near-surface soil has been disturbed by excavation, filling, and grading activities since land development began in the area. The uppermost stratum in the Study Area is the "surface sand" (0 to 20 feet). The surface sand has often been removed or augmented with fill of similar geologic characteristics, making it difficult to determine the boundary between the surface sand and overlying fill.

The surface sand is underlain by a discontinuous layer of lacustrine (former lakebed) clay with varying thicknesses (approximately 2 to 20 feet). Although thin, discontinuous silt layers are interbedded with the clay, this clay serves as an effective subsurface barrier to the underlying glacial till.

A layer of glacial till typically underlies the lacustrine clay layer. The glacial till consists of an unstratified mixture of rocks, gravel, sands, silts, and clays; however, soil in the glacial till is typically rich in clay. Permeability in the glacial till is typically low because of the silts and clays present. Fractures are common in the upper regions of the till. Some areas of sand, highly variable in length, thickness, and depth from surface, have been encountered in the glacial till unit. These areas of sand exhibit a significantly higher permeability than the clay and silty areas in the glacial till.

A sand layer underlies the glacial till; it consists of well-sorted sands and gravels interlayered with silt and clay seams. The regional sand is encountered at approximately 150 to 400 feet below ground surface.

3.1.5 Soil Characteristics

The Pre-RI Study performed in 2006 included the collection of soil samples throughout the Study Area and analysis for physical and chemical parameters that are reported to influence the bioavailability of dioxins and furans. Samples were analyzed for grain size distribution, total organic carbon (TOC), black carbon, and specific surface area. Sample results are presented in detail in the Pre-RI Study Report (CH2M HILL, 2007) and briefly summarized below. The Pre-RI Study Report is provided in Appendix G.

A trigram plot that displays the relative percentages of the three grain size classes (sand, clay, and silt) is presented on Figure 3-6. The sand fraction dominates the grain size distribution within the Study Area. Sand represents between 28 and 92 percent of the sample by weight, and averages 77 percent. Low sand content samples (less than 50 percent sand) are limited to 8 of the 337 sample locations. The trigram plot indicates that the predominant soil type in the Study Area is loamy sand using the U.S. Department of Agriculture (USDA) soil classification system (USDA, 1995).

TOC content in soil samples ranges between 0.79 and 13 percent, with an average of 3.4 percent. TOC, black carbon, and silt levels are positively correlated, indicating that in general, higher levels of TOC correspond to higher levels of black carbon and silt.

3.1.6 Hydrogeology

The hydrogeologic profile, based on information provided in Dow's 2002 License reapplication (Dow, 2002), is depicted conceptually on Figure 3-7. Hydrogeologic units, from deepest to shallowest, are as follows: bedrock, the regional aquifer, glacial till, lakebed clay, and surface sands. Groundwater contained in bedrock occurs primarily in sandstone layers. The potentiometric head in the bedrock aquifer is higher than the head in the regional aquifer, resulting in an upward hydraulic gradient. The regional aquifer overlies bedrock in some areas and consists of well-sorted sands and gravels interlayered with silt and clay seams. The low permeability of the overlying glacial till causes the regional aquifer to behave as a confined aquifer with an artesian head.

Groundwater is present throughout the glacial till at saturation, although the extreme compaction of this unit has reduced effective porosity and permeability. Sand bodies of significant size, generally referred to as glacial till sands, occur in the glacial till. Glacial till sands are highly variable in length, thickness, and vertical location in the glacial till, and are relatively more permeable. Glacial till sands are the sole sources of significant quantities of groundwater in the glacial till.

The lakebed clay is generally considered an aquitard, although some water is contained in thin, discontinuous silt layers interbedded within the clay. The lakebed clay acts as a barrier to downward movement of groundwater. The surface sands contain an unconfined aquifer that varies in both quantity and quality.

3.1.7 Ecology

The Study Area lies in the northern hardwood region of the Eastern Deciduous Forest, in the Saginaw Bay Lake Plain Regional Landscape Ecosystem, as established by the U.S. Geological Survey (USGS) (Albert, 1995). This regional landscape ecosystem is characterized by the prevalence of both upland and palustrine native plant communities, including forests, swamps, marshes, and scattered prairies. Human settlement of the Study Area in the 1800s had a significant effect on the native plant communities. A review of the Michigan Natural Features Inventory land cover change map for Midland County indicates that the vast majority of native forest has been converted to anthropogenic land uses (Michigan Natural Features Inventory, 2003).

Commercial and industrial land uses present limited suitable habitat for wildlife communities. Residential areas provide marginally more habitat opportunities. Limited agricultural and recreational areas exist in the Study Area, and provide more diverse habitats than the other, developed areas. Overall, the City of Midland is expected to encompass less ecologically diverse wildlife populations than the Tittabawassee River Study Area. A desktop evaluation of ecological habitat in the Study Area was performed as part of the ERA planning effort; results are summarized in Section 7.2.2. This evaluation will undergo field verification as part of the Phase I RI.

3.2 Historical Plant Operations and Waste Management Practices

The Midland Plant began operations in 1897 as The Dow Chemical Company. Expansion in production operations during the past century resulted in growth of the Midland Plant from 25 to approximately 1,900 acres. The majority of the Midland Plant is located on the east side of the Tittabawassee River and south of the City of Midland. Some of the current waste management (tertiary treatment ponds) operations are located on the southwest side of the river. The plant location and layout are depicted in Appendix F, Attachment 1. The following subsections summarize the historical operations and waste management practices of the Midland Plant. Tables 3-1 and 3-2 present listings of chemicals produced during the various stages of Midland Plant operations.

A timeline summarizing historical operations at the Midland Plant, chemicals produced, waste management practices, and the development of environmental laws and regulations over time was developed during the preparation of this RIWP and is provided in Appendix F, Attachment 2.

3.2.1 Overview of Plant Manufacturing Operations

Initially, the Midland Plant operations involved extracting brine from groundwater pumped from production wells ranging in depth from 1,300 to 5,000 feet below ground surface. Over the time of its operation, the Midland Plant has produced over 1,000 different inorganic and organic chemicals. These chemicals include the manufacture of 24 chlorophenolic compounds since the 1930s (Agin et al., 1984).

Early History of Dow Chemical

In the 1800s, bromine was an important chemical used in patent medicines, as a disinfectant, and in early photographic films. In 1878, the first successful brinewell was drilled in Midland, with Midland becoming a "center for bromine production [with] no fewer than 14 producers" over the next decade. Slab wood from lumber mills was used as cheap fuel to evaporate local brines to produce salt. "Bitterns" from the salt evaporators were "chemically oxidized to release the bromine." In 1890, Herbert Henry Dow, along with partner John H. Osborne, formed the Midland Chemical Company to extract bromine from cold brine using a novel electrolytic bromine recovery system. Early products included iron bromide, potassium bromide, and bromine purifier (Brandt, 1997; Dow, 1938; Dow, 1926; Leddy, 1989; Levenstein, 1998; Haynes, 1954a).

In 1893, an early experimental attempt to construct and operate a chlorine cell in Midland resulted in an explosion due to a build-up and mixing of hydrogen and chlorine gases. The Midland Chemical Company decided against further expansion in chlorine, and H.H. Dow left the company, moving to Navarre, Ohio, to continue his experiments with electrolytic chlorine cells. He joined with James Pardee and several other backers to form the Dow Process Company in Navarre. By 1896, Dow had completed development on the chlorine cell and had established a manufacturing process for the production of bleach or "chloride of lime" (calcium hypochlorite). He closed the Ohio plant and returned to Midland, Michigan. He built a small electrolytic chlorine cell room and bleaching powder plant, leasing land from the Midland Chemical Company and purchasing their debrominated

brine for the process. This original bleach plant was made of tar, wood, iron, glass, and concrete (Brandt, 1997; Dow, 1926; Haynes, 1954a; Karpiuk, 1984).

By 1897, the "new" Dow Process Company in Midland had been reorganized as The Dow Chemical Company and began the manufacture of bleaching powder using waste brine from bromine production operations. The chlorine plant consisted of nine electrolytic chlorine production cells fabricated of inexpensive, readily available materials including culled arc-light carbon rod for anodes, tar-coated pine and hemlock for wooden vessels, and a slaked lime absorber to form the calcium hypochlorite bleaching powder. Dow inserted wooden troughs around each bank of carbon rods to "trap" the chlorine. This was the basis for calling these early cells, the "Trap Cells," which Dow patented in 1899. A multitude of such Trap Cells and absorbers were arrayed in large wooden buildings (40 feet wide by 368 feet long). These early chlorine cells did not make caustic soda.

Dow's Trap Cells were unique in that they were bipolar and generated an autogenous membrane of metal hydroxides. The alkalinity in the brine itself deposited around the graphitic carbon cathode, causing a gelatinous precipitate of iron, magnesium, and calcium hydroxides to form on the surface of the cathode. This metal hydroxide layer acted as a diaphragm to prevent the hydrogen and chlorine from mixing, which caused explosions. In 1899, Dow found that carbon electrodes could be treated by soaking in molten paraffin (135°F melting point) to plug pores and minimize diffusion of hydrogen, thereby preventing explosions.

In the bipolar Trap Cell, the metal hydroxide sludge and slough from chemical attack of the graphitic carbon electrodes filled the cells within a week and required a shutdown for cleaning. The cells were designed with a knock-out plug in the bottom, so the solids could be washed out and the cells restored to service. Chlorine was conducted from the cells in wooden pipes (bored-out pine logs lined with coal tar pitch), cooled with water, and then passed over scrap zinc to dry it sufficiently to make good bleaching powder through reaction with lime. The corrosive conditions were harsh on such primitive construction materials. Historical anecdotal information indicates that the tarred wooden boards holding the carbon electrodes became "spongy" with exposure to the "corrosive chemicals" in the cells, and that replacing them "during the downtime" improved cell efficiency (Karpiuk, 1984). Such maintenance also included renewing the coal tar coating of the wooden vessels and replacing spent graphite electrodes, which was done approximately every 2 years. Eventually there were 16 cell buildings with two million graphitic carbon electrode rods in service in 26,000 Trap Cells (Haynes, 1954a; Karpiuk, 1984; Leddy, 1989). Graphitic carbon electrodes were so important to the chlorine production process that by 1913 Dow had begun manufacturing these components in Midland. This production continued until the mid to late 1970s, when dimensionally stable, rare metal-coated electrodes replaced graphitic carbon in electrolysis processes.

The first commercial sales of bleaching powder began in 1898. During this early time period, Dow also began production of sulfur chloride, various bromides, mining salts, Epsom salts, and magnesium carbonate, maximizing the economic return from the rich mineral resources available in the brine (Levenstein, 1998).

In 1902, the Midland Chemical Company merged into The Dow Chemical Company. That same year, H.H. Dow organized a new Midland Chemical Company, differentiated from the

original by being called Midland Chemical Company II, for the commercial synthesis of chloroform from carbon tetrachloride, using sulfur chloride from Dow's chlorine cell operation. Chloroform and carbon tetrachloride were first commercially available in 1903. The production building, known as 3-B and located on land leased from The Dow Chemical Company, continued to produce chloroform until 1942. Midland Chemical Company II was combined with The Dow Chemical Company in 1914 (Brandt, 1997; Dow, 1939; Haynes, 1954a; Karpiuk, 1984). Between 1904 and 1905, Dow began the manufacture of benzoic acid by treating toluene with chlorine and then converting the resultant benzyl chloride into benzoic acid. This represented Dow's first venture into benzene ring chemistry (Haynes, 1954a).

By 1908, Dow manufactured two principal products, bromides and bleaching powder, and other small-volume products based on bromine and chlorine extraction, including mining salts, chemical insecticides and food preservatives, sulfur chloride, benzyl chloride and benzoic acid, carbon tetrachloride, and chloroform. In 1908, H.H. Dow formed the Midland Manufacturing Company in equal partnership with the Fostoria Glass Company and the Libbey Glass Company to develop an electrolytic caustic potash cell to make chlorine and potassium hydroxide. This process produced minor amounts of potash. In 1910, Dow Chemical had its first sales of lime sulfur (calcium sulfide) and lead arsenate sprays. In 1911, both glass companies dropped out of the Midland Manufacturing Company (Brandt, 1997; Campbell and Hatton, 1951; Haynes, 1954a; Karpiuk, 1984; Levenstein, 1998).

In 1911, Dow scientists improved brine processing by developing a more sophisticated and efficient cell design. In the new plant, after removal of the bromine the brine flowed into a vacuum evaporator where steam heat and low pressure efficiently and rapidly boiled the brine and removed water. With evaporation, sodium chloride first precipitated and was removed. The liquid then passed into a second evaporator where magnesium chloride precipitated from the solution. The remaining viscous liquid was then transferred to a third evaporator, which removed the rest of the water, producing solid calcium chloride. In the spirit of economical extraction of benefits from the brine, Dow again increased the number of viable products obtained from the brine. Prior to this process improvement, only bromine and chlorine were recovered; the rest of the components of the brine being considered waste materials rather than raw materials for other chemical products (Haynes, 1954a; Karpiuk, 1984).

In 1913, Dow scientists further refined the chlorine electrolytic cell so that it could produce two usable products at the same time: chlorine and caustic soda (sodium hydroxide). They used the salt from the first stage vacuum evaporator and re-dissolved it in water as a feedstock. These new vertical-filter-press cells were also bipolar, but incorporated an asbestos diaphragm to more effectively separate the anolyte from the catholyte, rather than rely on autogenous generation of a metal hydroxide layer solely for that purpose. The result was purer chlorine and caustic soda product streams. The new cells were constructed of more durable materials, including concrete in place of tar-coated wood, and impregnated graphite instead of culled arc-light carbon electrodes of earlier designs. Dow "had elected to use 75 cells in a filter press series." Dow's new "bipolar cells," utilizing steel as the cathode and impregnated graphite as the anode, achieved "electrical continuity internally, with external connections to the rectifier circuit being made only at the anode and cathode terminals of a series which contains a multiplicity of cells" (Karpiuk, 1984).

By 1914, Dow had abandoned the original Trap Cells in favor of the newer bipolar, filter press-style "D.G." and "Ward" (M-21) cells. Also in 1914, H.H. Dow announced the company would quit the manufacture of bleaching powder. He told associates the "real future of the Company lay in the use of its chlorine for products other than bleaching powder, especially chlorinated hydrocarbons." Dow produced its last bleach powder in July 1915. Demand was shifting from bleaching powder to chlorine, prompted by chlorine's effectiveness in stemming typhoid outbreaks by: direct injection into domestic water supplies; the blockade of German dyestuffs and organic intermediates; the liquefaction of chlorine and its transport in cylinders and tank cars; and, the introduction of liquid chlorine into the manufacture of pulp and paper after World War I (Haynes, 1945a; Haynes, 1945b; Haynes, 1949; Leddy, 1989; Karpiuk, 1984).

In 1916, Dow began magnesium metal production in Midland using electrowinning from molten magnesium chloride. By 1918, Dow was manufacturing alloys of magnesium metal for use in airplane parts, portable tools, high-speed machinery, vacuum cleaners, and truck, trailer, and bus parts. In 1922, Dow formally established the "DOWMETAL" trademark for these magnesium metal alloys. By 1927, Dow was the sole domestic producer of magnesium metal and by 1929 was producing over 840,000 pounds annually. By 1942, Dow was responsible for producing 91 percent of all magnesium produced in the United States. In 1943-1944, Dow built an extrusion plant and rolling mill for magnesium at Midland, and a magnesium foundry in Bay City. During the years immediately before and during World War II (1939-1945), DOWMETAL™ became one of Dow's largest products by tonnage measure. In 1945, at the end of World War II, Dow shut down the magnesium ingot production operation in Midland and consolidated all magnesium metal production to the Freeport, Texas plant (Dow, 1939; Dow, 1966b; Gross, 1949; Haynes, 1945a; Haynes, 1945b; Pretzer, Undated).

Manufacturing After Bleach

During World War I (1914-1918), in response to the British Navy's blockade of German exports and subsequent increased domestic demand, Dow began the manufacture of phenol using a benzene-sulfonation process. Dow manufactured 40 tons per day for use in producing trinitrophenol for artillery shells. Dow's dramatic increase in phenol production was in response to the United States increase in demand (Whitehead, 1968). Other wartime-introduced products included dichloroethylsulfide (for mustard agent), monochlorobenzene (for explosives), and hexachloroethane (for smoke screens). In 1918, the United States Army operated a plant manufacturing mustard agent based on chlorine at the Midland Plant. The United States manufactured up to 10,000 pounds per day of mustard agent (Brandt, 1997).

During this same period, Dow also began to produce acetic anhydride, ethylene glycol, ethylene chlorohydrin and its acetate, dichloroacetic acid, aspirin and other salicylates, calcium chloride, monochlorobenzene, hexachloroethane, sodium acetate, trichloroethylene, trinitrophenol, and tetrachloroethylene. Also in response to wartime demand, Dow began commercial production of synthetic brominated indigo (400 pounds per day by 1917) and its intermediates, aniline and chloroacetic acid. Military needs for incendiary flares prompted the production of magnesium metal (3000 pounds per day by 1917), produced by electrolysis of magnesium chloride. Dow continued production of inorganic bromide- and chloride-based products, including caustic soda (50 tons per day by 1916), chlorine (45 tons

per day by 1916), bromine, Epsom salts, magnesium products, and insecticides (Bennett, 1926; Brandt, 1997; Dow, 1939; Haynes, 1945a; Haynes, 1945b; Leddy, 1989).

In 1918, Dow perfected a new synthetic process for production of phenol using chlorobenzene. This process used high pressure in a continuous system and yielded *o*- and *p*-xenols (phenylphenols). Shortly thereafter, Dow began production and marketing of Paradow™ (p-dichlorobenzene) (Haynes, 1945a; Haynes, 1945b).

Table 3-1 provides a list of products manufactured at Dow Chemical circa 1926-1928. During the 1920s Dow resumed production of its peacetime products and introduced several new products, including synthetic amino acids, phenylethyl alcohol, vinyl chloride, carbonic acid, ethylene dibromide, ethylene dichloride, propylene dichloride, synthetic oil of wintergreen (methyl salicylate), coumarin, synthetic ammonia, trichloroethane, and trichloroacetic acid. A larger plant was built in 1921 for production of acetylsalicylic acid (aspirin). By 1927, annual commercial production of phenol manufacture exceeded 8 million pounds, owing to an improved heat exchange system developed by Dow chemists W.H. Hale and E.C. Britton. In 1929, a new method for preparation of aniline from chlorobenzene and aqua ammonia led to the development of DOWTHERM™ heat transfer fluids (at that time, a mixture of diphenyl and diphenyloxide) (Dow, 1939; Haynes, 1945a; Haynes, 1945b; Dow, 1928; Midland Sun, 1926).

During the early 1930s, Dow began marketing a hydrochloric acid treatment method to revive old wells (Dowell™), and developed ethyl cellulose, Dow's first plastic, which was used extensively during World War II for telephone headsets, dust goggles, airplane parts, etc. During this time, Dow also began production of vinylidene chloride and 1,1,1-trichloroethane. In the mid-1930s, the Midland Plant began producing various chlorinated phenols, both directly for sale and for use as intermediates in the production of other chemicals. These chemicals were used primarily as fungicides, bactericides, or herbicides (DOWICIDES™). Dow scientists also invented the Dow styrene monomer process during this time, which consisted of passing ethylbenzene vapors through superheated steam to bring about partial dehydrogenation of ethylbenzene using special low inventory stills. Commercial production of polystyrene (STYRON™) followed in 1938. Also during this time period, the Thiokol Company arranged for Dow to begin production of Thiokol synthetic rubber at the Midland Plant and, by 1938, Dow had moved into large-scale production, producing over 2 million pounds annually. By 1939, Dow was producing 100 tons of Epsom salts per day and over 41 million pounds of aniline per year. By this time, Dow scientists had also worked out the polymerization and fabrication techniques for a copolymer of vinyl chloride and vinylidene chloride (Saran™). During this period, Dow experienced steady growth, becoming the single largest domestic producer of chlorine, the majority of which was used in the manufacture of various Dow products (Agin et al., 1984; Brandt, 1997; Dow, 1928; Dow, 2006; Haynes, 1948; Karpiuk, 1984; Whitehead, 1968). Brine electrolysis continued to be an important source of chlorine for Dow, and in 1939 Dow migrated from M-21 cells to the M-25 "Pocket Cell" design when the patent for the more economical Hooker "S" cell expired. Like the M-21 before it, the M-25 was a bipolar, multi-plate filter press design capable of producing both chlorine and caustic soda. It was constructed of durable materials including concrete bodies, impregnated graphitic carbon plate electrodes, and an asbestos diaphragm to separate the anolyte from the catholyte. This M-25 design was utilized for the electyrolysis of brine to produce chlorine

and other materials in Midland until Dow ceased such production in the 1980s (Appendix F, Attachment F-2).

As Dow entered the 1940s, over 500 products were being manufactured at the Midland Plant, which by then covered 525 acres. Dow added 2,4-D herbicide to its product line and built a larger production facility. DOWEX™ ion exchange resins were developed and used for purification of water, liquid food, and other materials. In an attempt to make a flexible, low loss dielectric for early radar applications, Dow scientists tried to copolymerize styrene with isobutylene. Rather than copolymerizing, the isobutylene vaporized within the styrene polymer, forming a rigid cellular product that paved the way for Styrofoam™.

During World War II, additional plant facilities were made available for Thiokol production. Several new products were introduced, many in response to wartime needs. In addition, Dow operated the Midland Chemical Warfare Service (CWS) Plant for the production of CC-2 from February 1943 to April 1944 (Brandt, 1997). CC-2, also known as impregnite, was used during World War II for the impregnation of clothing for protection against vesicant agents such as mustard agent and lewisite. The plant plans were based on a DuPont pilot plant. By April 1944, the military forces had sufficient stockpiles of impregnite and the plant was placed on standby. It never operated again (Brandt, 1997).

In 1947, a new pentachlorophenol plant was built. By the end of the decade, over half the American domestic production of phenol was produced at the Midland Plant (Brandt, 1997; Haynes, 1954b). See Table 3-2 for a listing of products introduced during the 1940s.

During the 1950s, the Midland Plant expanded its manufacturing capacity of existing products and added several new products including acrylic acid, acrylamide, ethanolamines, phenolics, herbicides, soil fumigants, polyacrylamide and other plastics, and styrene/butadiene latexes. By the end of the 1950s, chemicals accounted for 53 percent and plastics accounted for 35 percent of Dow sales (Brandt, 1997; Dow, 1947; Karpiuk, 1984). See Table 3-2 for a listing of new products introduced during the 1950s.

In the 1960s, the Midland Plant continued to expand both its production capacity and the number and range of products being manufactured, while ceasing to produce other products. Many of the new products introduced during the 1960s would be produced through the mid-1970s, with a few of these products continuing in production into the 1980s and beyond. In 1964, Dow improved the 2,4,5-T production process to increase efficiency and reduce waste. During the late 1960s, Dow built a new trichlorophenol plant and a new chlor-alkali plant and expanded existing plant operations for ethylbenzene, styrene, bromine, bisphenol A, and polystyrene (Dow, 1960; Dow, 1966a; Dow, 1970). Table 3-2 provides a listing of products introduced during the 1960s.

In the 1970s, Dow commenced full-scale production of the chlorpyrifos insecticides Dursban™ (household market) and Lorsban™ (agricultural market). Dow also introduced 2-chloro-*N*-isopropylacetanilide (Propachlor™). During the early to mid-1970s, the chlorine/caustic facilities were modernized. Also, a new 2,4-D herbicide plant was built that provided recycling of much of the process water and byproducts, and the existing chlorinated benzene production facilities were replaced and expanded to more efficiently produce monochlorobenzene, *o*- and *p*-dichlorobenzene, trichlorobenzene, and tetrachlorobenzene. During the mid- to late 1970s, Midland stopped production of

1,2-dibromo-3-chloropropane (Fumazone™), *o*,*o*-dimethyl-*o*-(2,4,5-trichlorophenyl) phosphorothioate (Ronnel™), and 2,4,5-T (Dow, 1966a; Dow, 1970).

In the 1980s and 1990s, onsite production began to decrease both in terms of capacity and range of products. The Midland Plant pentachlorophenol manufacturing facility was closed in October 1980. Also during this time, the decision was made to shut down the chlorine/caustic soda production facilities and, by the mid-1980s, the Midland Plant exited the brine business. At this time, Dow doubled its household product lines producing Saran Wrap™, Handi-Wrap™, and Scrubbing Bubbles® cleaner. Dow also introduced Seldane™, a non-sedating antihistamine, and Drytech™, the active absorbent in disposable diapers. In 1998, Dow exited the magnesium business corporation-wide (Brandt, 1997; Dow, 1973; Dow, 1975; Dow, 1977; Dow, 2006a; Amendola, 1986).

Currently, the Midland Plant consists of approximately 30 production plants and a core centralized Research & Development campus that serves Dow's global operations. The Midland Plant has been and remains a major research and development center for Dow. The research and development conducted at present is a mixture of pure research up to and including the construction of pilot plants to test manufacturing processes prior to construction of manufacturing facilities at Dow's various global locations.

3.2.2 Overview of Plant Waste Management Practices

Waste management practices have evolved with the changing production and regulatory environment. Waste management practices at the Midland Plant have included onsite and offsite treatment and disposal of various waste products (MDEQ, 2003b). In the very early history of the Midland Plant, wastes were discharged directly to the Tittabawassee River and, sometime later, wastes were stored and treated in ponds. Other wastes were disposed of onsite either on land or by burning (Agin et al., 1984). Over time, improvements in waste management practices included the installation and operation of a modern wastewater treatment plant as well as the use of incinerators instead of open burning. Improvements in the wastewater treatment plant and subsequent incorporation of pollution controls into both the operations of and emissions from the incinerators have reduced or eliminated releases and emissions from the Midland Plant.

Historic waste burning and waste incineration appear to be the primary source of elevated furans and dioxins found in surface soil in the Midland Study Area, as reported in "Point Sources and Environmental Levels of 2,3,7,8-TCDD (2,3,7,8–tetrachlorodibenzo-*p*-dioxin) on the Midland Plant Site of The Dow Chemical Company of Midland, Michigan, November 5, 1984" (1984 Agin Study) (Agin et al., 1984). This study conducted by Dow was "a comprehensive search for all critical point sources of 2,3,7,8-TCDD to the air, soil, and water in the Midland area." The results of the study were submitted to federal, state, and local governmental agencies. The 1984 Agin Study contains details about historic manufacturing processes and waste management practices, focusing on 2,3,7,8-TCDD. Prior to the construction of wastewater storage ponds in the 1920s, wastes from manufacturing processes were discharged directly to the Tittabawassee River.

Historical Aqueous Waste Management

Beginning in the 1920s, aqueous waste was managed using a network of collection ditches, pipelines, and pumps that delivered waste to a series of storage ponds. Outlet structures

controlled releases to the Tittabawassee River during high river flow periods. Approximately 30,472 barrels per day of waste brines were placed in a series of storage ponds. Two additional ponds were constructed during the 1930s, resulting in over 2 years of waste brine storage capacity at then present waste brine pumping rates. Sludges were stored in a 64-acre pond designed to collect and thicken suspended matter. Organic system wastes, defined by odor, were also stored in ponds designed for long retention periods. Acid wastes were stored in a 109-acre pond system during cold months; during warmer months discharges to the river were controlled based on temperature and stream condition. Clear water wastes from condenser and cooling waters were continuously discharged. Discharges were periodically monitored for sodium chloride concentration and phenol content (Michigan Stream Control Commission, 1937). Leaching from waste impoundments located near the river impacted the groundwater, which may have subsequently migrated to the river.

In the 1930s, a secondary wastewater treatment plant (trickling filter) was built and operated to treat phenolic wastes. As Dow increased production to meet the government's demands, Dow's efforts to upgrade its treatment plant were delayed due to denials of materials by the United States War Production Board (Bay City Times, 1947). However, in 1945, the wastewater treatment plant (WWTP) was upgraded to include preliminary treatment in trickling filters followed by activated sludge treatment and final clarification (Velz, 1958). The wastewater treatment processes have undergone several upgrades over the years, including the construction of tertiary treatment ponds (referred to as "T-ponds") in 1974. In 1985, mixed media sand filters were constructed to remove particulates from the tertiary effluent prior to discharge to the river. Operation of the T-ponds has been regulated by Dow's NPDES permit since 1988. Historically, the WWTP received flows from the process areas and sanitary wastewaters. During the 1970s and 1980s, additional flow contributions were directed to the WWTP, specifically waste scrubber water from the rotary kiln incinerator and tar burner, sludge dewatering system discharges, cooling tower blow down, other non-contact cooling water, water softener backwash, tank car washings, surface water runoff, and leachate from the Salzburg Landfill. At present, sanitary and laboratory sink wastes are directed to the Midland municipal waste treatment facility along with sanitary wastewaters from the Midland Cogeneration Venture (MCV) plant (MDEQ SQD, 1970-2000).

Effluent from the WWTP discharges to the Tittabawassee River via an outfall. Historically, up to 11 outfalls from the Midland Plant discharged to the Tittabawassee River (MDNR, 1972). Over time, the number of outfalls was reduced to a primary process wastewater outfall, with one emergency backup outfall and several stormwater outfalls.

By 1984, through efforts to recover and reclaim process wastewaters, the wastewater effluent discharge flow to the River had dropped from 35.4 million gallons per day (MGD) to 20 MGD. Continued efforts throughout the 1980s and 1990s resulted in construction of several process waste recovery and reclamation facilities and subsequent reduction of influent pollutant loads at the facility-wide WWTP.

During the early 1980s, Dow discontinued the use of deep disposal wells for discharge of phenolic wastes. These wells discharged into the Sylvania formation and the Dundee formation. Historic deep well disposal activities are presently being investigated as part of the Onsite Corrective Action Program.

In the late 1970s, construction began on a 2.5-mile-long Revetment Groundwater Interceptor System (RGIS). The T-pond RGIS system was added in 1992. The RGIS flanks most of the plant site on both sides of the river. From 1990 to the present, upgrades and replacement work have continued to take place on the RGIS. A new horizontal interceptor pipe system was constructed in 2002 along a portion of South Saginaw Road. The estimated length of all perforated pipe horizontal interceptor systems is approximately 7 miles (Agin et al., 1984).

Uncontrolled Aqueous Release Management

The Tittabawassee River has a long history of significant flood events, with records dating back to the late 1800s. During the early years of the Dow facility, flood control in the river was especially troublesome, many times resulting in inundation of the plant site and waste treatment facilities. Particularly severe storm events have caused flooding of the entire Midland region, including the Dow facility. These heavy floods usually occurred during the spring and resulted in discharges to the Tittabawassee River of stored brines and untreated or partially treated process wastewaters. Releases to the river, as a result of flooding, included overflows from the brine storage and tertiary treatment ponds (MDEQ surface water quality [SWQ] files 1970-2000; MWRC, 1960; *Midland Daily News*, 1950).

As in any manufacturing operation of this size, accidental spills of process materials and infrequent excursions of isolated parameters above the WWTP National Pollutant Discharge Elimination System (NPDES) discharge permit levels occurred at the Midland Plant. Beginning in the early 1970s, Dow recorded reportable spills and excursion events and reported them to the MDEQ, Surface Water Quality Division (SQD). While some of the reported spills resulted in releases to the Tittabawassee River, many were contained, controlled, and/or treated through the onsite WWTP and did not result in a direct release to the river. Reported NPDES excursions have been promptly addressed (MDEQ SWQ files, 1970-2000).

Historic Air Emissions Management

Process Emissions

Historically, waste process gases were vented to the atmosphere. Dow chemists and engineers have always viewed waste materials as process inefficiencies. As a result, efforts have been focused on recovering wastes for reclamation and reuse (Agin et al., 1984; Haynes, 1945a; Haynes, 1945b; Haynes, 1948; Haynes, 1949; Haynes, 1954a: Haynes 1954b). Beginning in the late 1960s, Dow more aggressively pursued reduction in emissions from its process vents through process changes or elimination, implementation of material recovery and reuse, and installation of air pollution control technologies (Agin et al., 1984; Dow, 2006a).

Due to the high demand for electrical power, Dow has historically supplied its own power needs using onsite power generation plants. As of 1984, the onsite 60 megawatt electrical, 2 million pound per hour steam cogeneration plant (Plant Powerhouse) burned 2,000 tons of coal per day. Exhaust gases were directed through an economizer prior to stack exhaust to the atmosphere. The powerhouse was retrofitted with baghouse filters in October 1982 to remove 99 percent of the flyash previously discharged to the environment (Agin et al., 1984).

Airborne Deposition and Fugitive Dust Emissions

Exhaust constituents from process vents, power generation, and thermal destruction processes may have deposited onto plant soils. During dry periods, desiccated Midland Plant soils may have resulted in fugitive dust emissions. Samples of Midland Plant soils at the plant fence line have shown higher levels of chlorinated dioxins than soils located in distant city of Midland residential soils. Current information indicates that concentrations in Midland Plant soils (average is less than 1 ppb) decrease radially from inside the plant outward, suggesting a windborne mechanism. The Midland Plant soils with the highest concentrations of dioxins were located near historic chlorophenolic production areas, the waste incinerator, and ash handling facilities (see discussion on combustion of solid wastes below.) Two small areas directly associated with the long-term manufacture or handling of chlorophenolic production compounds (477 Building and the area by 11th and J Street) demonstrated the highest levels of chlorinated dioxins. These areas occupy less than 0.5 percent of the total land surface of the Midland Plant site. Concentrations in these areas were localized and dropped off dramatically within a few hundred feet, suggesting that fugitive dust transport was not a major occurrence in these areas (Agin et al., 1984). During 2006, an area of elevated 2,3,7,8-TCDD was identified adjacent to the butadiene tank farm. This area is presently being investigated as part of the onsite corrective action program.

Early Combustion of Liquid Waste Tars

As early as 1930, the Dow Midland facility disposed of organic liquid tars by incineration. Two basic types of incineration were used: liquid tar burners using several different configurations and rotary kiln solid waste trash incineration. Improvements in burn efficiency and environmental controls have been consistently made since this time. In 2003, Dow completed upgrades to several of its thermal destruction devices to meet USEPA Maximum Achievable Control Technology (MACT) standards for industrial incineration devices (Agin et al., 1984; Dow, 2006a).

In the mid 1930s, two tar burners were installed northwest of the present Midland Plant waste incinerator. Liquid tars were burned inside vertical brick lined towers with combustion exhaust gases and particulates vented directly to the atmosphere. Fuel oil was also used to assist in start up and maintenance of the burner flame (Agin et al., 1984).

In 1951, a new vertical tar burner replaced these two units. Within the new 15-foot-diameter by 50-foot-tall brick-lined tower, four tangential feed nozzles dispersed process wastes, blended with supplemental fuel oil, for incineration. Combustion exhaust gases and particulates were vented directly to the atmosphere. This unit was removed from service in 1974 and demolished in the late 1970s (Agin et al., 1984).

In 1957, the 707 Building tar burner was constructed just east of the present Dow Midland Plant waste incinerator. This unit provided air exhaust scrubbing equipment to reduce hydrogen chloride emissions when burning chlorinated tars. Depending on the materials undergoing incineration, the vent emissions could be diverted directly to a 125-foot stack or to a water quench chamber prior to venting to the atmosphere. This unit was removed from service in 1975 (Agin et al., 1984).

High temperature (approximately 1,000 degrees Celsius [°C], or higher) combustion of organic liquid tars began in 1968 with construction of the 830 Building tar burner. This unit operated at a temperature of 900 to 1,000°C with a tar feed rate of 10 gallons per minute

(gpm). Combustion exhaust gases and particulates (30,000 cubic feet per minute [cfm]) were directed through a water quench system, venturi scrubber, and demister before stack discharge. In 1975, chlorinated waste tars were directed to the afterburner of the rotary kiln incinerator (discussed below). In 1981, this unit was placed in standby mode to be used only for tar inventory control. The unit has not operated since December 1982 (Agin et al., 1984).

Three natural gas augmented incinerators for destruction of process halogenated byproduct streams were in operation by 1984. The 1058 Building burner was designed to destroy waste chlorinated aromatic materials and recover usable hydrogen chloride. The 564 Building burner was designed to destroy waste chlorinated monomers. The 1009 Building burner was designed to burn a variety of halogenated waste solvents and byproducts.

Combustion of Solid Wastes

Prior to 1948, solid wastes were either landfilled on the Midland Plant site or stockpiled for open air burning. In 1948, a rotary kiln incinerator was placed in service to burn rubbish, waste solids, packs, and liquid tars. Solids were manually shoveled into the feed chute and various liquids were sprayed into the front of the kiln. Combustion exhaust gases and particulates were vented directly to the atmosphere (Agin et al., 1984).

In 1958, this original rotary kiln was replaced with a new dual rotary kiln system (703 Building Kiln No. 1 and Kiln No. 2) to burn paper and wood trash, solid chemical waste, chemically contaminated waste equipment, and a variety of liquid wastes. From 1958 to 1975, only Kiln No. 1 was used. This unit provided increased capacity and improved burner control. The operating temperatures in the rotary kiln ranged between 500 and 900°C with a 30-to 45-minute bulk solid residence time. Combustion exhaust gases and particulates were directed through a water-spray quench system before discharge to the atmosphere. In 1970, to reduce stack particulate emissions, a secondary combustion unit afterburner (using natural gas for supplemental fuel) was installed between the kiln and the quench chamber. In 1975, the Kiln No. 2 was placed into service and Kiln No. 1 was shut down. The Kiln No. 2 system included a rotary kiln, an improved afterburner and air pollution control system consisting of a water quench system, venturi scrubber, and demister. Beginning in 1978, in response to research studies indicating that a higher temperature was needed to minimize formation of chlorinated dibenzo-p-dioxins and to assure their efficient destruction, natural gas was added to the afterburner to increase the temperature control point to approximately 1,000°C. In 1981, the addition of a wet electrostatic precipitator to the Kiln No. 2 system resulted in further reduction of particulate emissions to the atmosphere. By 1984, further improvements, including process computer control, resulted in the afterburner operating temperatures between 1,000 and 1,100°C with a residence time of a few seconds. Liquid wastes and tars were atomized either directly into the kiln or directed to the afterburner, with higher British thermal unit (BTU) liquid feeds and dichlorophenol distillation wastes directed to the afterburner and higher ash-containing feed directed to the kiln. Mass flow measurements of 2,3,7,8-TCDD levels in the incinerator system in 1984 showed that the incinerator ash captured about one-half of the 2,3,7,8-TCDD. The other half was 95 percent captured by the exhaust scrubber equipment (Agin et al., 1984).

Historically, wet kiln ash was lifted from the ash trough by conveyor belt to dump trucks for transport to onsite landfill disposal. From 1979 to 1982, after closure of the onsite

landfills and before completion of the Salzburg Landfill, kiln ashes were stockpiled in an open area south of 11th Street and west of the waste incinerator. The pile was sprayed regularly with an aqueous dust suppressant to minimize desiccation and fugitive emissions of particulates. In 1982, a building was constructed around the ash transfer operation to totally enclose the conveyor and truck loading operation. Ash handling methods were also implemented to prevent drying and dusting of kiln ash at all stages of loading, transport, and landfilling (Agin et al., 1984).

Prior to 1985, liquid waste being fed to the secondary combustion chamber burner was atomized through the use of an air fan. The type of burner nozzle was changed to employ the use of steam atomization, which was more efficient, thereby lowering the amount of 2,3,7,8-TCDD that was formed. To lessen the amount of particulates, several improvements were added to the 703 incinerator in the 1987-1988 timeframe. The venturi scrubber was modified to employ a variable throat, which created a greater pressure drop. A series of high-efficiency water nozzles were added to the entrance into the quench tower. This greatly improved the efficiency of the venturi scrubber (Dow, 2006b).

In 1988, the secondary combustion chamber of the 703 incinerator was reconfigured. A high-efficiency vortex burner was installed just after the rotary kiln. This installation increased the secondary combustion zone residence time significantly and employed a highly efficient burner. These changes allowed Dow to demonstrate within the year that this burner was capable of 99.99 to 99.999 percent efficiencies (Dow, 2006b).

In 1990, another rotary kiln incinerator, 830, replaced the existing 830 tar burner. This unit had a 60-foot-long rotary kiln with two 30 million BTU per hour (BTU/hr) burners, and a large secondary combustion chamber with over 2 seconds residence time. This chamber was fitted with two 30 million BTU/hr vortex burners. From the combustion chamber, gases flowed through the following units: a rapid quench chamber, a hydrochloride (HCl) absorber, a variable throat venturi scrubber, a demister, an initial fan, four ionizing wet scrubbers, a second fan, and then to the stack. This unit was permitted at 99.999 percent efficiency (Dow, 2006b).

Planning for the new, state-of-the-art 32 Building rotary kiln began in the late 1990s. This new kiln was built to insure that Dow could meet the forthcoming MACT standards. The kiln was designed to burn both solid and liquid wastes. The kiln, which had two 35 million BTU/hr burners, was outfitted with carbon seals on both ends to greatly minimize the possible occurrence of fugitive emissions. Where older kilns often had less than 0.25 inch of water vacuum on the combustion chamber, the new kiln was designed to run at greater than 1 inch of water vacuum (Dow, 2006b).

Exhaust gases from the new rotary kiln pass into a large circular secondary combustion chamber having a 3.5 second retention time where three 30 million BTU/hr burners fire tangentially into the chamber. After the secondary combustion chamber, the gasses pass into a nitrogen oxides (NO_x) reduction system then into a rapid quench designed to minimize dioxin formation. From the quench chamber, the flue gases pass into a packed condenser tower which removes most of the hydrochloric acid that is formed in the combustion process. The condenser tower also aids with the pre-treatment of particulates prior to entering the high-energy venturi scrubber. After the venturi, which removes the bulk of particulates in the gas stream, the flue gases pass into a packed tower chlorine

scrubber. Sodium hydroxide is used to react with any remaining residual chlorine in the gas stream. After the chlorine scrubber, the gases are pulled through the first induced draft fan. From the fan, the gases pass through nine ionizing wet scrubber (IWS) units, which remove the last of the fine particulates from the gas stream. From the IWSs, the gases pass through a second induced draft fan and then up a 200-foot stack. At the stack, oxygen, carbon monoxide, sulfur oxides (SO_x) and NO_x are continuously monitored (Dow, 2006b).

After starting up the 32 Building kiln in 2003, the 703 Building and 830 Building incinerators were closed under Resource Conservation and Recovery Act (RCRA) requirements. Whereas the older units were permitted to process 85 million BTU/hr and 60 million BTU/hr, the new 32 Building kiln was licensed to operate at 130 million BTU/hr. This reduction in capacity was possible because Dow had implemented new technologies to recycle wastes as useful raw materials (Dow, 2006b).

By 2003, Dow had completed upgrades to its thermal destruction devices to meet USEPA MACT standard for industrial incineration devices. Between 2003 and 2006, Dow implemented new technology to further improve the performance of their thermal destruction devices. Since, 1995, Dow has reduced dioxin emissions to the air by over 95 percent (Dow, 2006a).

3.3 Affected Media

Data from the previous investigations summarized in Section 2.1 provide some information about the nature and extent of dioxins and furans in surface soil in the Study Area. The results of the Pre-RI Study provide additional data about the concentrations of dioxins and furans in Study Area soils, although the sample locations associated with the results are not yet known because the results are blinded. The Pre-RI Study results also provide initial information about chemicals other than dioxins and furans.

3.3.1 Distribution of Dioxins and Furans in Surface Soil

The distribution of TEQ concentrations in surface soil samples collected during the 1996 MDEQ and 1998 Dow studies is shown on Figure 3-8. The TEQ values represented on Figure 3-8 were recalculated on a consistent basis using the 2005 WHO-recommended TEFs (Table 2-1); therefore, the TEQ concentrations presented on Figure 3-8 may vary from the original data sources because of changes to several of the TEFs for specific congeners.

The sampling results shown on Figure 3-8 indicate that TEQ concentrations in surface soil are generally highest at the Midland Plant, and decrease with increasing distance from the facility. The highest offsite concentrations are found east and northeast of the plant, which are the predominant downwind directions. This map also shows samples collected along the route used by trucks hauling waste to the Salzburg Landfill from the Midland Plant. Elevated TEQ concentrations in several surface soil samples collected along Salzburg Road may have been caused by track-out along the haul route. The soil at the location with the highest TEQ concentration was excavated and the area was backfilled in 2001. The interim measure report for this action is provided in Appendix B.

As described in Section 2.1.1, TEQ concentrations in soil samples collected for the Pre-RI Study (2.4 to 950 ppt) were consistent with concentrations measured in previous studies.

Additionally, statistical comparisons of TEQ concentrations in samples collected from 0- to 1-inch and 1- to 6-inch depth intervals indicate no significant differences between the two sample intervals.

A map showing the 2,3,7,8-TCDD and TEQ results for samples collected in the Study Area from 1984 through 1998 is provided in Appendix C. The TEQ values presented on this map were recalculated using the 2005 WHO-recommended TEFs. The results shown on this map are not directly comparable from station to station because of differences in how dioxin data were reported. TEQ concentrations for all samples are tabulated in Appendix C.

3.3.2 Congener Distributions

Different sources of dioxins and furans are characterized by different congener and homologue patterns. Studies conducted by MDEQ (2002a), Dow (2000), and the University of Michigan (2006) evaluated dioxin and furan congener patterns in soil and sediment samples collected in the vicinity of Midland and along the Tittabawassee River.

The most common congener profile pattern, believed to be attributable to combustion products, was found in soils throughout Jackson/Calhoun and Midland/Saginaw counties, and in the river upstream of the Midland Plant. This congener profile pattern is dominated by dioxins, with 2,3,7,8-TCDD contributing the majority of toxicity. The next most common pattern was found mainly in and near the Tittabawassee River Study Area. This pattern has been attributed by MDEQ as being related to historical aqueous discharges from the Midland Plant to the river. The Tittabawassee River Study Area congener profile pattern is dominated by furan congeners, with 2,3,7,8-tetrachlorodibenzofuran (TCDF) and 2,3,4,7,8-pentachlorodibenzofuran (PeCDF) contributing the majority of the TEQ. A third pattern, found in the Midland area downwind of the Midland Plant, was similar to the combustion pattern but had elevated 2,3,7,8-TCDD and 1 ,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) levels. The UMDES concluded that this pattern is a result of historical airborne emissions from the Midland Plant (University of Michigan, 2006). Figure 3-9 shows the percent contribution to total TEQ for dioxins and furans by region as defined by the UMDES; Region 4 (Midland/Saginaw Plume) generally appears to correspond with the Study Area.

3.3.3 Other Chemicals

A total of 82 soil samples were collected from locations proximal to the Midland Plant and analyzed for a suite of additional chemicals as part of the Pre-RI Study to determine whether additional Dow-related hazardous substances are present in Midland area soils. Samples were analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. Full results are presented in the Pre-RI Study Report (CH2M HILL, 2007). Seventeen chemicals (eight metals, four SVOCs, four VOCs, and one general chemistry parameter) exceeded the most stringent MDEQ generic cleanup criteria available for each chemical. Assessment of whether these compounds are related to releases from the Midland Plant will be done when the requirements for unblinding the sample locations have been met, and the precise sample locations are available.

TABLE 3-1
Products Circa 1926-1928, The Dow Chemical Company
Midland Area Soils Remedial Investigation Work Plan

acetic acid	DOWMETAL™	orthodichlorobenzene
acetic anhydride	Epsom salt (magnesium sulfate)	orthophenylphenol
acetylene tetrabromide	ethyl chloride	paradibromobenzene
acetylsalicylic acid	ethyl monochloracetate	paradichlorobenzene
ammonium bromide	ethylene bromide	paradichlorobenzene
ammonium salicylate	ethylene chlorbromide	paraphenetidin
aniline hydrochloride	ethylene chlorhydrin	paraphenylphenol
aniline oil	ferric chloride	pentachloroethane
anthralic acid	ferrous chloride	phenol
barium bromate	hexachloroethane	phenol salicylate
Bordo mixtures	hydrobromic acid	phenyl acetate
bromoform	lead arsenate	phenyl ethyl alcohol
cadmium bromate	lime sulfur	potassium bromate
calcium arsenate	lithium bromide	potassium bromide
calcium bromide	lithium salicylate	propylene chloride
calcium chloride	magnesium arsenate	purified bromine
camphor monobrominated	magnesium bromate	salicylaldehyde
carbolic acid	magnesium bromide	sodium bromate
carbon bisulfide	magnesium chloride	sodium bromide
carbon tetrachloride	magnesium oxychloride	sodium chloride
caustic soda	magnesium salicylate	sodium salicylate
chloracetyl chloride	methyl anthranilate	sodium sulfide
chlorine	methyl bromide	strontium bromide
chloroform	methyl salicylate	strontium salicylate
Ciba dyes (7 colors)	methylene chloride	sulfur chloride
cinchophen	Midland Vat Blue dyes (3 types)	sulfur monochloride
coumarin	mining salts	synthetic indigo
dichloromethane	monobromobenzene	tetrachloroethane
dichloroacetic acid	monochloroacetic acid	tetrachloroethylene
diethylaniline	monochlorobenzene	tribromophenol
dimethylaniline	nicotine sulfate	trichloroacetic acid
diphenyloxide	orthocresotinic acid	

Source: *Midland Sun* (1926) and Dow Chemical Company Product Catalog (1928)

TABLE 3-2
New Product Produced during the 1940s, 1950s, and 1960s, The Dow Chemical Company
Midland Area Soils Remedial Investigation Work Plan

Decade	Product	Production Years (where available)	Source
1940s	1,1-dichloroethane	1945-1980	A
	1,2,4,5-tetrachlorobenzene	1945-1980	A
	2,4,6-trichlorophenol		
	2-(2,4-dichlorophenoxy)acetic acid (2-4-D; Dowspray™ 66; Esteron™ 44; Esteron™ 99; Esteron™ Brush Killer)	1945-1983	A
	2-chloropropionic acid	1949-1984	A
	4-chloro-2-phenyl-phenol (DOWICIDE™ 32)	1948-1972	A
	acrylonitrile		A
	alpha-methylstyrene		A
	antipyrene		A
	bromoform	1944-1983	A
	demethylaminobenzene		A
	dicyclopentadiene		A
	diethylbenzene	1946-?	A
	diisopropanolamine	1944-2000	A
	dinitro-o-sec-butylphenol (Dinoseb™, Premerge™, DN289™)		A
	methylchloroacetate	1947-2000	A
	propylene glycol		A
	sodium trichloroacetate	1948-1977	A
	toluene		A
	xylidene		A
	2,4,5-T (Esteron™ 245)	1950-?	A
1950s	4-chloro-2-cyclopentyl-phenol (DOWICIDE™ 9)	1965-1982	A
	1,2-dibromo-3-chloropropane (Fumazone™)	1957-1975	A
	1-methoxy-2-propanol (DOWANOL™ PM)	1958-1990	A
	2-(2,4,5-trichlorphenoxy) ethyl 2,2-dichlorpropanoate (Erbon™)	1954-1979	A
	2,2-dichloroproprionic acid (Dalapon™)	1954-?	A
	2-chloro-1-morpholin-4-yl-ethanone (Morpholine™)	1950-?	A
	2-ethoxyethanol (DOWANOL™ EE)	1957-1988	A
	2-methoxyethanol (DOWANOL™ EM)	1957-1988	A

TABLE 3-2
New Product Produced during the 1940s, 1950s, and 1960s, The Dow Chemical Company
Midland Area Soils Remedial Investigation Work Plan

Decade	Product	Production Years (where available)	Source
	acrylamide	1954-1971	A
	acrylic acid		
	bromobenzene	1950-1970	A
	bromomethylbenzene	1952-1976	A
	dimethoxy-sulfanylidene-(2,4,5- trichlor-phenoxy-phosphorane (Ectoral™, Trolene™, Ronnel™, Korlan™, Nankor™, Viozene™)	1957-1977	A
	Kuron™ herbicide containing 2,4,5-trichlorophenoxypropionic acid (also known as Silvex™)	1953-1980	A
	monoisopropanolamine	1953-2000	A
	o,o-dimethyl-o-(2,4,5-trichlorophenyl) phosphorothioate (DOWPON™, Ronnel™, Ruelene™)	1951-?	A
	o-chlorophenol	1950-1965	A
	parachlorophenol		B
	p-dibromobenzene	1950-1968	A
	polyacrylamide (Separan™)	1950s-?	A
	SE-651	1958-1980	A
	styrene/butadiene latex	1950s-?	A
	Styrofoam™ brand plastic foam		B
	tetrachlorobenzene		B
	tetraethylene pentamine	1951-1966	A
	tetrasodium 2-[2-bis-(carboxylatomethyl)amon]ethyl-(carboxylatomethyl)amino]acetate (Versene™)	Pilot plant; 1951	A
	trichlorophenol		B
	Vidden™ (a mixture of dichloroprpenes and dichloropropanes)	1959-1983	A
1960s	(17-acetyl-6-chloro-3-hydroxy-10,10-dimethyl-1,2,3,8,9,11,12,14,15,16-decahydrocydopenta[a]phenanthren-17-yl)acetate (Verton™)	1962-1979	A
	(4-dimethylamino-3,5-dimethyl-phenyl methylaminoformate (Zectran™)	Pilot scale; 1961-1975	A
	2,3,5-trichloro-1H-pyridin-4-one (Daxtron™)	1965-1968	A
	2,4,5-T and 2,4-D mixture	1962-1970	A
	2-butoxyethanol (DOWANOL™ EB)	1960-1988	A
	2-phenoxyethanol (DOWANOL™ EP and DOWANOL™ EPH)	1960-1967	A
	chlorpyrifos o,o-diethyl o-(2,4,6-trichlor-2-pyridyl)l (Dursban™)	Pilot scale;1965	A

TABLE 3-2
New Product Produced during the 1940s, 1950s, and 1960s, The Dow Chemical Company
Midland Area Soils Remedial Investigation Work Plan

Decade	Product	Production Years (where available)	Source
	decabromodiphenyl oxide	1969-1986	A
	dimethylamine salt of of 2-methyl-chlorophenoxyacetic acid	1963-1975	A
	DOWICIL™ TBS	1962-1971	A
	l-isobutoxy-2-propanol (DOWANOL™ PIB)	1962-1981	A
	methylene bromide	1960-1978	A
	o-2,4-dichlorophenyl-o-methyl isopropylphosphoramidothioate (Zytron™)	1960-?	A
	o-sec-butylphenol	1964-1979	A
	pentachloropyridine	1966-?	A
	pentachlorphenol (glazed, prilled form)	1965-?	A
	t-butylsalol	1966-1970	A
	tert-butyl-salol (TBS, Tausol™)	1963-1965	A
	tricyclohexylstannane hydrate	1967-1979	A
	triisopropanolamine	1966-2000	A
	Zetabon™ (a mixture of aluminum and ethylene copolymer	1965-?	A

Sources:
(A) Birch, A. (2006)
(B) ATS (2006)

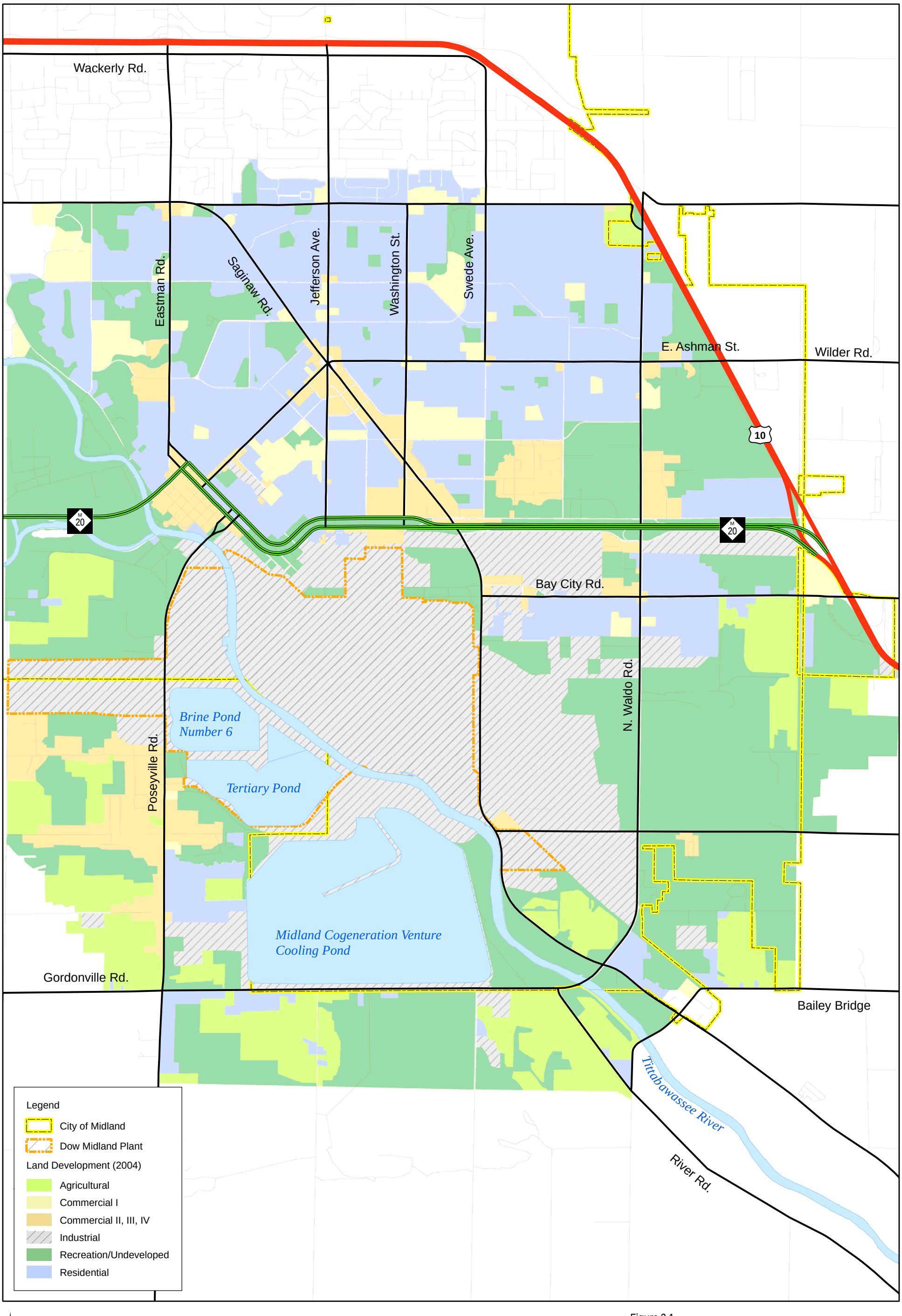


Figure 3-1
Midland Land Development (2004)
Midland Area Soils Remedial Investigation Work Plan

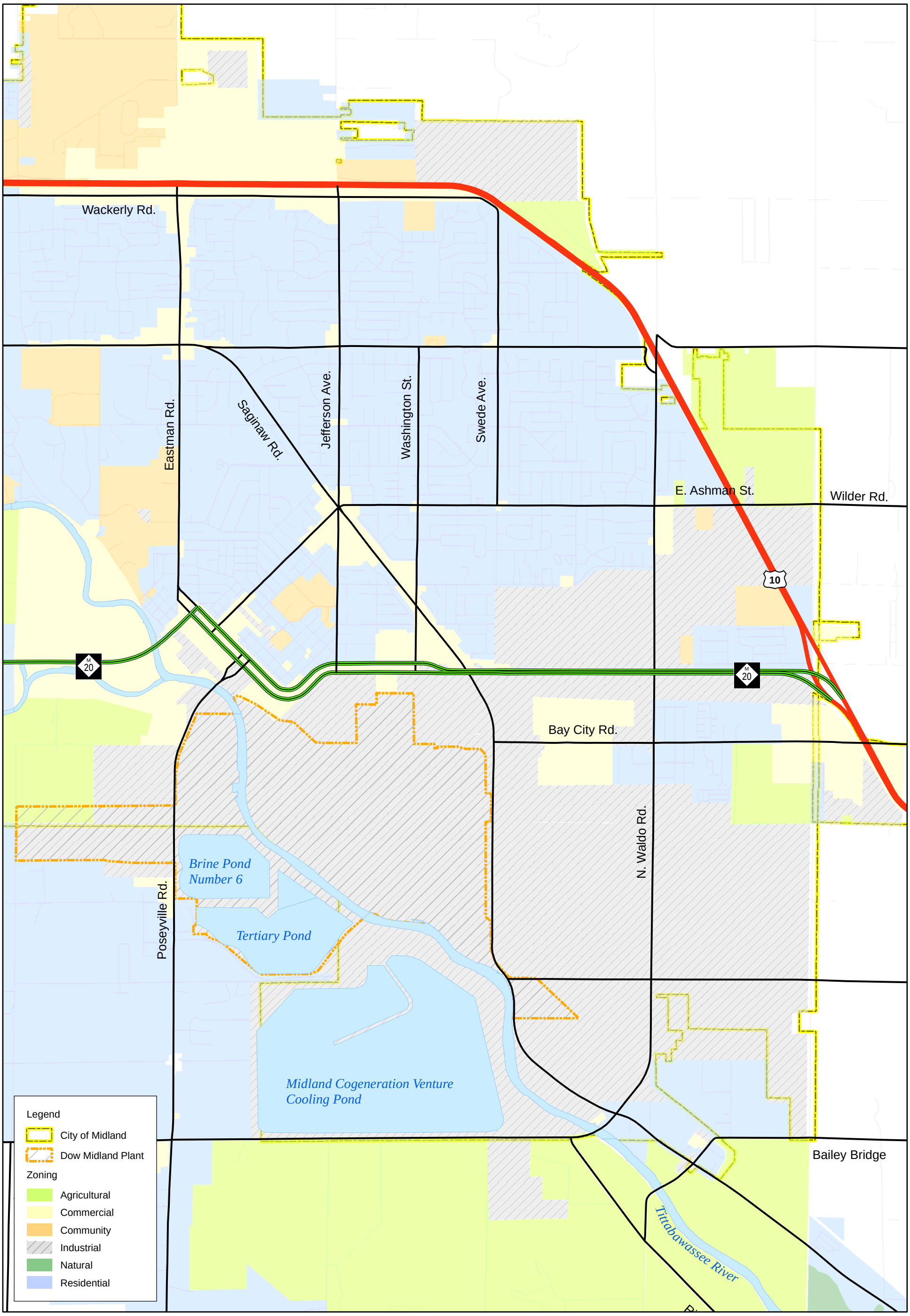
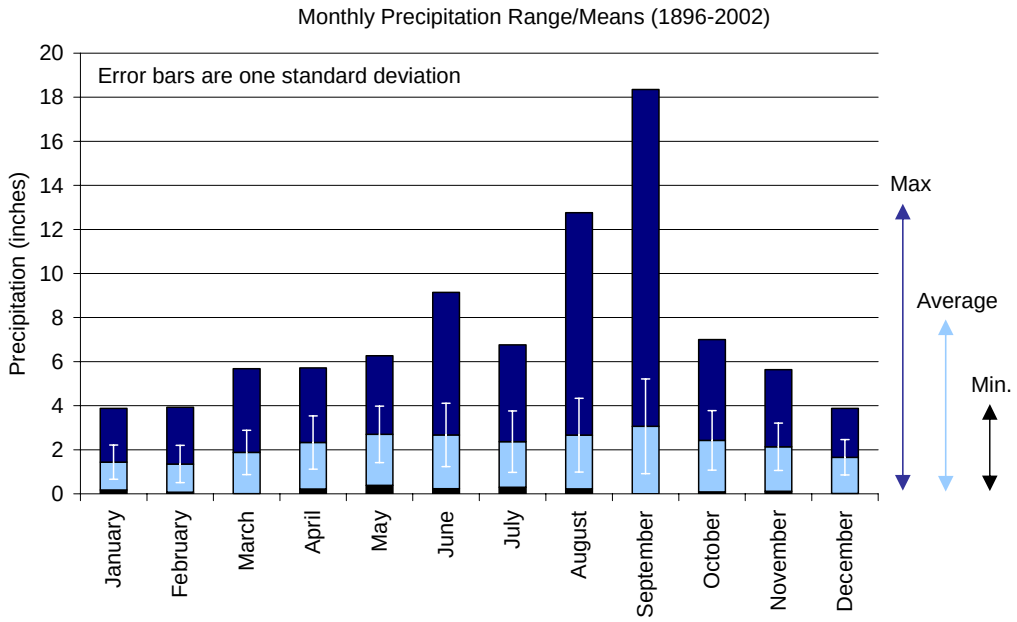
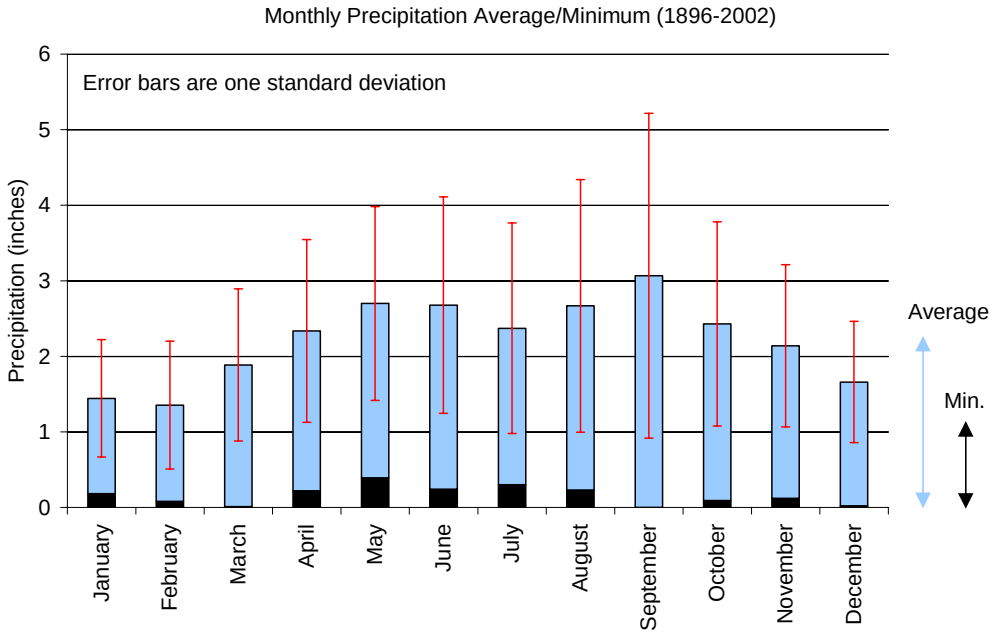


Figure 3-2
Zoning in the Study Area
Midland Area Soils Remedial Investigation Work Plan





September 1986 storm included.
Top chart includes maximum, bottom chart shows average and minimum only.

Period of Record: 1896-2002
Large storm event in 1986 causes spread in September.

Data Source: United States Historical Climatology Network (USHCN) Database
(http://cdiac.ornl.gov/epubs/ndp/ushcn/state_MI_mon.html)

Figure 3-3
Midland Area Precipitation
Midland Area Soils Remedial Investigation Work Plan

Wind Rose for Meteorological Station No. 72639 (Dow Midland Plant) Composite for 1987-1991

Source: Incinerator Upgrade Human Health Risk Assessment,
The Dow Chemical Company,
July 2001 (Figure 3-2)
Wind Rose originates from monitoring
station on Midland Plant.

Note: Wind rose indicates direction from which wind originates.

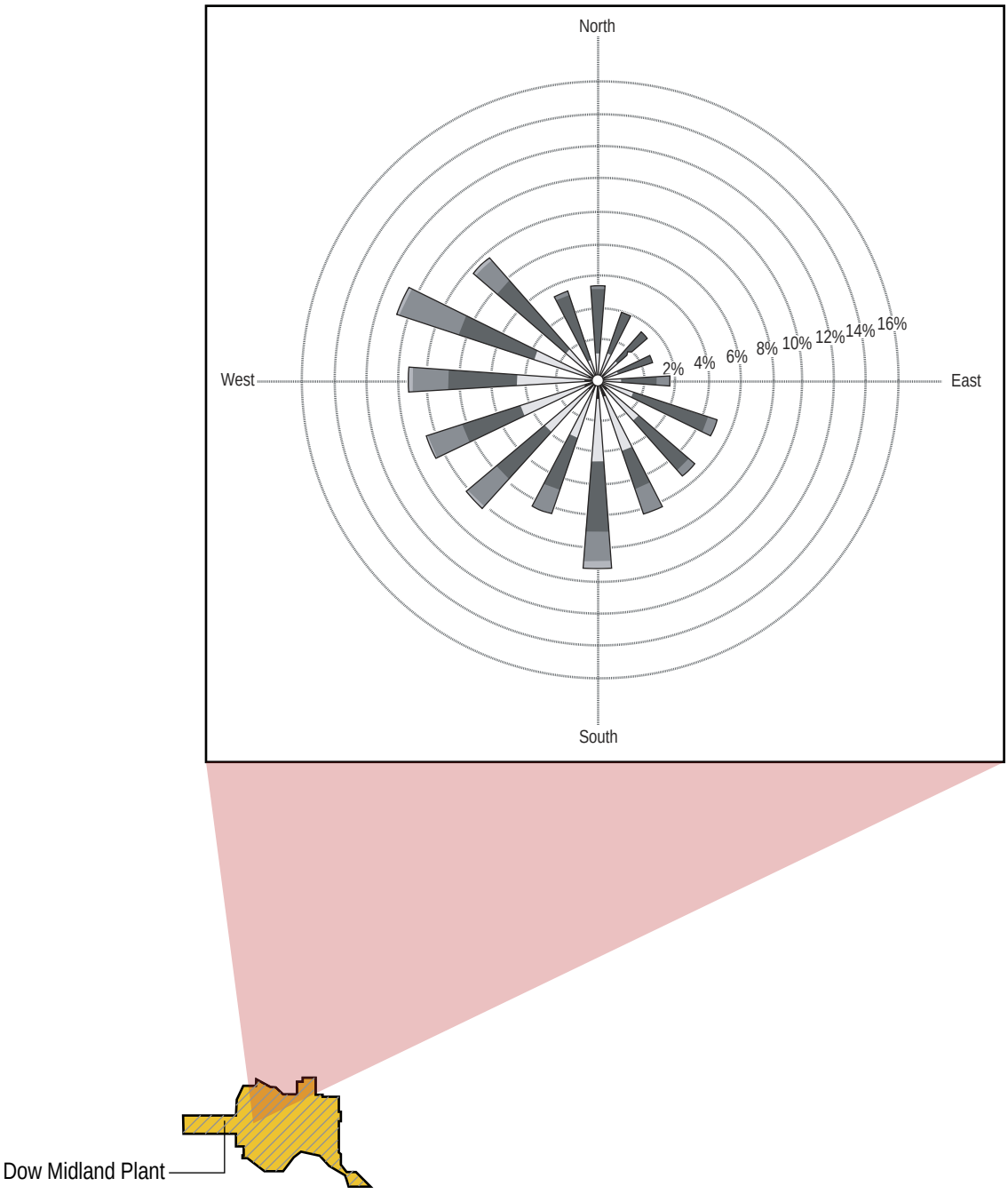


Figure 3-4
Wind Rose Diagram
Midland Area Soils Remedial Investigation Work Plan

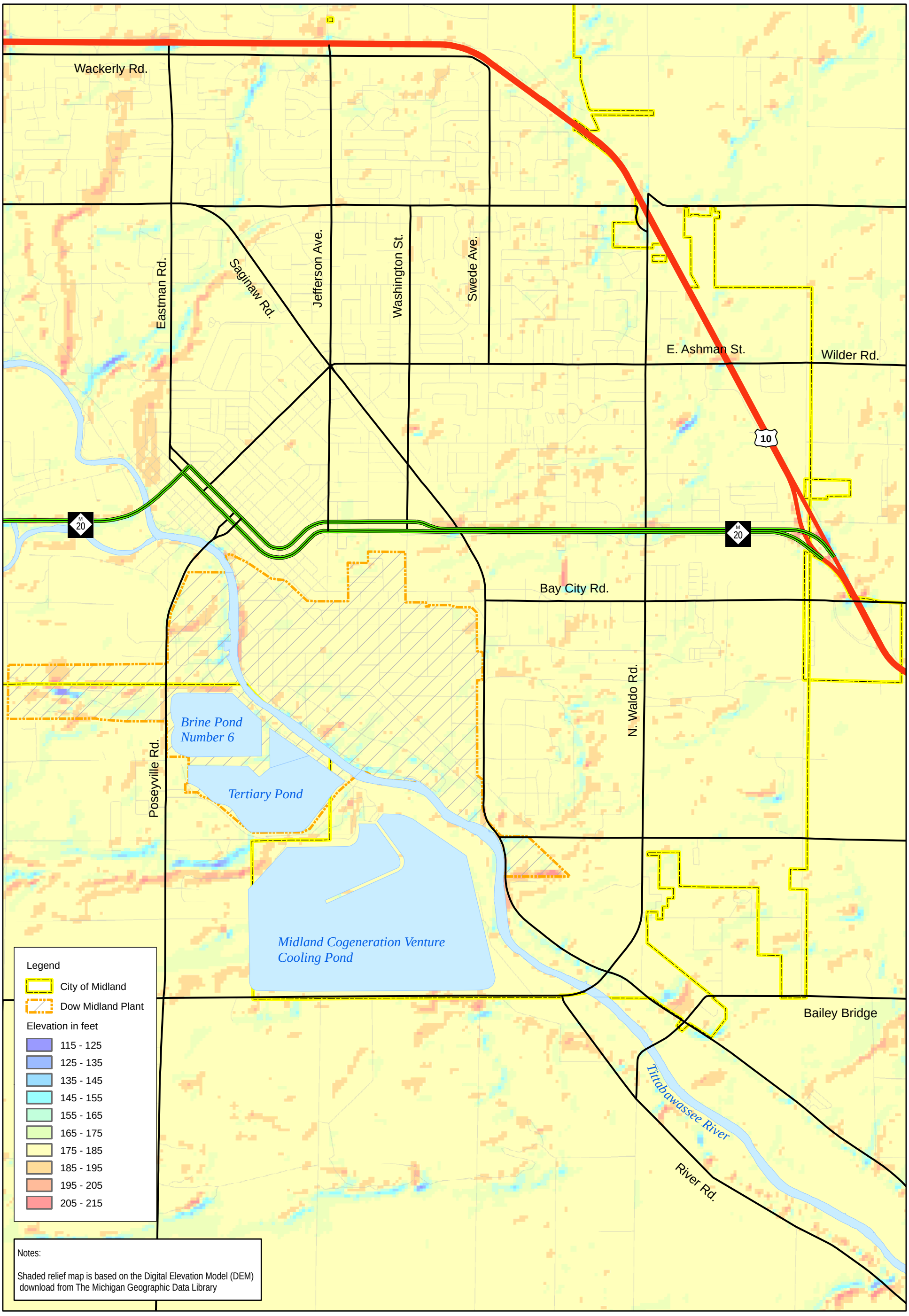


Figure 3-5
Midland Topographic Features
Midland Area Soils Remedial Investigation Work Plan

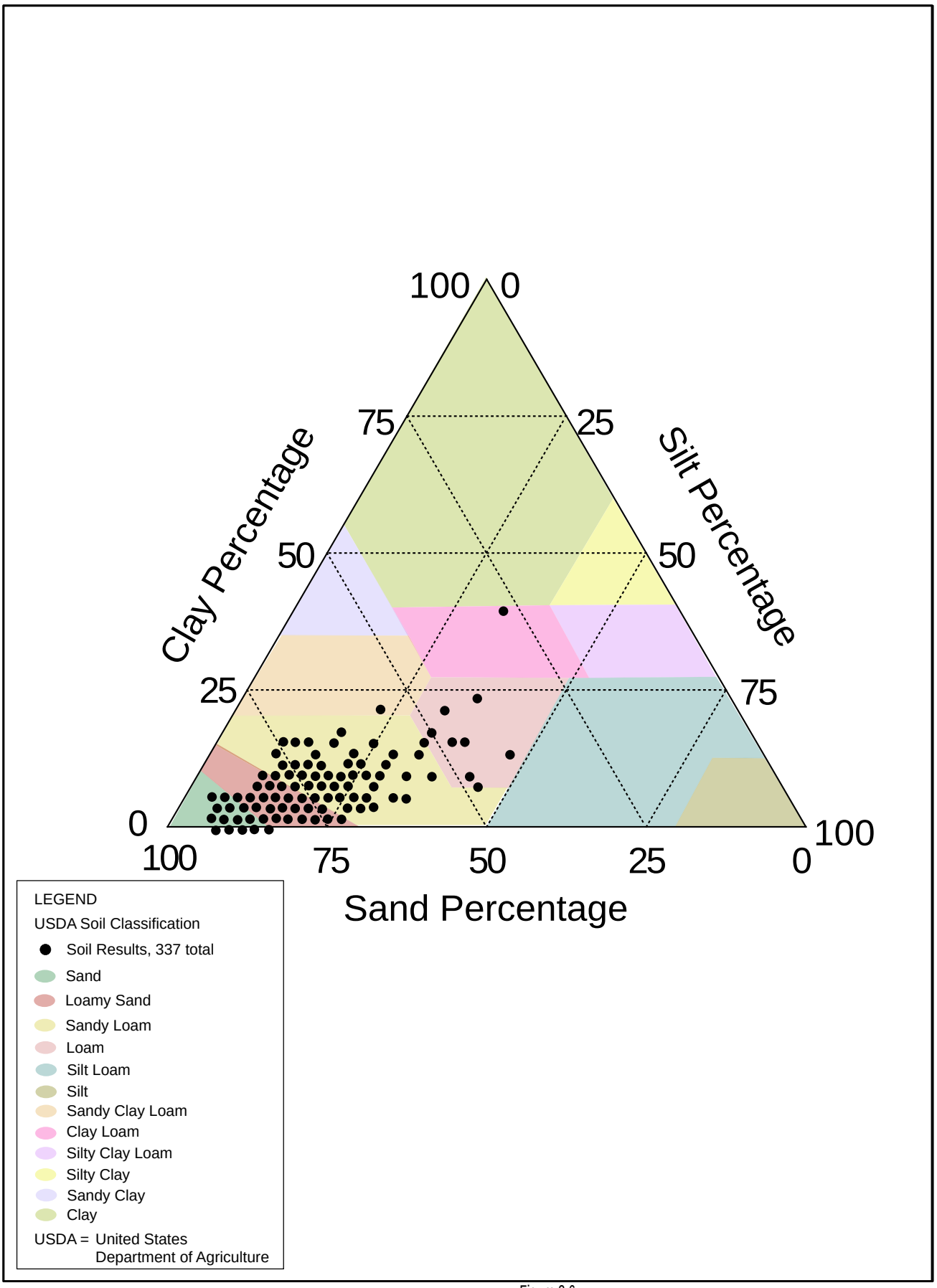


Figure 3-6
Grain Size Distribution
Midland Area Soils Remedial Investigation Work Plan

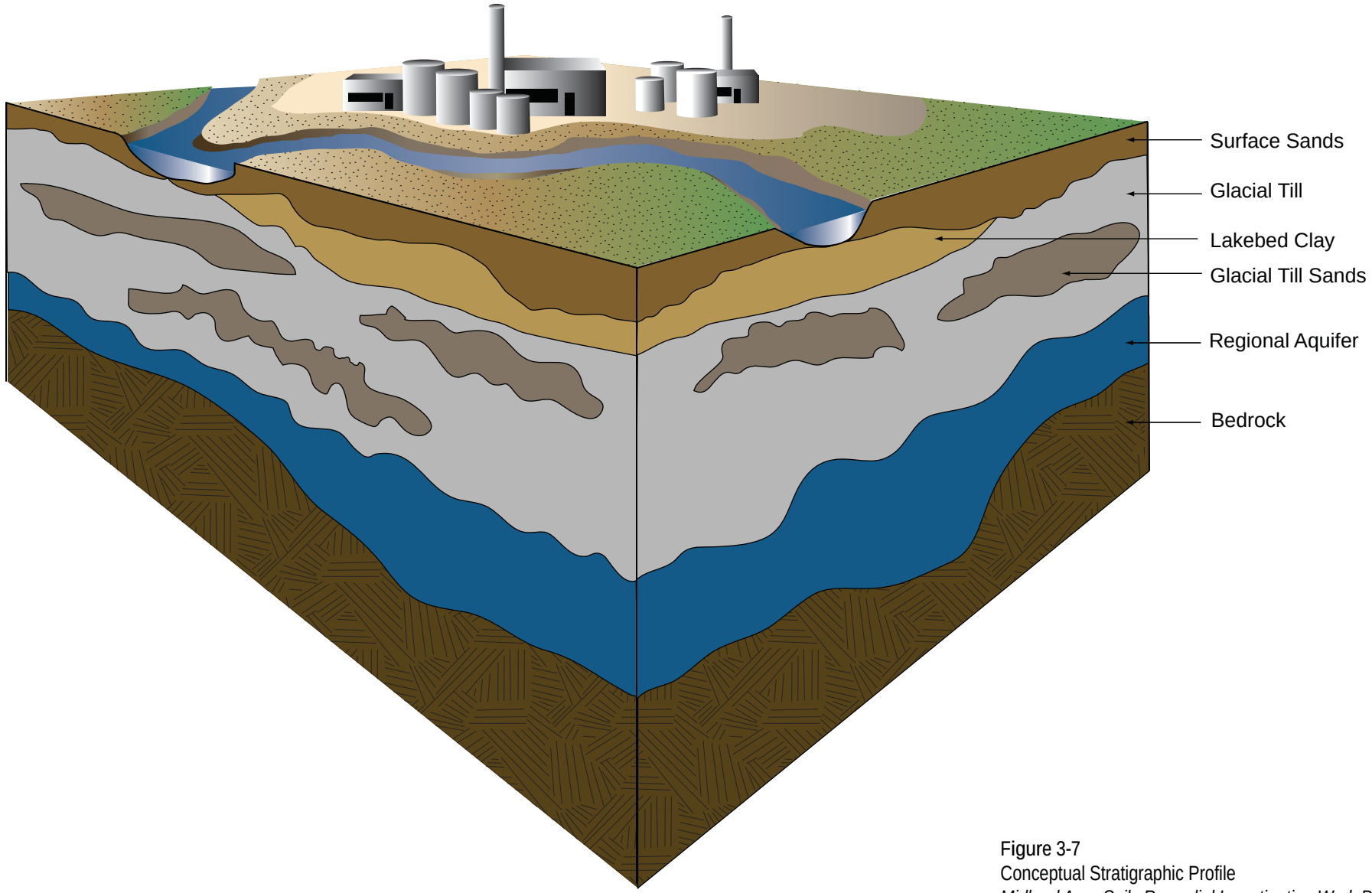


Figure 3-7
Conceptual Stratigraphic Profile
Midland Area Soils Remedial Investigation Work Plan

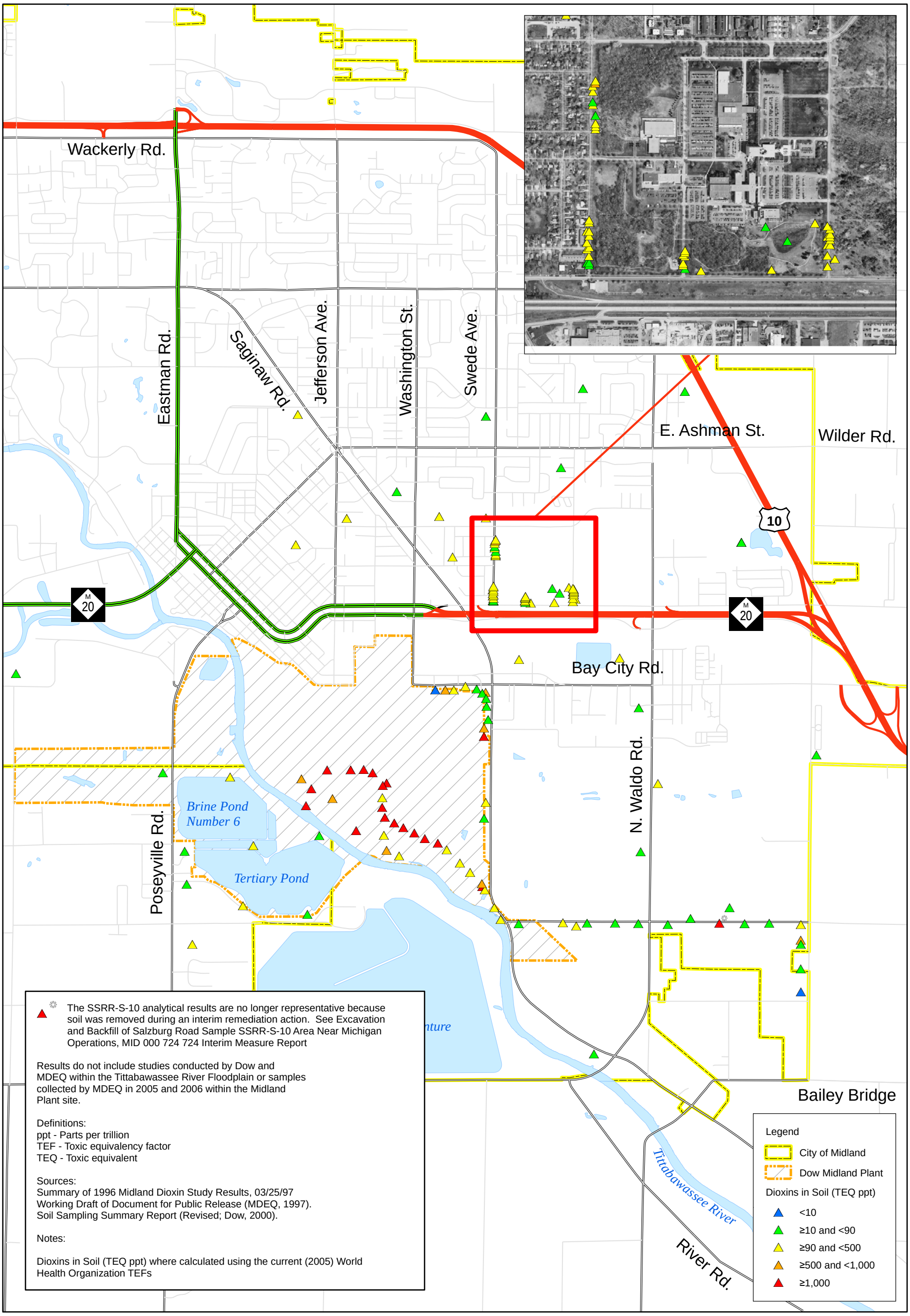
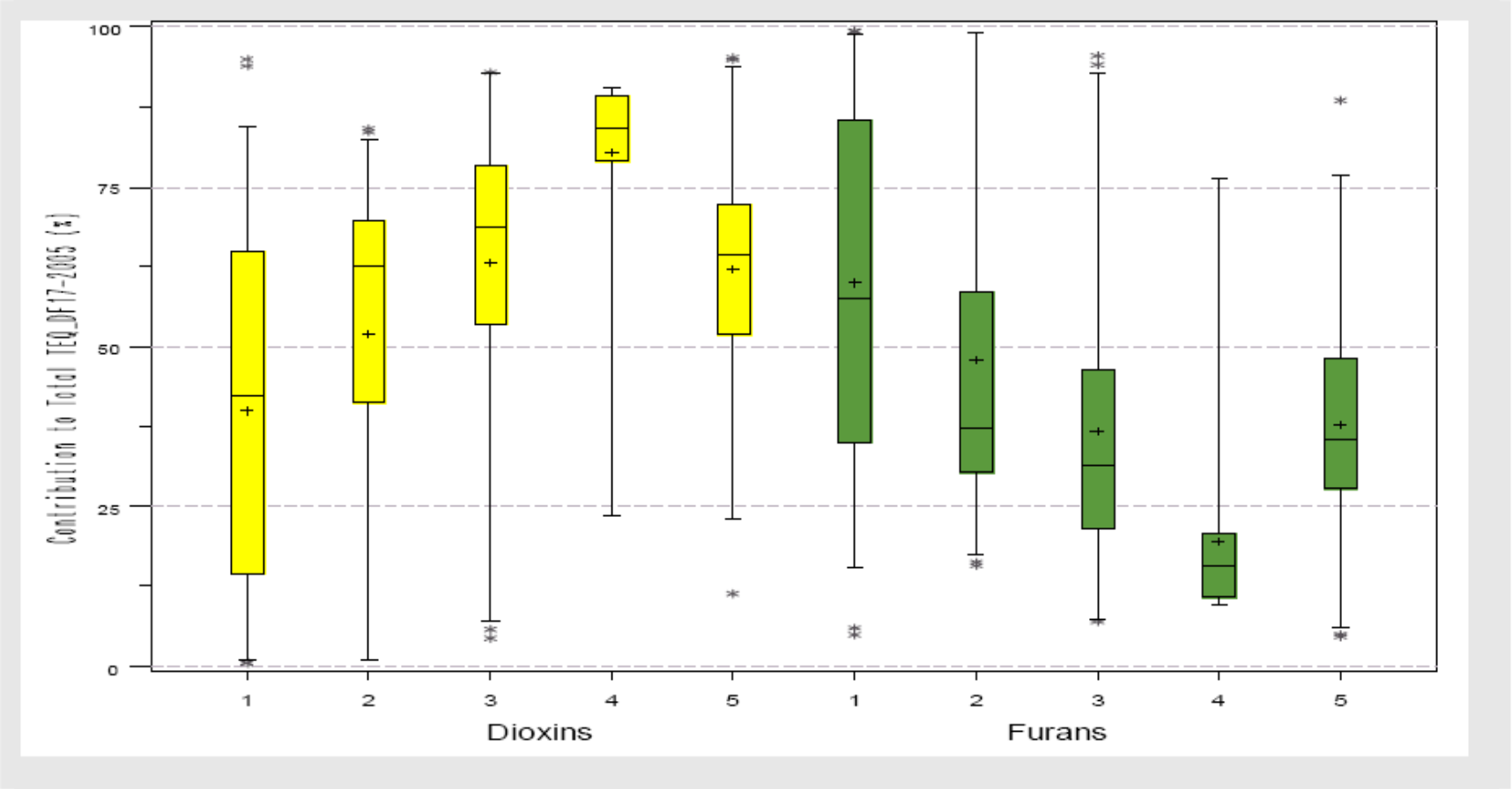


Figure 3-8
Midland Area Soil Surface TEQ Results
Midland Area Soils Remedial Investigation Work Plan



Region* 1-Midland/Saginaw FP; 2-Midland/Saginaw Near FP; 3-Midland/Saginaw Out FP; 4-Midland/Saginaw Plume; 5-Jackson/Calhoun

Source – University of Michigan, 2006; house perimeter soil samples, 0-1 inch strata

Figure 3-9
Example Weighted Soil Concentrations: Percent Contribution to Total TEQ for Dioxins and Furans
Midland Area Soils Remedial Investigation Work Plan

SECTION 4

Preliminary Conceptual Site Model

Development of a PCSM is an essential element of a results-based corrective action program. It is an important assessment tool that integrates the information needed to understand how hazardous substances move through the environment and come in contact with human and ecological receptors. Development of a PCSM is an iterative process: as new information becomes available, the model is refined. The PCSM can be an effective tool in identifying sources of uncertainty and additional data needs, and in supporting management decisions regarding sampling strategies, project constraints, and compliance with regulatory requirements. This section presents a PCSM for the Study Area soils. Key elements of the PCSM are grouped into major categories describing the potential sources, the distribution of dioxins and furans in soil, fate and transport mechanisms, and exposure pathways and receptors. Figure 4-1 depicts the relevant sources and transport pathways for this project.

4.1 Potential Sources

As summarized in Section 3.2, the primary source of hazardous substance releases from the Midland Plant to the Study Area, for the purposes of the Midland Area Soils RI, is airborne particulate deposition from past waste handling and disposal operations at the Midland Plant. Relevant past waste handling and disposal activities include open burning, waste incineration, and hauling and disposing of materials in landfills. The following discussion focuses on dioxins and furans, which have been the focus of previous investigations in the Study Area. The results from the recent Pre-RI Study support the focus on dioxins and furans. Pre-RI Study data did not reveal the presence of any other chemicals that appear likely to drive the investigation or corrective actions for the Study Area.

As indicated in the 1984 Dow and 1985 USEPA studies, combustion sources have been identified as a source of dioxin and furan emissions to the atmosphere from the Midland Plant (Agin et al., 1984; USEPA, 1985). Dioxins and furans are typically associated with stack emissions because of incomplete combustion of waste materials containing dioxins and furans or chlorinated organic compounds present in the waste materials.

Production of chlorinated phenolic compounds (principally the higher-chlorinated phenols: tri-, tetra-, and pentachlorophenols) also has been associated with the formation of both dioxins and furans. Typically, dioxins and furans have not been detected in mono- and dichlorophenols (ATSDR, 1998). Dow no longer produces higher-chlorinated phenols at the Midland Plant.

A secondary potential historical source of offsite particulate contamination is “track out” of particles on vehicles hauling and disposing of waste materials at landfills. Dow operates a licensed hazardous waste disposal facility on Salzburg Road that received waste from the Midland Plant. As discussed in Section 1.1, the potential for current contamination by this

pathway is addressed under Section X.L. of the License, which establishes soil monitoring programs.

4.2 Dioxin and Furan Distribution

Surface and near-surface soils are the most likely media to be affected by air emissions and subsequent deposition of hazardous substances such as dioxins and furans. As described in Section 3.3.1, elevated dioxin and furan TEQ concentrations are predominantly found to the northeast (downwind) of the Midland Plant. This pattern is consistent with airborne distribution of hazardous substances.

As part of developing the sampling strategy for the UMDES, geostatistical methods were used to combine existing TEQ concentration data for soils and predictions from a dispersion model for incinerator emissions to estimate the probability of exceeding 90 ppt TEQ in the Midland area soils (Adriaens et al., 2006). This analysis indicated that field data showed a higher correlation with the predicted dry deposition pattern than with the predicted wet deposition pattern. The predominant impact from dry deposition was predicted to be to the northeast, downwind of the Midland Plant. The combined wet deposition and dry deposition trend indicated predominant deposition to the east of the plant.

Potential contamination from track out along haul routes to landfills, if present, is expected to be limited to areas immediately adjacent to the roads along the haul routes.

4.3 Fate and Transport Mechanisms

The primary mechanism for transfer of hazardous substances to the Study Area is wind dispersion, as depicted on Figure 4-1. Wind dispersion of air emissions from different waste management units and processes at the Midland Plant, followed by deposition onto the ground, could have transferred dioxins and furans, as well as other hazardous substances, to offsite soils. These emission sources fall into two categories: fugitive dust and combustion. The fate (vapor phase and half-life) and transport mechanisms associated with these categories potentially influence the distribution of dioxins and furans, as well as other hazardous substances, in offsite soils.

Fugitive dust emission sources originate from the suspension of particulates from surface soil, either by wind or mechanical disturbance (driving over surfaces, excavating, or grading). Fugitive dust particle concentrations in air are highest close to the emission source and decrease rapidly with downwind distance, generally within a few hundred feet, because of a combination of vertical mixing in air and particle deposition (USEPA, 1995a; Etyemezian et al., 2003; Countess, 2003). Dispersion of emissions from combustion sources is influenced by exhaust gas temperature and plume release height (that is, stack height), in addition to meteorological conditions. In principle, higher exhaust temperatures and higher stacks result in greater plume rise and more, but more dilute, downwind dispersion (USEPA, 1992). Therefore, fugitive dust sources at the Midland Plant (such as landfills or affected surface soil) are likely to have been associated with deposition relatively close to the Midland Plant, and deposition from combustion sources is likely to have occurred farther away.

Contaminants are emitted to the air either in vapor or particle form. Generally, most metals, and organic compounds with very low vapor pressures, adhere to particles that can then be deposited on soil. Compounds with high vapor pressures (such as VOCs) occur only in the vapor phase; concentrations of VOCs in air do not have an effect on surface soil. SVOCs might partition between vapor and particle phases, depending on their vapor pressure and the particle concentration in the air (USEPA, 2005a). In multimedia transport modeling, the tendency for an SVOC to partition onto airborne particles is expressed by the fraction of pollutant air concentration in the vapor phase (Fv) (USEPA, 2005a). A chemical with an Fv of 1.0 is present entirely in the vapor phase, and is assumed not to be deposited onto the soil with airborne particulates emitted from a source.

Another chemical-specific property that affects the presence of a chemical in soil after it has been deposited is its half-life in soil. The half-life in soil reflects the persistence of a chemical, taking into account degradation through microbial and abiotic transformations. Abiotic transformation processes include photolysis and hydrolysis. USEPA has defined criteria for persistence, for which chemicals with a half-life in soil greater than 60 days are considered persistent, and chemicals with a half-life in soil greater than 180 days are considered very persistent (USEPA, 1999b).

Accounting for chemical-specific properties as discussed above, chemicals potentially emitted to the air from the Midland Plant that continue to be present in soils in the Study Area would have the following characteristics:

1. Tend to partition onto airborne particulate matter (that is, have an Fv less than 1.0)
2. Are persistent in soil (that is, have a half-life greater than 60 days)

Secondary transfer mechanisms also are shown on Figure 4-1. After deposition on soils, particle-bound hazardous substances such as dioxins and furans have the potential to be redistributed through surface water runoff and construction and grading activities. In the case of surface water runoff, the particle-bound substances may be mixed with solids that accumulate in ditches and drainage basins. In the case of construction and grading, particle-bound substances in surface soil may be transferred to and mixed with subsurface soil.

4.4 Exposure Pathways and Receptors

To assess potential human health and ecological risks associated with past Dow operations, exposure pathways must be identified to evaluate the potential for risks in the Study Area. The relevant exposure pathways associated with human health risk are discussed in detail in Section 6.2. The approach for identifying ecological exposure pathways and receptors for the Study Area is presented in Section 7.2.2.

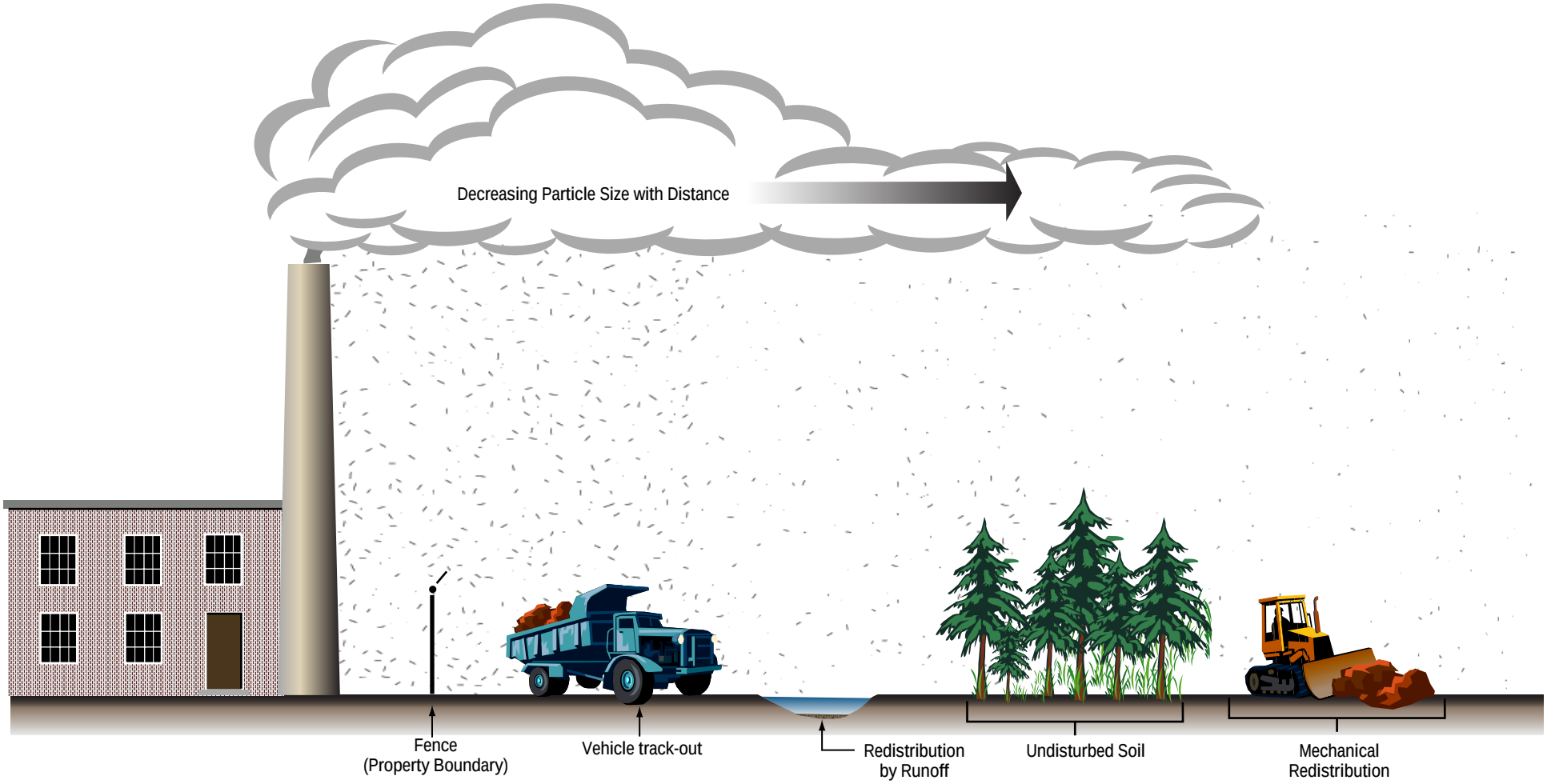


Figure 4-1
Preliminary Conceptual Site Model
Midland Area Soils Remedial Investigation Work Plan

SECTION 5

Remedial Investigation Approach

The RI approach outlined in this section has been developed to meet the purpose and objectives of the Midland Area Soils RI described in Section 1. The goal of Dow, MDEQ, and USEPA is to streamline the corrective action process by controlling risks to human health and the environment as quickly and effectively as possible. Consequently, the approach incorporates several risk management decision points into the RI process in order to facilitate risk-based remedial decision making. This section describes the overall approach and sequence of activities for the Midland Area Soils RI. The implementation schedule is provided in Section 9.

Figure 5-1 presents the phased, results-based approach for the Midland Area Soils RI. The investigation will be conducted in two general phases, with data collection and evaluation in each phase focused on providing the information needed to support risk management decisions. Some elements of the RI approach will be developed in more detail or modified in ongoing technical discussions with MDEQ. The focus of each phase of investigation is summarized as follows:

- Pre-RI: The Pre-RI Study has provided soil sample data for physical and chemical soil characteristics, dioxin and furan concentrations, and chemicals other than dioxins and furans for a subset of samples from the Study Area. In addition, the TAL for the Phase I RI will be developed.
- Phase I: Phase I will build upon the results of the Pre-RI Study, and will lead to risk management decision point No. 1 and potentially a remedy decision if sufficient information is available. Work performed during this phase will include, but is not limited to, development of site-specific direct contact criteria (DCC) for soils, detailed mapping of current land use and zoning, and identification and selection of a background area (if necessary). Additional soil sampling will not be performed until Phase II, after DCC are available. If required, data collection to support the HHRA also may be initiated in Phase I.
- Phase II: Phase II will build upon the results of the Phase I study and also will lead to risk management decision point No. 2, and potentially a remedy decision if sufficient information is available. Work performed during this phase will focus on field sampling to provide data needed to facilitate a remedy decision, a human health screening level risk assessment (SLRA), and a screening level ecological risk assessment (SLERA). If undertaken, data collection to support the HHRA will be completed in Phase II.
- Phase III: If the data and information available at the conclusion of the Phase II RI are insufficient for supporting risk management and final remedy decisions, then the HHRA and possibly a baseline ecological risk assessment (BERA) will be completed in Phase III. In this case, final remedy decisions will be made on the basis of the full risk assessment results.

The flexibility provided by this RI approach will allow implementation of a remedy as early in the process as possible, potentially eliminating the need for ongoing investigation throughout the Study Area and full risk assessments.

In order to support remedy decisions, information will be provided that meets the provisions of in R 299.5528 (3). In general, this means that the following information may need to be obtained for the Study Area:

- Identification of any unacceptable risks to public health, safety, or welfare, or the environment in the Study Area due to releases from the Midland Plant
- Identification of CoPCs and COPECs associated with human health or ecological risks
- Delineation of the horizontal and vertical extent of soil with CoPC and COPEC concentrations exceeding the applicable criteria
- Documentation of current property use and zoning within the Study Area

The RI approach presented on Figure 5-1 and described in this section focuses on the collection of this information, and describes how it will be used to support risk-based remedial decision making. A Phase II sampling and analysis plan (SAP) will be prepared and submitted to MDEQ for review and approval prior to any Phase II field sampling. The Phase II SAP will provide data quality objectives (DQOs) and detailed information on the sampling approach and rationale. Detailed descriptions of the human health and ecological risk assessment approaches are provided in Sections 6 and 7, respectively, with general summaries provided below.

5.1 Pre-Remedial Investigation Activities

Several pre-RI activities provided information to guide the Phase I RI and preparation of the Phase II SAP. The Pre-RI Study (Section 5.1.1) provided soil data that will be used to assess the nature and extent of contamination and guide future soil sampling efforts. The TAL (Section 5.1.2) will be used to identify chemicals other than dioxins and furans that will be investigated in the RI.

5.1.1 Sampling and Analysis Plan in Support of Bioavailability Study (Pre-RI Study)

Pre-RI soil sampling in the Study Area was initiated in October 2006 and was completed in late November 2006. Blinded sample results are reported in the Pre-RI Study Report (CH2M HILL, 2007) (Appendix G). Exact sample locations will be revealed (that is, the data will be unblinded) after DCC are approved by MDEQ. The study accomplished the following objectives:

- Characterized the distribution of physical and chemical parameters reported to influence bioavailability so that information for the range of soil properties is available for any future bioavailability studies
- Obtained information on concentrations of dioxins and furans and additional chemicals in surface soils in the Study Area

- Developed and implemented a process so chemical results for samples obtained on residential properties remain confidential until DCC are developed

The Pre-RI sampling approach was developed collaboratively by Dow and MDEQ and is documented in detail in the Pre-RI Study Report (CH2M HILL, 2007). The investigation approach is based on the PCSM of release, aerial transport, and deposition of potentially hazardous constituents from the Midland Plant, as described in Section 4. The sampling design consisted of samples collected from 23 radial transects extending from the Midland Plant into the surrounding community (Figure 5-2). Transects were arrayed such that soils in the dominant downwind direction were sampled more densely than soils in the upwind direction. The transects varied in length from approximately 3,000 to 11,000 feet beyond the Midland Plant boundary.

Soil samples were collected within defined sample stations at regularly spaced intervals of approximately 950 feet along each transect, as shown on Figure 5-2. Each sample station consisted of a nominal 300-foot by 300-foot box encompassing properties with similar land use. Where multiple properties were present within a sample station, multiple samples were collected and one sample was selected for laboratory analysis. The exact location of the analyzed sample will remain anonymous until DCC for Midland area soils are developed and approved by MDEQ. At sample stations with a single property or property owner, only one sample was collected and submitted for analysis. A total of 136 stations were sampled (access was not obtained for nine stations, as shown on Figure 5-2).

Samples were analyzed as follows, as shown on Figure 5-3:

- Samples from the 0- to 1-inch interval at all stations except fully developed industrial or commercial properties were analyzed for soil parameters that may influence bioavailability (soil organic carbon, specific surface area, particle size, hydrogen/carbon/nitrogen, and black carbon)
- Dioxins and furans were analyzed in 0- to 1-inch interval samples collected at all sampled stations, and in the 1- to 6-inch interval samples collected at stations in close proximity to the Midland Plant.
- Additional chemicals were analyzed in the 0- to 1-inch and 1- to 6-inch interval samples from selected stations in close proximity to the Midland Plant, as shown on Figure 5-3. Additional chemicals consist of an expanded 40 Code of Federal Regulations (CFR) Part 261 Appendix IX list of analytes that includes VOCs, SVOCs, metals, pesticides, and PCBs. Tentatively identified compounds (TICs) also were identified using a process detailed in the Pre-RI Study Report (CH2M HILL, 2007).

Analytical results for the soil parameters that may affect bioavailability were used to calculate best estimates of the ranges of values and will aid in the selection of soils that may be used in a full bioavailability study, if performed. Results for dioxins and furans were evaluated to establish statistical concentration distributions. Results for additional chemicals were used to evaluate the presence or absence of hazardous substances at concentrations above MDEQ generic cleanup criteria. After sample results are unblinded, they will be used to establish spatial concentration distributions and determine whether any of the additional chemicals may be associated with the Midland Plant. Sample results from

the Pre-RI Study will be used to help formulate the sampling strategy for the Midland Area Soils RI as described in Section 5.3.1.

It is important to note that the Pre-RI Study SAP includes provisions to protect the anonymity of sample results for property owners participating in the study. These provisions preclude releasing of information about the sample locations until after DCC have been approved by MDEQ for the Study Area. Therefore, a complete evaluation of the Pre-RI Study results will not occur until after these criteria are approved.

5.1.2 Development of Target Analyte List

Sampling and analysis for the RI will include evaluation of a wide range of hazardous substances that may be associated with potential releases from the Midland Plant. Although a broad range of additional chemicals was analyzed under the Pre-RI Study, some hazardous chemicals on the TALs developed for the RI may not be on the Pre-RI Study Appendix IX list because the TAL evaluation for the RI was not complete at the time of the Pre-RI Study.

The TALs for the RI are being developed based on identification and evaluation of hazardous substances potentially associated with the Midland Plant based on current and historical production and waste disposal operations at the facility. The process for developing the TALs for the Midland Area Soils RI is described in detail in Appendix D. Briefly, the TALs are method-specific compilations of chemicals that will be analyzed in samples collected for the RI. Because of the large number of chemicals included on the TALs, all RI samples may not be analyzed for all TALs.

5.2 Phase I Remedial Investigation

The Phase I RI will be initiated upon approval of the RIWP. The overall objective of the Phase I RI is to develop information to support remedial decision making by supplementing the historical data and Pre-RI Study data (Section 5.1.1). The key components of the Phase I RI are as follows:

- Develop DCC for dioxins and furans in the Study Area for various land uses (for example, residential, commercial, recreational, etc.) based on protection of human health (Section 5.2.1)
- Identify current and potential future land use based on the results of land use and zoning surveys and detailed land use mapping (Section 5.2.2)
- Identify a background location for soil sampling, if necessary (Section 5.2.3)
- Initiate data collection efforts to support the HHRA, if necessary (Section 6.1.5)
- Initiate the problem formulation for a SLERA (Section 7.2.2)
- Develop initial remedial action alternatives for consideration (Section 5.2.6)

Phase I activities are described further below.

5.2.1 Development of Site-Specific Direct Contact Criteria

DCC will be developed for dioxin and furan TEQ for residential, commercial/industrial, agricultural, and recreational land uses as warranted. The approach for developing DCC for the Study Area will involve, among other things, consideration of changes to default exposure parameters and default toxicity criteria. After DCC are developed, a technical memorandum will be prepared and submitted to an Independent Science Advisory Panel (ISAP) for review. The development of DCC is discussed further in Section 6.1.2.

5.2.2 Detailed Land Use and Zoning Survey and Mapping

The HHRA and remedial action approaches for the Study Area will be based on land use; therefore, an accurate characterization of current land use and its compatibility with zoning, as an indicator of potential future land use, is an important component of the RI. Land use and zoning information will be used to identify current and potential future land use. Current land use will be established by conducting a detailed survey of actual land use within the Study Area, which will establish a baseline for understanding potential exposures under current conditions. In order to develop an understanding of potential future land use, information will be collected to document zoning and other land use restrictions established within the Study Area.

Figure 3-1 provided a preliminary assessment of land development in the Study Area based primarily on aerial photograph review. In the Phase I RI, detailed land use maps of the Study Area will be prepared to document current land use and zoning. Initially, the project geographic information system (GIS) will be updated with more recent aerial photography from 2005 that covers the entire Study Area. Land use will be classified based on MDEQ Part 201 Sec. 20120a(1) designations as follows:

- Residential—The primary activity on the property is residential and includes single- and multi-family dwellings, condominiums, and apartment buildings.
- Commercial I—The primary activities on the property are to house, educate, or provide care for children, the elderly, or the infirm. Generally, activities on these properties are characterized by exposures which approximate those on residential properties. Examples of businesses in this category include day care centers, schools, educational facilities, hospitals, nursing homes, and elder care facilities.
- Commercial II—The primary use on the property is commercial with reliably restricted access to the public through fences, security, or both. Generally, activities of these properties are characterized by exposures which approximate those on the industrial property category. Examples of businesses in this category include commercial warehouses and wholesale lumber yards.
- Commercial III—The primary use on the property is commercial with unrestricted public access; however, public occupancy is intermittent and lower than for workers at the site. Examples of types of businesses in this category generally include establishments which have primarily indoor activity, but have some outdoor activity such as: retail gas stations, auto dealerships and repair, retail warehouses with some outdoor storage, and small warehouse operations.

- Commercial IV—The primary use on the property is commercial with unrestricted public access; however, occupancy is intermittent and public access is lower than for workers at the site. Primary activities of the public and workers on these properties are indoors. Examples of types of businesses in this category include professional and governmental offices, medical and dental offices, financial institutions (banks, credit unions), retail businesses with indoor sales (grocery stores, restaurants), and personal services (health clubs, barbers).

- Industrial—The primary activity is industrial in nature, including manufacturing, utilities, industrial research and development, petroleum bulk storage, landfills, and other similar facilities. Access to these properties is reliably restricted by fences and/or security guards.

- Recreational—This category is identified as a land use category in Part 201 Section 20120a; however, it is not defined by published guidance. It is proposed that property in this category in the Study Area include properties intended for regular outdoor activities by the general public. Examples of properties that will be included in this classification are developed parks, picnic areas, boat launches, athletic fields, golf courses, public gardens, and country clubs.

- Agricultural—This category is not identified as a land use category in Part 201 Section 20120a, but would fall under category of "other land use categories defined by the department." There is a limited amount of agricultural land within the Study Area. These properties will have potential exposures that are significantly different from the other land uses defined above. Examples of properties included in this classification include cultivated fields, orchards, and pasture land for livestock. .

- Undeveloped—This category is not identified as a land use category in Part 201 Section 20120a, but would fall under category of "other land use categories defined by the department." There is a significant amount of undeveloped private property within the Study Area. This category will include undeveloped parkland, wildlife areas, and undeveloped private land. This category is intended to represent lands that are primarily in a natural state and have limited human activities.

These land use maps will be verified in the field on a parcel-by-parcel basis for the entire Study Area. Land use also will be compared with current zoning designations to identify nonconforming uses.

The field verification of land use will also include identification of areas with obvious visual evidence of soil disturbance and low-lying areas where soil may accumulate. A qualitative evaluation of the nature and degree of soil disturbance in the Study Area will be performed to better understand the location and degree of land disturbance over time given that disturbances may significantly impact the expected distribution of hazardous substances in surface soils. The contaminant distribution pattern that would result from aerial dispersion of emissions from the Midland Plant could be disrupted by post-depositional anthropogenic activities. This information will be used to support evaluation of the Pre-RI Study results once DCC are approved.

Land disturbance within the Study Area will be assessed by evaluating the following:

- The timing and location of historical land disturbances based on examination of available historical aerial photographs
- Recent land disturbances (within the last 1 to 2 years) will be evaluated based on recent aerial photographs, information about construction and development activities within the Study Area such as public works projects, and visual observations recorded during the land use survey.

During the field verification of current land use, low-lying features where soil and sediment deposition and accumulation may occur will be identified. These areas may be targeted for future sampling. Features that will be identified and mapped include large drainage ditches, stormwater retention basins and/or ponds, and streams. The purpose of this mapping exercise is not to identify all such features in the Study Area, but rather to identify representative features for possible screening-level sampling. Mapping of these features will not extend into the floodplain of the Tittabawassee River, which is the subject of a separate RI.

5.2.3 Identification of a Background Location

Soil sampling at a background location may be needed as part of the RI to help distinguish between analytes that can be attributed to releases from the Midland Plant from those that can be attributed to naturally occurring conditions (such as metals in soil) or anthropogenic sources (such as PAHs in automobile exhaust). In the event that the initial list of CoPCs and COPECs for the RI (that is, Appendix IX chemicals from the Pre-RI Study that are detected at concentrations exceeding human health or ecological benchmark values), then a background area sampling program may be conducted as part of the Phase II RI. The purpose of the background area sampling program is to determine the site-specific background concentrations for these analytes. Background results would be used to help refine the list of CoPCs and COPECs for the RI.

According to MDEQ guidance, background samples must be collected from areas that are representative of background condition and have not been impacted by a release at or regionally proximate to the site (MDEQ, 2002b). Three types of background are recognized: statewide default, regional background, and facility-specific background. The reference area samples for the Midland Area Soils RI will be used to support facility-specific (that is, site-specific) background determinations. Ideally, the background area data set will adequately represent soil conditions in Midland, without impacts from Midland Plant releases. Therefore, the following criteria will be used to identify potential background locations during the Phase I RI:

- **Location**—The background area should not be proximal to or downwind of the Midland Plant.
- **Soil**—Soil types in the background area should be similar to Midland area soils types, including disturbed urban soils. As soil characteristics may vary both laterally and vertically, it may be necessary to determine background concentrations for different types of soils.

- **Geology**—Geology in the background area should be similar to that found in the Study Area (that is, soil derived from glacial and post-glacial fluvial processes).
- **Land use**—The background area should contain a similar mixture of commercial, recreational/undeveloped, residential, and agricultural land as the Midland area.

It may be difficult to find background locations that fully meet the criteria identified above. At a minimum, the background area will be located upwind or well beyond the area of potential impact from airborne releases from the Midland Plant in an area with similar soils and geology. Differences in land use could be accommodated by a biased or stratified sampling program. In general, however, the proposed background areas will not include the following types of locations:

- Areas in which management, treatment, handling, storage or disposal activities of any of the following are known or suspected to have occurred: hazardous substances or petroleum, solid or hazardous wastes, or waste waters
- Storm drains or ditches presently or historically receiving industrial runoff
- Areas within 3 feet of any current structure, or the former location of any structure, which is likely to have been painted with lead-based paint

Proposed background area(s) will be proposed to MDEQ in the Phase II SAP.

5.2.4 Phase I Human Health Risk Assessment Activities

Data collection efforts to support the HHRA will be initiated in the Phase I RI. These activities are described in Section 6.1.5. In addition, the exposure assessment described in Section 6.4 will be initiated.

5.2.5 Phase I Ecological Risk Assessment Activities

The problem formulation phase for the SLERA will be initiated during the Phase I RI. The problem formulation process is discussed in Section 7.2.2.

5.2.6 Development of Initial Remedial Action Alternatives

In the Phase I RI, potential remedies will be developed and evaluated, and may include but are not limited to containment (such as placement of cover material such as topsoil), removal and disposal, physical mixing of surface soil layer (for example, rototilling), and land use changes or controls. Corrective action approaches could vary based on land use, and different approaches could be used at different locations. Conceptually, the potential corrective actions could consist of the following:

- Capping/cover
- Removal/disposal
- Physical mixing
- Land use change
- Institutional control

Table 5-1 summarizes the data needed to support the selection and implementation of the potential remedies and identifies the RI phase in which the data will be collected.

5.2.7 Phase I Data Evaluation and Risk Management Decision Point No. 1

Phase I data evaluation will be performed after the DCC have been developed and approved, and the Pre-RI Study sample locations have been unblinded. Phase I data evaluation activities will include the description of the distribution of contamination based on Pre-RI Study and historical data. The distribution of dioxins and furans will be evaluated relative to DCC. The distribution of other chemicals will be evaluated relative to Part 201 generic cleanup criteria, as available. A Phase I RI Report will be prepared and submitted to MDEQ for review.

Upon submittal of the Phase I RI Report, the following information will be available: (1) DCC for dioxins and furans; (2) unblinded Pre-RI Study results; (3) detailed land use and zoning maps; (4) identification of relevant and complete human health exposure pathways; (5) identification of ecological habitats, receptor species and relevant and complete exposure pathways; and (7) potential remedial approaches. This information will be integrated and evaluated with regard to R 299.5528(3) to evaluate remedies.

As referred to within this RIWP, remedies that will be considered are preferred response action technologies applied successfully at sites having similar characteristics. Remedies are expected to ensure consistency in remedy selection as well as reduction in cost and time to address similar sites. A remedy may be applied conservatively in order to offset uncertainties in the RI data; for example, capping or physical mixing could be broadly applied in some areas to address uncertainty about the exact limits of the area of soil with chemical concentrations exceeding applicable cleanup criteria.

Factors that will be considered as part of the remedial decision-making process include:

- Identification of areas where dioxin and furan concentrations in soil do or do not exceed the applicable DCC
- Assessment of whether any additional chemicals identified in Phase I are expected to have a similar distribution as dioxins and furans based on similar fate and transport characteristics and whether they would be adequately addressed by a remedy designed to manage potential risks associated with dioxins and furans
- Identification of areas that do or do not pose a potential ecological concern

Remedies may be applied in parts of the Study Area at any time to address human health and/or ecological risks. If the data and information available at the conclusion of the Phase I RI are insufficient to support corrective action decisions for the entire Study Area, then additional data will be collected in the Phase II RI to provide the specific information needed to support remedial decision making.

5.3 Phase II Remedial Investigation

The scope and approach for the Phase II RI will be guided by the results of the Pre-RI Study and Phase I RI. A conceptual-level approach is described below. Phase II will include field sampling to support a screening level HHRA and SLERA, complete the definition of the nature and extent of contamination, develop exposure and toxicity information for the HHRA, and complete the ecological exposure and effects assessments for the BERA (if

necessary). Information available at the end of Phase II will be integrated and evaluated by Dow with regard to R 299.5528(3) to determine whether a remedy can and should be performed in any portion of the Study Area. If the data and information are still insufficient to support corrective action decisions, then the Phase III RI will be implemented. Phase III comprises a HHRA, and a BERA if necessary.

5.3.1 Phase II Sample Collection and Analysis

The overall objective of the Phase II soil sampling effort is to address specific uncertainties identified during evaluation of information and daa collected during the Pre-RI and Phase I RI. Soil samples may be collected to identify CoPCs and COPECs, and refine the delineation of the nature and extent of contamination to the degree necessary to support corrective action decisions. The specific objectives of the Phase II sampling effort may include the following:

- Provide TAL data for the identification of CoPCs and COPECs.
- Complete the delineation of dioxins, furans, and other CoPCs and COPECs as needed to support corrective action decision making.
- Characterize background concentrations of TAL constituents in soil from the background area identified in Phase I to assist in the identification of site-related CoPCs and COPECs.
- Supplemental sampling along haul routes. Dow will review the results of previous sampling along haul routes from the Midland Plant to offsite disposal areas in order to identify any data gaps. The interim measures report for corrective actions along Salzburg Road is included in Appendix B.
- Sampling in MCV cooling ponds. Dow will evaluate the need for sampling of these ponds.

If required, a Phase II SAP will be prepared and submitted for review. The SAP will include DQOs and detailed information about sampling design and analytical parameters. Sampling elements may include the following:

- Study Area soil sampling—Soil samples will be collected to provide data for the identification of CoPCs/COPECs, and refine the horizontal and vertical delineation of CoPCs/COPECs to the degree necessary to support corrective action decisions.
- Background samples—Surface soil sample data will be collected from background location(s) that meet criteria defined in Section 5.2.3, if determination of background concentrations is deemed necessary. Background data will be used to help identify CoPCs and COPECs related to releases from the Midland Plant.

Phase II samples will be analyzed for the TAL constituents identified in the Phase I RI. The Phase II sampling strategy will rely on Pre-RI Study and historical sample results and detailed land use maps. Field sampling and data evaluation approaches will be presented in a Phase II SAP.

5.3.2 Phase II Human Health Risk Assessment Activities

CoPCs will be identified and a SLRA will be performed in the Phase II RI. The process for identifying CoPCs is described in Section 6.3.2, and the SLRA is described in detail in Section 6.6.3. In addition, information about exposure will be refined for input into the HHRA. Briefly, findings from the SLRA will be reviewed to determine which CoPC-receptor pathway combinations contribute the most to site risks. These will be carried into a possible HHRA in the Phase III RI. In addition, any exposure media studies will be completed, and exposure point concentrations will be developed based on the results of the data collection efforts, if applicable. The Activity Survey, if performed, will be completed during the Phase II RI.

5.3.3 Phase II Ecological Evaluation Activities

A SLERA will be performed in the Phase II RI. The SLERA is described in detail in Section 7.2. In addition, exposure and effects assessments from the SLERA will be refined using available site-specific information. This tier of the ERA will utilize the information collected from the Tittabawassee River Study Area. The Tittabawassee River Study Area assessment is designed to gain an understanding of food chain transfer and effect levels, specifically for furans and dioxins. When established, these congener-specific relationships also will apply to the wildlife habitat and receptors that are present in the Midland Study Area. Application of the effects levels determined in the Tittabawassee River Study Area assessment will take into consideration the uncertainties associated with current TEFs and the different congener distributions for the Tittabawassee River Study Area relative to the Midland Study Area.

For the exposure assessment, measured concentrations of furans and dioxins in Midland area soils will be used in conjunction with the Tittabawassee River Study Area congener-specific bioaccumulation factors to model exposure to receptors of concern that were identified in the SLERA. Effect levels for receptors that are studied in the Tittabawassee River Study Area will provide a basis for evaluating effect levels within the Midland Study Area that may not otherwise be available from the scientific literature. Dietary exposures and receptor tissue concentrations modeled using Tittabawassee River Study Area bioaccumulation factors will be compared to effect levels established in the literature or on the Tittabawassee River to estimate the potential for risk. This assessment is described in more detail in Section 7.2.4.

5.3.4 Phase II Data Evaluation and Risk Management Decision Point No. 2

The Phase II data evaluation will include development of a refined description of the nature and extent of contamination based on available data. Maps depicting contaminant concentration data will be developed to support risk- and land use-based corrective action decision making. A Phase II RI Report will be prepared and submitted to MDEQ.

At the conclusion of Phase II the following information will be available: (1) more detailed description of the horizontal and vertical distribution of CoPCs and COPECs in the Study Area; (2) final identification of CoPCs and COPECs; and (3) a refined understanding of human health and ecological exposure and effects. Similar to risk management decision point No. 1, this information will be evaluated to determine whether a remedy can and should be performed in any portion of the Study Area. If the data and information available

at this point in the RI are insufficient to support corrective action decisions for the entire Study Area, then a complete HHRA and possibly a BERA will be performed in the Phase III RI.

5.4 Phase III Remedial Investigation

In Phase III, a forward-looking HHRA will be performed if necessary, to quantify potential human risk for CoPCs in the Study Area. The HHRA is described in Section 6.6.4. If necessary, a second tier of the BERA will proceed to develop and implement site-specific studies of unique COPECs, receptors, or exposure pathways within the Study Area in order to characterize site-specific ecological risks. This phase of the BERA is discussed in Section 7.3.6. The results of the HHRA and BERA will be presented in a Phase III RI Report that will be submitted to MDEQ. The results of the risk assessments will be used develop corrective action decisions for portions of the Study Area that were not addressed at by remedy implementations at the end of Phase I or Phase II.

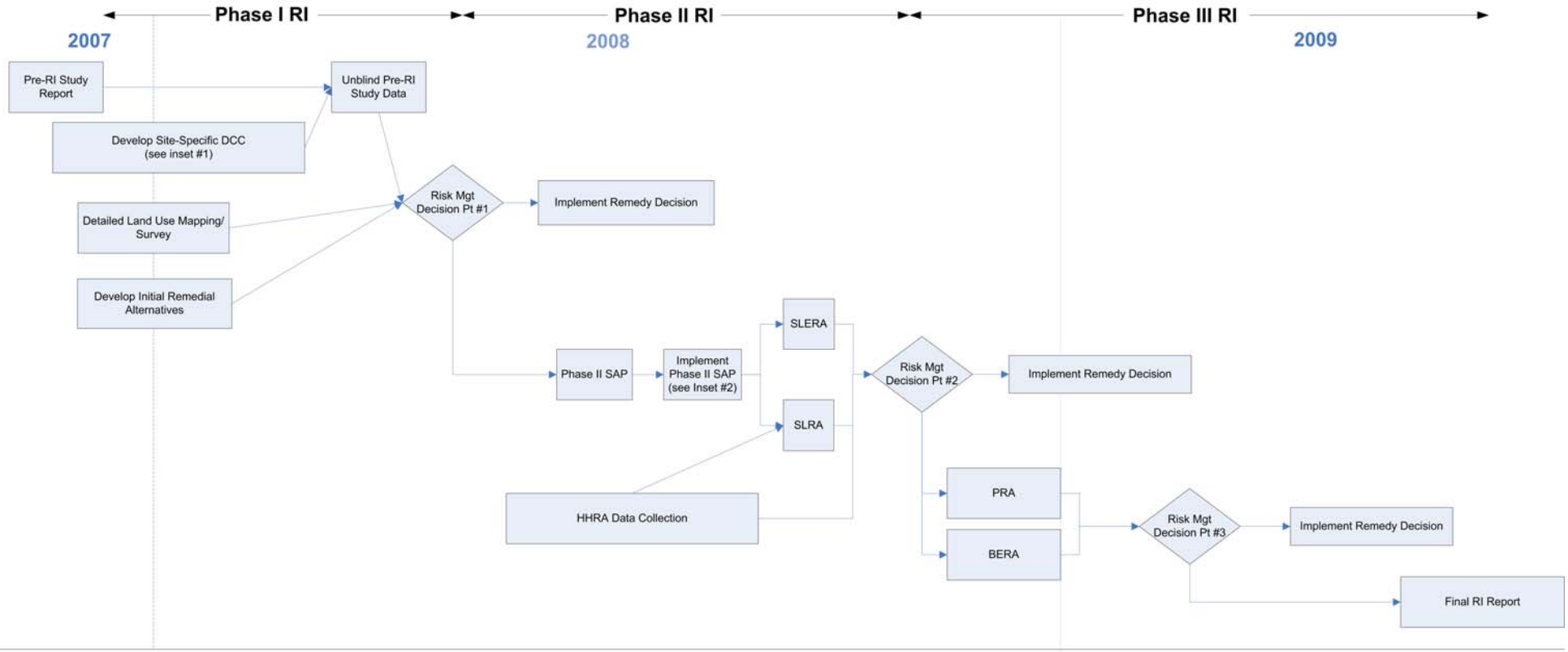
5.5 Feasibility Study

Potential remedial action approaches will be developed in the Phase I RI as described in Section 5.2.6. These approaches will be refined and evaluated in an FS if necessary. An FS could be conducted at the conclusion of the Phase I or Phase II RI, as well as at the conclusion of the Phase III RI.

TABLE 5-1
Data Needs for Evaluating Potential Corrective Actions for Soil
Midland Area Soils Remedial Investigation Work Plan

Remedial Approach	Land Use	Zoning	Horizontal Extent (Pre-RI Study)	Horizontal Extent (Phase II RI)	Vertical Extent (Phase II RI)	Soil Characteristics (Pre-RI Study)
Capping/cover	●	●	●	(●)		
Excavation and disposal	●		●	(●)	●	●
Physical mixing	●		●	(●)	●	●
Land use changes	●	●	●	(●)	(●)	
Institutional controls	●	●	●	(●)	(●)	
No Action	●	●	●	(●)	(●)	
Monitor Only	●	●	●	(●)	(●)	
Restrictive Covenant	●	●	●	(●)	(●)	

● Data needed for remedy decision or design
(●) Data may or may not be necessary (to be determined after Phase I RI)



Inset #1: Process for development of Direct Contact Criteria (DCC)

Inset #2: Phase II Field Sampling

- Soil sampling to identify COPCs/COPECs
- Soil sampling as needed to define nature and extent for remedy decision
- Background area surface soil sampling, if deemed necessary

LEGEND

DCC	Direct Contact Criteria
HHRA	Human Health Risk Assessment
SAP	Sampling and Analysis Plan
SLRA	Screening Level Risk Assessment
SLERA	Screening Level Ecological Risk Assessment
BERA	Baseline Ecological Risk Assessment
ISAP	Independent Science Advisory Panel
PRA	Probabilistic Risk Assessment

FIGURE 5-1
Remedial Investigation Approach for Midland Area Soils
Midland Area Soils Remedial Investigation Work Plan

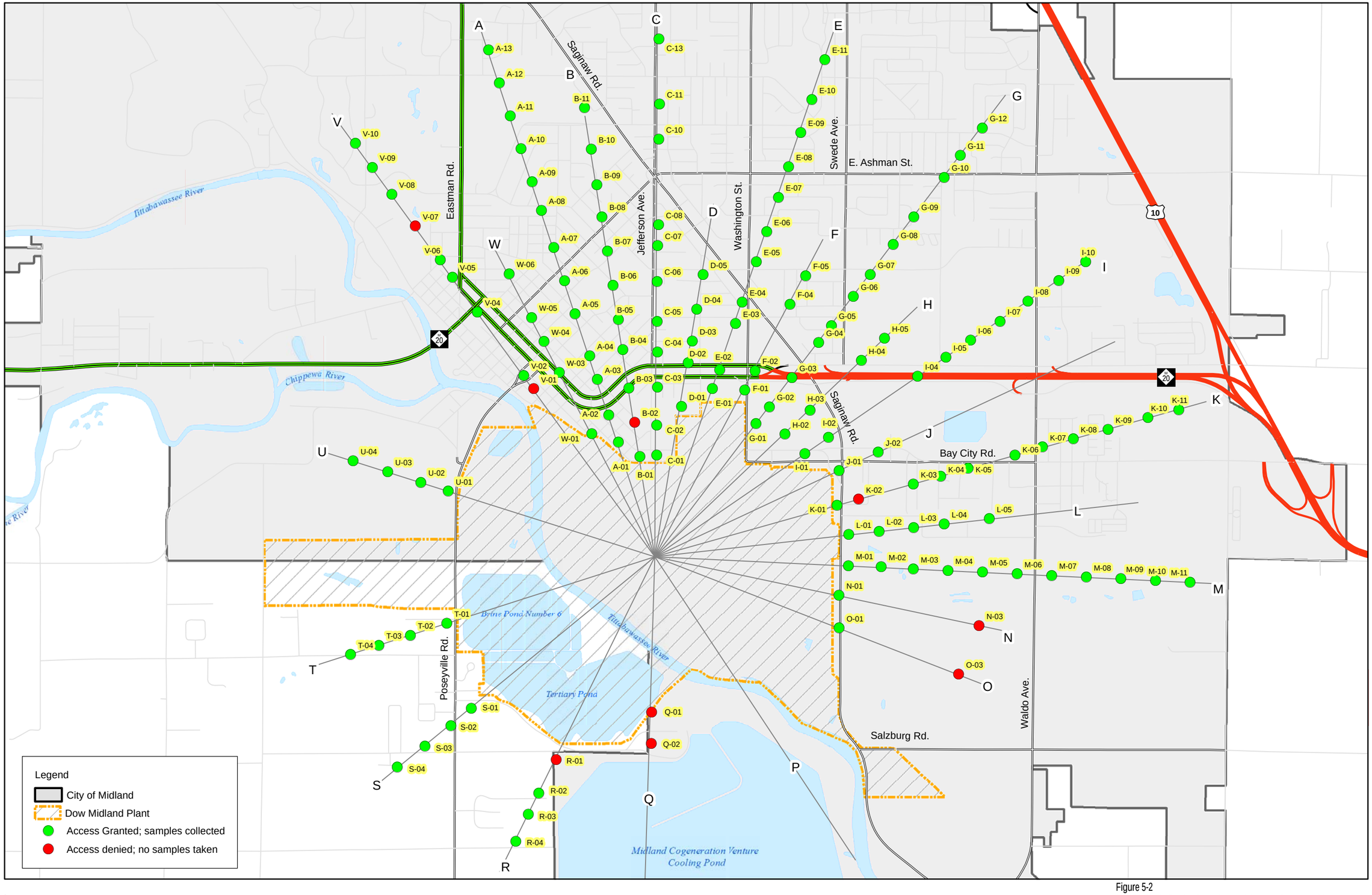


Figure 5-2
Pre-RI Study Station Location and Access Summary Map
Midland Area Soils Remedial Investigation Work Plan

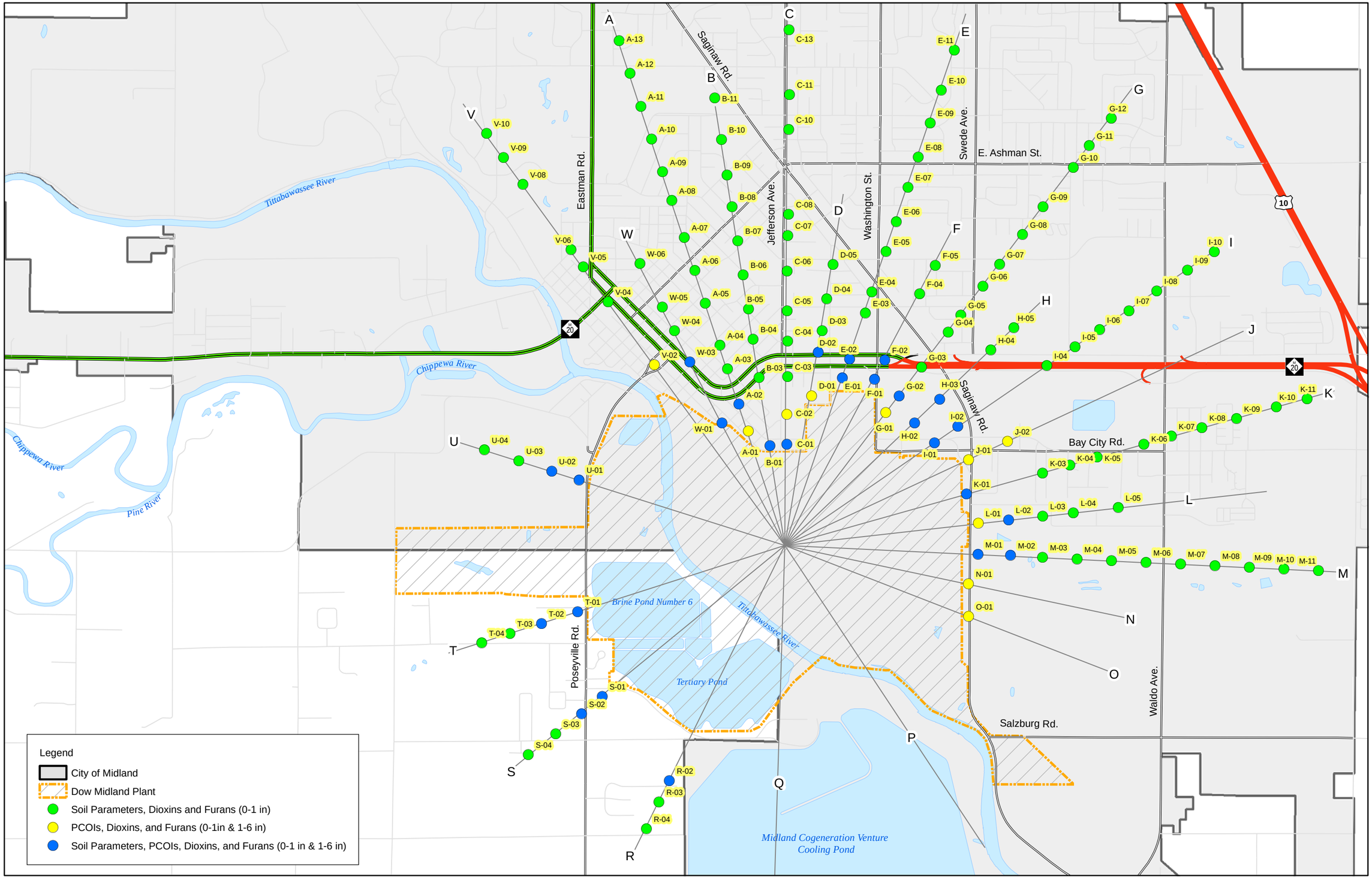


Figure 5-3
Pre-RI Study Analytical Summary Map
Midland Area Soils Remedial Investigation Work Plan

SECTION 6

Human Health Risk Assessment

6.1 Introduction

The purpose of this baseline HHRA is to present an assessment of the theoretical human health risks associated with potential exposure to CoPCs[2] in the Study Area. The risk assessment approach described here was developed to be consistent with Part 111 and Part 201 of Act 451 as amended and the Administrative Rules for Part 201, which is being used as a means to meet Dow's hazardous waste corrective action obligations under its License and under Part 111 of Act 451. References cited in this section are provided in Section 10.2.

This risk assessment draws from the scientific literature and also complies with USEPA risk assessment guidance that has been developed and modified over the past 20 years (for example, USEPA, 1989b; 1991a and 1991b; 1992; 1997a, 1997b, and 1997d; 2001; 2004a; 2005a) for sites being evaluated under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP). Early steps in the HHRA include the finalization of the CoPCs evaluated in the risk assessment, identification of the receptor populations along with the complete exposure pathways relevant to each, and establishment of the algorithms used to quantify exposure and the input variables needed. The HHRA also proposes to derive the needed toxicity criteria for cancer and noncancer endpoints in keeping with the recent recommendations of the National Academy of Science's (NAS's) review of the USEPA Dioxin Reassessment (*Health Risks from Dioxin and Related Compounds: Evaluation of the EPA Reassessment*; NAS, 2006), and define where and when deterministic and probabilistic methods are to be used. The HHRA will address scientific information and recommendations that were not available at the time of MDEQ's promulgation of the footnoted DCC for dioxin.

At present, the primary compounds of interest are dioxins (or PCDDs) and furans (or PCDFs). Together, dioxins and furans are often referred to as PCDD/Fs and that terminology is used in this HHRA work plan. From a TEQ perspective, the primary PCDD/Fs in Midland are certain PCDDs such as 2,3,7,8-TCDD as well as low levels of PCDFs. Although the text of this section reflects the primary focus to date on PCDD/Fs, as further described in Section 6.3, analytical data for a comprehensive list of contaminants potentially related to historic manufacturing activities (termed here the TAL) will be evaluated to identify a complete list of CoPCs for consideration in the HHRA. If any of the additional identified CoPCs emerge that require additional or differing risk assessment evaluation (for example, through consideration of additional exposure pathways, toxicity values, or chemical-specific exposure data), the approach presented herein will be modified accordingly.

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[2] CoPCs for the human health risk assessment are defined as TAL chemicals from Dow operations present in soil, sediment, or another environmental medium at a concentration that is higher than background concentrations (for example, for naturally occurring metals) and higher than relevant risk-based screening values derived either by MDEQ or USEPA, or where risk-based concentrations are not available from either of these sources, through methods described further in this RIWP for screening potential toxicity and exposure.

Study Area populations may be exposed to CoPCs through ingestion, inhalation, or skin contact with these CoPCs in soil, sediment, or dust, or as the result of the ingestion of local foods (that is, sport-caught fish or game in the Tittabawassee River area, home-raised meat, milk, eggs, or garden plants raised in the Study Area). The HHRA will assess both the qualitative and quantitative aspects of all relevant completed exposure pathways using available and newly generated local data (such as the UMDES data set [www.umdioxin.org; also provided in Appendix E, Attachment E-5]) or media-specific measurements of chemical concentrations made in areas including the Study Area.

The 2006 NAS report also will be relied upon for guidance. The HHRA will include assessment of the potential risk from Study Area exposures first using conservative point estimates of exposure and toxicity (that is, a deterministic screening level risk assessment or SLRA evaluation) to eliminate CoPCs and exposures that do not contribute significantly to added risk. The HHRA also will include consideration of additional deterministic evaluations or a probabilistic risk characterization to more fully characterize the risk from remaining sources of exposure and illuminate the uncertainty and variability in the risk estimates.

6.1.1 Proposed Assessment Approach

A proposed schedule for the HHRA is provided in Section 9, although the HHRA elements within this schedule remains dependent on many variables, including ISAP reviews and MDEQ approval(s) as well as on the completion of any scientific study or data collection effort identified as necessary for addressing specific risk assessment needs.

Steps in Risk Assessment

The HHRA will include the four steps identified by USEPA guidance for risk assessment (USEPA, 1989). Although MDEQ does not provide specific guidance for risk assessment, applicable MDEQ Part 201 rules have been applied as appropriate. These rules describe the risk assessment methodology used in deriving cleanup criteria as well as considerations in toxicity assessment and these elements and assumptions also have been applied as appropriate. The four steps to be applied include the following:

- **Identification of CoPCs**, through screening the TAL (Section 6.3.2).
- **Exposure assessment** including an evaluation of exposure pathways that are now complete, or are reasonably anticipated to be complete in the future. The exposure assessment will include collection and/or collation of the following: site-specific and (where appropriate) non-site-specific data considered to be representative of Study Area conditions (such as soil ingestion rates); CoPC concentrations in various media (soil, dust, behavioral and activity patterns (outdoor activities, soil ingestion, and the frequency and time spent for these activities); and chemical specific parameters (for example, chemical properties, published absorption values and bioavailability data gathered for PCDD/F and for any other CoPCs).
- **Toxicity assessment** including assembling appropriate USEPA- and MDEQ-recommended toxicity values for all CoPCs and deriving toxicity measures as appropriate, including the toxicity criteria for PCDD/F to take into account new data available since the last MDEQ evaluation of cancer potency and development of the

footnoted Part 201 generic residential soil DCC of 90 ppt. In addition, CoPCs without recommended toxicity values may be evaluated, or existing values may be updated and substituted as necessary.

- **Risk characterization** will combine exposure and toxicity assessments to derive cancer risk estimates and noncancer hazard indices. The risk characterization will include assessment of variability and uncertainty in individual inputs and in overall risk estimates to evaluate the range of potential Study Area risks. Delineation of the variability and uncertainty will be developed to assist efforts to place potential site risks in context and facilitate informed risk management decisions. Alternate means of evaluating risk such as a margin of exposure analysis may be developed to help place this evallation into context for the risk managers and public. Comparison of the modeled risk estimates to site-specific information such as the results of the UMDES also will be made and the reason for any differences observed discussed.

Planned Assessment Elements

Because this is a large and complex Study Area and there may be a number of potential exposure pathways, a sequential approach is planned for the risk assessment. Specifically, the following steps are proposed:

- **DCC:** Due to changes in the scientific understanding of PCDD/F toxicity and hazard as well as changes in methodology and the availability of relevant site-specific information, there is a need for an updated DCC for soil in Midland Study Areas. Part 201 rules allow for such a re-evalution in these cases. These criteria will be used for early decision making about sampling and early risk management decision points. The methods proposed to derive these criteria are described in Section 6.1.2.

- **SLRA**: An initial screening level risk assessment or SLRA will be conducted to determine which CoPC—exposure pathway—receptor combinations require more thorough evaluation, which can be eliminated from further consideration because their contribution to potential risk is negligible (that is, lifetime carcinogenic risk estimate less than 10^{-7}, or hazard index [HI] less than 0.001), and which may be incorporated in further refinement using screening level methods because their contribution is minor (that is, lifetime carcinogenic risk estimate less than 10^{-6}, or HI less than 0.01)[3].

- Pathway-receptor combinations that have SLRA risk estimates that are negligible for all CoPCs will be omitted from any further consideration in the HHRA. This would include COPCs that are less than the MDEQ Part 201 pathway specific criteria.

- CoPCs that have SLRA risk estimates that are negligible for all pathways for a given receptor will be omitted from further consideration for that receptor.

[3] This risk range is based on the acceptable risk range (that is, risks between 10^{-6} and $10^{-4}$for carcinogenic effects and a hazard index of 1 for noncarcinogenic effects) cited in USEPA's NCP (40 CFR 300) and the MDEQ risk level of 10^{-5} applied in derivation of cleanup criteria for carcinogens and hazard index of 1.0 identified for single chemicals pursuant to Part 201 Sec. 20120a(4). The lower target risks and lower hazard index are provided to be protective of multiple CoPCs or pathways.

- Pathways and CoPCs not eliminated by the above two screens will be further evaluated in a refined risk assessment that uses deterministic methodologies, probabilistic methodologies, or a combination of both risk assessment methodologies:
  - CoPC/pathway/receptor combinations, while not required to be evaluated under Michigan's Part 201 statute and rules for the purposes of the development of criteria, will be evaluated as part of the HHRA as provided for in USEPA's risk assessment guidance that provides for the consideration of exposure pathway combinations when it is likely that the same individuals will be exposed to CoPCs through more than one pathway (USEPA, 1989).
  - CoPC/pathway/receptor combinations with minor contributions in the SLRA may be incorporated in the probabilistic risk assessment (PRA) using the SLRA screening methods and parameter values[4].
  - CoPC/pathway/receptor combinations with SLRA risk estimates greater than 10^{-6}, or HI greater than 0.01 will be evaluated using PRA where possible. Where not possible, more detailed screening methods will be used to further evaluate these combinations.
- **PRA**: Those pathways identified to be of concern in the SLRA (see above), will be further evaluated in a forward-looking individual and population-based[5] risk assessment that is either wholly or partially probabilisitic to better characterize the theorectical risks and the key aspects of variability and uncertainty in the calculated human risk estimates and ranges.
- **ISAPs:** ISAPs will be used to review the HHRA and HHRA components, as appropriate. The involvement of an ISAP is not necessary or beneficial in preliminary stages of the HHRA or during development of the HHRA process, and use of numerous ISAPs to evaluate too many issues will unnecessarily delay progress. The HHRA proposes to use an ISAP to review only important substantive issues or determinations, particularly development of site-specific criteria as contemplated by the SOW. The independent review provided by these panels will provide a separate and autonomous technical evaluation and check on both the process and interpretation of outcomes. The ISAP review also will provide valuable technical feedback that will allow refinement of the HHRA technical approaches as needed. The ISAPs and the processes they use also are intended to assist the public in understanding the HHRA elements and to ensure that approaches applied are technically and scientifically sound. A description of the ISAP process is contained in Appendix E, Attachment E-2.

[4] In implementing a PRA, it may be simpler to incorporate a CoPC/pathway/receptor combination probabilistically rather than attempt to maintain separate values for common variables used in both the SLRA and the PRA.

[5] The PRA will evaluate hypothetical individuals randomly chosen from within the population evaluated; an estimate of potential total population effects will be obtained by summing over all such individuals.

Applicable Risk Assessment Guidance

The risk assessment will be conducted in compliance with applicable methodology in the MDEQ Administrative Rules for Part 201 and in accordance with USEPA guidance, including, but not limited to, the following documents as appropriate to the assessment:

- *Table 4: Toxicological and chemical-physical data for Part 201 generic cleanup criteria and screening levels,* MDEQ R 299.5752 (MDEQ, 2006).
- *Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual* (Part A) (USEPA, 1989b).
- *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors",* Interim Final (OSWER Directive # 9285.6-03), March 1991 (USEPA, 1991a).
- USEPA Region 9 preliminary remediation goals (PRG) table (USEPA, 2006b) may be used in development of the CoPC list for chemicals that do not have MDEQ values and may also be consulted as an initial summary of toxicity values from the USEPA Health Effects Assessment Summary Tables (HEAST) and USEPA National Center for Environmental Assessment (NCEA).
- *Risk Assessment Guidance for Superfund (RAGS) Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final,* EPA/540/R/99/005, OSWER 9285.7-02EP, July 2004 (USEPA, 2004a).
- *Risk Assessment Guidance for Superfund (RAGS) Volume III–Part A, Process for Conducting Probabilistic Risk Assessment*, EPA 540-R-02-002, OSWER 9285.7-45, December 2001 (USEPA, 2001).
- *Supplemental Guidance to RAGS: Calculating the Concentration Term* (USEPA, 1992) and *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (USEPA, 2002a). In addition the USEPA statistical package ProUCL version 3 will be applied as appropriate[6].
- *Exposure Factors Handbook,* Volumes I through III (USEPA, 1997a).
- *Guidelines for Carcinogenic Risk Assessment,* 70 Federal Register (FR) 17765-17817, April 7, 2005, reprinted as EPA/630/P-03/001F, March 2005 (USEPA, 2005a).
- *Supplemental guidance for assessing susceptibility from early-life exposure to carcinogens*, EPA/630/R-03/003F, March 2005 (USEPA, 2005b).
- *Approaches for the application of physiologically based pharmacokinetic (PBPK) models and supporting data in risk assessment* (USEPA, 2006c).
- Guiding principles for Monte Carlo analysis, EPA/630/R-97/001, March 1997 (USEPA, 1997b and any applicable MDEQ guidance that is available at the time of the HHRA).

[6] http://www.epa.gov/nerlesd1/tsc/images/proucl3.pdf

- *Guidelines for neurotoxicity risk assessment,* 63 FR 26926-26954, May 14, 1998, reprinted as EPA/630/R-95/001F, April 1998 (USEPA, 1998c).

- *Guidelines for developmental toxicity*, 56 FR 63798-63826, December 5, 1991, republished as EPA/600/FR-91/001, December 1991 (USEPA, 1991d).

- *Guidelines for reproductive toxicity assessment*, 61 FR 56274-65322, October 31, 1996, reprinted as EPA/630/R-96/009, October 1996 (USEPA, 1996).

- *Guidelines for the Health Risk Assessment of Chemical Mixtures,* 51 FR 34014-34025, September 24, 1986, reprinted as EPA/630/R098/002, September 1986 (USEPA, 1986).

- *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures*, EPA/630/R-00/002, August 2000 (USEPA, 2000b).

- Other sources as appropriate.

Additional reference materials to be relied upon include:

- *Health risks from dioxin and related compounds*: *Evaluation of the EPA reassessment*. National Research Council, Committee on USEPA's Exposure and Human Health Reassessment of TCDD and Related Compounds (NAS, 2006).

- *Measuring people's exposure to dioxin contamination along the Tittabawassee River and surrounding areas: Findings from the University of Michigan dioxin exposure study.* University of Michigan (University of Michigan, 2006) as well as ongoing updated analyses of these data from UMDES. In addition, the associated questionnaire results and blood and soil data results, as published, will be extensively used, augmented by responses to queries to the University of Michigan team for more detailed information, particularly on questionnaire results (provided in Appendix E Attachment E-5 and www.umdioxin.org).

- *The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds* (van den Berg et al., 2006).

- *An examination of EPA risk assessment principles and practices*. Office of the Science Advisor, U.S. Environmental Protection Agency, Washington, D.C. 20460 EPA/100/B-04/001 March 2004 (USEPA, 2004b).

6.1.2 Derivation of Site-Specific Direct Contact Criteria for the Study Area

As done in other states and some USEPA regional offices, MDEQ has developed generic soil DCC associated with different property uses (industrial, commercial, residential, etc.). For example, for PCDD/Fs (as TEQ), MDEQ has promulgated a footnoted generic residential soil DCC of 90 ppt. The proper interpretation of any generic values is that at or below the stated value (such as 90 ppt TEQ), the regulatory agency is reasonably certain that no unacceptable risk will accrue to potentially exposed individuals because of the highly protective nature of the assumptions used to derive the criteria. Such values do not imply that above the promulgated value, harm will occur, only that further evaluation may be

needed to determine the extent and nature of the theorectical risk. Accordingly Part 201 allows the development of a site-specific risk assessment and direct contact criteria to better determine whether a risk exists in the area under question and its extent and nature. Under Michigan regulations, the License, and the SOW, the HHRA will include development of site-specific DCC, and other criteria, based upon the best available data and methodologies.

The draft HHRA will include a site-specific DCC to incorporate appropriate new scientific findings unavailable when the Part 201 generic DCC was created in 2002, site-specific information generated by the UMDES or as a result of site investigations, and development of new techniques to place this information in context. These include potential revisions to some of the inputs to the DCC:

- Changes to default exposure parameters based on changes MDEQ has made elsewhere but not yet incorporated into the PCDD/F DCC (for example, changes to dermal absorption, soil adherence and exposed surface area assumptions)
- Changes to default exposure parameters based on site-specific information (for example, oral bioavailability, exposure frequency and duration, body weight extrapolated from the UMDES and other data sources, etc.)
- Changes to default exposure parameters based on best available science (for example, soil ingestion rates, etc.)
- Changes to default toxicity criteria based on new toxicity data or the derivation of new criteria pursuant to MDEQ Part 201 R 299.5701(c) (for example, use of the Department of Health and Human Services National Toxicology Program [NTP] 2004 bioassay for cancer slope factors, etc.)

The HHRA will identify those parameters that can and should be updated for residential, commercial/industrial, agricultural, and recreational land uses as warranted. The final criteria, site-specific or facility-specific generic DCC for various land uses, also will be subject to third-party ISAP review to provide transparency and ensure values are scientifically justifiable.

6.1.3 Prior Studies and Proposed Use of the UMDES Exposure Data

The Midland Study Area has been the subject of many investigations (see Section 6.3.1) that have generated considerable site-specific information available for use in the HHRA. Most of these investigations, conducted by Dow, MDEQ, and USEPA, have examined contaminants in soil; other studies are described in Section 6.3.1. These prior studies have helped to focus this investigation, and data from those studies are proposed for use in the HHRA. The most informative and recent study is the UMDES, with an initial report in August 2006 and with analyses still ongoing (http://www.sph.umich.edu/dioxin/whatsnew2.html). This human exposure and biomonitoring study measured PCDD/Fs and PCBs congeners and reported these individually as well as a single combined TEQ in blood serum, soil, and household dust. The UMDES also administered detailed exposure surveys to elicit participants' reports of their consumption of various foods (both locally grown and store bought) and participation in various activities expected to contribute to PCDD/F and PCB exposure.

The UMDES collected data from stratified random samples from five populations, consisting of persons resident in the following five mutually exclusive geographic areas:

- Floodplain of the Tittabawassee River (defined as the floodplain of the river between the Midland Plant and the confluence of the Tittabawassee and Shiawassee rivers in Saginaw)
- Near floodplain (defined as census blocks adjacent to the Tittabawassee River Floodplain between the Midland Plant and the confluence of the Tittabawassee and Shiawassee rivers in Saginaw)
- Midland Plume area (defined as an area downwind of the Midland Plant in the city of Midland)
- Other Midland/Saginaw areas (defined as other areas in Midland County, Saginaw County, and Williams Township in Bay County, excluding the previously defined areas and excluding also the floodplain of the Saginaw River and the confluence floodplain of the Shiawassee River)
- Control area thought not to be affected by Midland Plant activities consisting of Jackson and Calhoun counties over 100 miles away from the Midland Plant

Persons who had lived at their current address for 5 years or longer and who were at least 18 years old were eligible for inclusion in the study. Complete 1-hour interview data were obtained for 1,324 persons, including 359 from the control area. Persons whose blood was sampled also had to meet medical eligibility criteria: weight at least 110 pounds, no chemotherapy within the last 6 months, no history of bleeding or clotting disorders, not currently taking blood thinner medications, not currently nursing or (known to be) pregnant, not currently diagnosed or treated for anemia, and having not donated blood within the previous 8 weeks. Blood sample data were obtained from 946 of the interviewees, including 251 from the control area.

The UMDES study team went to substantial effort in the design and execution of the UMDES to ensure that the sample would be representative of the underlying population and to ensure that valid inferences could be drawn. The protocol (UMDES study protocol, 2005; http://www.sph.umich.edu/dioxin/protocol.html; Appendix E, Attachment E-5) defined the populations to be sampled, the method of sampling, and the many quality control procedures required. Extensive evaluation of the sampling approach and iterative corrections for various biases were incorporated (Lepkowski, 2006[7]) and great care taken in executing the design (Ward et al., 2006d; LaDronka et al., 2006). Cooperation and response rates were higher than expected (overall response rate 74.3 percent) (Lepkowski, 2006). A follow-up survey of non-responders also had a high response rate (50 percent), and indicated that non-responders to the main study participated in fewer activities that are related to potential PCDD/F exposure (hunting or fishing in, and consuming game and fish from, Michigan and the Tittabawassee River or floodplain), but showed no significant differences in the most significant predictors of blood PCDD/F levels (age, sex, and body mass index [BMI]) (Olson et al., 2006). The study design and its preliminary results have all been reviewed and commented upon by an independent scientific advisory board

[7]These papers are available at www.umdioxin.org and are attached as Appendix E Attachment E-5 to this report.

consisting of Linda Birnbaum, PhD, Diplomat of the American Board of Toxicology (DABT) (USEPA); Paolo Boffetta, MD, MPH (International Agency for Research on Cancer); Ronald Hites, PhD (Indiana University); and David Kleinbaum, PhD (Emory University) (Franzblau, 2006).

The study included analyses of the 17 PCDD/F congeners substituted with chlorines at the 2,3,7, and 8 positions and the 12 PCB congeners identified by WHO (van den Berg et al., 2006) as having dioxin-like properties, and also calculated total TEQs in various ways using the PCDD/F and PCB congeners identified by WHO (van den Berg 2006).[8] The initial reports of the study evaluated the seven individual congeners contributing most to TEQ in blood together with the total TEQ values that combined dioxins, furans, and PCBs. These analyses were collected and reported for the following:

- Blood serum data were reported for 946 persons, including 251 persons from the control area considered (because of its distance) to be unexposed to Dow activities.
- Soil sample results for 766 samples, including 194 from the control area, from the surface soil (0 to 1 inch) stratum around house perimeters; 449 samples, including 53 from the control area, for the 1- to 6-inch stratum around house perimeters; 484 samples, including 124 from the control area, of the 0– to 6-inch stratum in soil contact zones in gardens; and 191 soil samples each from 0 to 1 inch and 1 to 6 inch from garden areas in the Study Area.
- Vegetation sample results for 416 samples including 52 from the control area, associated with the house perimeter soil samples; and 163 vegetation samples associated with the soil samples from the Tittabawassee River Floodplain. All vegetation samples were opportunistic grab samples associated with the corresponding soil samples (UMDES protocol, 2005).
- Household dust sample results for 764 samples, including 198 control area samples.
- Interview data were obtained from 1,324 participants, including 359 from the control area.
  - Interview data included demographic and general physical characteristics of study participants (for example, body weight, age, years of residence).
  - Interviews also included extensive questions about exposure, including local and general consumption of local caught or grown foods as well as fish or game caught elsewhere or purchased, work history, years of residence in the area where studied, remediation at residence if any, activities involving soil contact including gardening, activities in and around the Tittabawassee River and other areas, and breast feeding history.
- A complete set of interview data, serum data, soil and dust sample data were reported for 731 persons including 183 individuals from the control area.

8 The TEQs initially reported by the UMDES were based on the 1998 WHO TEFs for 29 congeners, which includes coplanar PCB congeners. Additional analyses limited to PCDD/F and the 2005 updated TEFs have been calculated and were discussed at a June 2007 public meeting. Summaries of these analyses are availbale on the UMDES Web site. .

UMDES has conducted statistical analyses of the sampling results to evaluate potential associations in four PCDD/F congeners, three PCB congeners, and TEQ concentrations between blood serum and soil concentrations, dust concentrations, and food consumption and other demographic characteristics, personal characteristics, or residence locations.[9] UMDES is continuing analyses on the other congeners that were measured.

Because the UMDES included 1,324 interviews (including 965 in or near the area of interest), the investigation reports provide helpful and relevant site-specific information about food consumption rates, duration of residence, and demographic characteristics including ethnicity and body weight distributions in the Study Area.

The HHRA will integrate the relevant aspects of the UMDES conclusions and data, including exposure data gathered through these interviews into appropriate aspects of the HHRA. The UMDES team has meet and will continue to meet with Dow and MDEQ to address questions, provide data and identify how best to use the UMDES data to inform the HHRA and risk management decisions. Requests have been (and will be) made to the UMDES study team for further evaluation of the various aspects of the relevant questionnaire items.

In each instance of use within the HHRA, the UMDES interview data will be compared with any available parameter data provided by USEPA or MDEQ sources, and where appropriate with U.S. national or regional data. Where there are no statistically significant differences between UMDES distributions (known to be representative of the Study Area) and those obtained with lower uncertainties (generally using larger samples sizes), the lower uncertainty estimate will be used or suitably merged with the UMDES data. The HHRA may also use the results of additional site-specific data collection efforts and combine these with existing exposure variables or the UMDES variables that are deemed appropriate for risk assessment use to obtain additional site-specific variables for algorithm inputs to various exposure pathways. Other requests will be made to the UMDES project team jointly or independently as needed.Where the UMDES distribution is incomplete for a particular requirement,the distribution obtained from UMDES will be merged with suitable other data (including possibly site-specific data or national data) as mentioned above.

Initial findings of the UMDES have been reported and are being reported as analyses are finished[10]. Because of the size of the study and its design, it had the ability to detect very small differences in the population studied. Among these results that may have impact on the HHRA and overall risk management decision process are the following:

- Although some differences in blood serum levels were noted between exposed and local control populations for certain of the parameters measured, these differences were small and similar to that found in the general U.S. population. The primary determinant of elevations in blood levels was age, sex, and body mass. Because of the long life of some dioxins and furans the body, these findings may represent exposures occurring primarily in the past.

9 The seven congeners evaluated so far are the major contributors to TEQ in blood samples in the UMDES and in the United States generally (UMDES brochure, 2006 http://www.sph.umich.edu/dioxin/PDF/UMDES%20Brochure_FINAL_08042006_lores.pdf; Appendix E Attachment E-5).

10 http://www.sph.umich.edu/dioxin/PDF/060507_CAP_Presentations/Garabrant%20slides%20for%20CAP%20060507%20V12.pdf

- Even individuals residing on soil with 1,000 ppt for many years showed very little effects on their blood levels (that is, 0.5 ppt) suggesting that such exposure was largely inconsequential. Similar findings were found when the correlations between blood levels and higher soil concentrations (90th percentile) for various congeners were compared.
- There was no correlation between levels of dioxins and furans in house dust and dioxin and furan blood levels of residents.
- Although game and fish ingestion was associated with increased blood levels of some congeners or TEQ, this was true regardless of the source of fish and game. In other words, consumption of fish from restaurants or grocery stores had the same effect on blood levels as consumption of local sport caught fish.
- Consumption of vegetable, again regardless of source, was associated with decreased blood levels of dioxins and furans in consumers of store bought or homegrown vegetables.
- Specific chemical markers of historic releases (such as 2,3,4,7,8-PeCDF) that were found at elevated levels in soil, dust, and local biota were largely not found to be elevated in the blood of local residents again suggesting exposure was not occurring or inconsequential.

These site-specific findings and others must be reconciled with the results of the hypothetical exposures and risk estimates in order for proper weight to be given to the risk assessment, its conclusions, and the risk management decisions resulting from it.

6.1.4 Comparison of PRA with UMDES Blood Concentrations

The PRA proposed here is designed to obtain the best estimates available for the distributions of doses and risks from the Study Area media. During the necessary risk assessment calculations, the concentrations of PCDD/Fs in blood to be expected from the estimated doses also can be calculated and compared to the results of blood sampling collected during the UMDES. The blood concentration distributions and the potential relationships between blood concentration and environmental measurements (concentrations of PCDD/Fs in soil) will be evaluated from the results of this simulation exercise and compared with the results observed in the UMDES. A similar exercise will be performed using results from the SLRA; however, the SLRA is conservative by design, and moreover will be performed only on a pathway-by-pathway basis, so comparisons will be less direct. However, these comparisons may be able to detect extreme overestimates or underestimates of doses in particular pathways.

6.1.5 Studies Proposed to Support the HHRA

The HHRA will be supported by a number of exposure pathway specific data collection efforts. The work plans, and or protocols, for these studies are provided in Appendix E, Attachment E-3. These include the following:

- **Bioavailability:** A pilot bioavailability study, a follow-up investigation, and a bioaccessibility study were conducted to evaluate the potential oral absorption of

PCDD/F in soil relative to absolute oral absorption potential (that is, bioavailability). These results also were compared to similar studies conducted elsewhere as well as studies of local soil characteristics that might influence bioavailability; as such, these data provide a basis to evaluate oral absorption of PCDD/Fs from local soil in the HHRA. A deterministic value of 25 percent is proposed to replace the 50 percent previously used in MDEQ calculations. The results of the pilot study are available on the MDEQ Web site[11], the results of both the pilot study and the follow-up study also are provided in Appendix E, Attachment E-3. In addition, as described above, Attachment E-1 provides the memorandum summarizing the evaluation of bioavailability and the weight-of-evidence justification for the selection of the alternate bioavailability value that was provided to MDEQ on July 9, 2007, and as updated with comments received from MDEQ on August 16, 2007. Further discussion of this issue is provided in Section 6.4.5. Further analysis of bioavailability data to develop a probability density function for use in the PRA may be conducted if necessary to provide variables for input into the additional HHRA effort.

- **Soil ingestion rates:** Soil ingestion rates are being further investigated by Drs. E.J. Calabrese and E.J. Stanek III at the University of Massachusetts (hereafter referred to as the UMass Soil Ingestion Project). These investigators are recognized as the international experts on soil ingestion. A general summary of the protocol for these investigations is provided in Appendix E, Attachment E-3 and more discussion on soil intake assumptions for the HHRA is provided in Section 6.4.3. Once completed, alternate soil ingestion rates (probabilisitic and deterministic) for children and adults will be proposed for use in the risk assessment. These values will need to be reconciled with increased understanding of the role of soil ingestion in exposure assessment as well as the UMDES results as discussed above.

- **Additional exposure parameters:** There are certain exposure parameters for which site-specific information is not currently available and for which generic or default values developed in the past or for other situations may be unsuitable. These include some aspects of ingestion rates for various food items associated with the Study Area exposure pathways (for example, ingestion rates of soil and garden vegetables) as well as estimates of exposure frequency and duration of adult and child activities likely to bring these populations into contact with contaminated media (for example, days spent outdoors, hours spent in contact with soil, etc.). Table 6-1 lists such information or values**.** An Activity Survey has been proposed to better characterize some of these exposure parameters by building on and supplementing data from the UMDES that relates to the types of activities that could result in contact with CoPCs in Study Area media, potential contact rates, consumption of local foods collected from within the Study Area, or observing activities within the Study Area. The need for and scope of the Activity Study has not yet been determined although a draft study plan has been developed for review and planning purposes.

[11] http://www.deq.state.mi.us/documents/deq-whm-dioxin-PilotStudyReportFINALFeb24.pdf

6.2 Conceptual Site Model: Human Health Exposure Pathways

The conceptual site model (CSM) describes the network of relationships between CoPCs present at a site and the receptors that may be exposed to those CoPCs through various pathways leading from the site and ending with exposure through ingestion, inhalation, or dermal contact. The CSM incorporates the range of potential exposure pathways and identifies those that are present and may be important for human receptors. The CSM helps to identify main pathways and eliminates those pathways that are incomplete and therefore do not require further evaluation.

Exposure pathways consist of the following four elements: (1) a source; (2) a mechanism of release, retention, or transport of a chemical to a given medium (such as air, water, or soil); (3) a point of human contact with the medium (that is, an exposure point); and (4) a route of exposure at the point of contact (for example, inhalation, ingestion, or dermal contact). The sources and transport and fate mechanisms were described in Section 4; this section describes exposure pathways relevant for human exposure, which are depicted on Figure 6-1. The current exposure pathway model reflects emphasis on PCDD/Fs, which are the current CoPCs under consideration. This conceptual model may be modified depending on the CoPCs ultimately included in the HHRA. As land use mapping is completed during the RI, exposure scenarios will be associated with land uses to facilitate current and potential future use evaluations for the HHRA. All potentially exposed human receptor populations will be identified considering the land uses present in the Study Area to ensure that the media and exposure pathways that pose the greatest potential human health risk are identified and evaluated in the HHRA.

6.2.1 Potential Human Receptors

Receptor Groups

Receptor groups to be considered include residents and workers. Both adults and children will be considered in the resident evaluation. Potential pathways for each of these receptor groups are discussed further in the RIWP.

The HHRA also will address reasonably anticipated potential sensitive subpopulations, which could include the developing fetus, young children, elderly people, and people with chronic diseases. The toxicity values and exposure assumptions applied in the SLRA are derived to be protective of the entire population including sensitive subpopulations; in the PRA, appropriate toxicity values will be developed and applied to the appropriate subpopulations. For PCDD/Fs, the toxicity values currently available for noncancer endpoints are derived on the basis of potential impacts on the infant and fetus. Any new noncancer toxicity values to be developed will consider exposures *in utero*, exposures resulting from breastfeeding in infancy, exposures during childhood, and subsequent exposures as an adult, as appropriate for the end point(s) examined.

Furthermore, the risk assessment will also address reasonably anticipated potential or actual highly exposed individuals. These are individuals whose activities or consumption rates result in higher contact with CoPCs than those of the majority of the population. Examples include those that are thought to have higher rates of soil ingestion as a group (such as children), or that have higher rates of ingestion of food items (such as local game or fish)

due to behaviors that directly or indirectly increase such intake. The exposure assessment used in the SLRA will be conducted to evaluate the reasonable maximum exposure (RME) scenario. The RME approach is intended to combine upper-bound and mid-range exposure assumptions so that the result represents an exposure scenario that is both protective and reasonable, although not the worst possible case (USEPA, 1989). The ultimate estimates are intended to represent exposures generally in the 90th to 98th percentile range but possibly up to the 99.9th percentile of exposures (USEPA, 1992, 1997a, 2003). The PRA will incorporate all available information on distributions of exposures (where SLRA estimates are deemed inadequate for characterization), allowing explicit evaluation of all exposure percentile(s).

Use of Probabilistic Techniques to Address Highly Exposed Receptors

As mentioned, all relevant exposed populations, including sensitive subpopulations, will be included in the HHRA. The HHRA work plans propose to develop a two-dimensional (variability and uncertainty) probabilistic assessment for the exposed populations from the site now and in the future, using Monte Carlo techniques. A detailed explanation of the techniques, decisions, and inputs will be included in the PRA document when completed. This population assessment is constructed by evaluating risks to all the individuals (strictly, a constructed representative sample[12]) that is designed to be representative within that population (that is the variability component of a two-dimensional probabilistic assessment), while taking account of the uncertainty involved (that is the uncertainty component).

It is in this sense that the HHRA becomes both "population-based" and "individual-based." By summing across all the individuals evaluated (that is, the whole hypothetical exposed population), the total population effect may be obtained in an unbiased fashion, together with the uncertainty on that total population effect. All sensitive or highly exposed subpopulations are incorporated in the total population involved, by appropriate incorporation in the variability distributions of the relevant parameters that describe factors accounting for such sensitivity, be they exposure factors (Section 6.4) or toxicity factors (Section 6.5). The approach described can obtain risk estimates in the exposed population, at any specified percentile of the variability distribution, and any specified percentile of the uncertainty distribution; in fact, for any statistic that can be defined on the variability and uncertainty distributions.

The Monte Carlo technique evaluates individuals with all possible combinations of exposure factors, weighted by the likelihood for these combinations occurring. This set of combinations necessarily incorporates the individual with "reasonable maximum exposure (RME)," and the results of the Monte Carlo assessment, therefore, also incorporate such an individual. Indeed, the probabilistic approach is exactly what is required to estimate a "reasonable maximum exposure," given the definition of that term as "the highest exposure that is reasonably expected to occur at a site" with the intent that it "is to estimate a conservative exposure case (that is, well above the average case) that is still within the range of possible exposures" (USEPA, 1989; pages 6-4 to 6-5). It should be noted that the previous

[12] In the Monte Carlo procedure, a hypothetical sample individual from the population is constructed by selecting a set of characteristics for that individual—just those characteristics needed for estimating that individual's dose and risk. The selection is done in a representative fashion, taking account of the probabilities for real individuals in the population to have each characteristic and each combination of characteristics.

and following documents also are exactly those cited in MDEQ's Part 201 generic soil direct contact criteria technical support document (TSD), "More details on Dioxin 90 ppt value" (MDEQ, 1998). This intent also has been clarified by more recent guidance. For example, USEPA's Guidance on Risk Characterization for Risk Managers and Risk Assessors (USEPA, 1992; Memorandum from F. Henry Habicht II) clarifies the following:

- The high-end risk descriptor is a plausible estimate of the individual risk for those persons at the upper end of the risk distribution. The intent of this descriptor is to convey an estimate of risk in the upper range of the distribution, but to avoid estimates that are beyond the true distribution. Conceptually, high-end risk means risks above about the 90th percentile of the population distribution, but not higher than the individual in the population who has the highest risk.

- This descriptor is intended to estimate the risks that are expected to occur in small but definable "high end" segments of the subject population. The individuals with these risks may be members of a special population segment or individuals in the general population who are highly exposed because of the inherent stochastic nature of the factors, which give rise to exposure.

- In those few cases where the complete data on the population distributions of exposures and doses are available, high end exposure or dose estimates can be represented by reporting exposure or doses at selected percentiles of the distributions, such as the 90th, 95th, or 98th percentile.

- In the majority of cases where complete distributions are not available, several methods help estimate a high-end exposure or dose. If sufficient information about the variability in lifestyles and other factors are available to simulate the distribution through the use of appropriate modeling, such as Monte Carlo simulation, the estimate from the simulated distribution may be used.

It is only if "limited information on the distribution of the exposure or dose factors is available," that "the assessor should approach estimating the high end by identifing the most sensitive parameters and using maximum or near-maximum values for one or a few of these variables, leaving others at their mean values."

More recent guidance from USEPA in their *Guidance for Risk Characterization* (Science Policy Council, February; USEPA, 1995) confirms these points, and clarifies the guidance to provide more prominence to certain assumptions. Among the guiding principles emphasized is the necessity of distinguishing between variability and uncertainty (pointing out that the high end individual risk estimates are intended to capture the variability in exposure, lifestyles, and other factors that lead to a distribution of risk across a population). The guidance goes on to point out the following:

- High-end descriptors are intended to estimate the exposures that are expected to occur in small, but definable, "high end" segments of the subject population. The individuals with these exposures may be members of a special population segment or individuals in the general population who are highly exposed because of the inherent stochastic nature of the factors that give rise to exposure. Where differences in sensitivity can be identified within the population, high end estimates addressing sensitive individuals or subgroups can be developed.

- In those few cases in which the complete data on the population distributions of exposures and doses are available, high end exposure or dose estimates can be represented by reporting exposures or doses at a set of selected percentiles of the distributions, such as the 90th, 95th, and 98th percentile. High-end exposures or doses, as appropriate, can then be used to calculate high-end risk estimates.

The HHRA RIWP envisions that the high-end descriptors will be obtained in this manner, so that attempts to define hypothetical "sensitive subpopulations" are unnecessary; any such populations should (and will) be incorporated in the distributions used to represent population variability. The RIWP has been modified, however, to specify that where only particular subpopulations are at risk for particular endpoints, results for those subpopulations will be presented separately. An example of such a subpopulation would be neonates exposed as fetuses and subject to developmental risks.

6.2.2 Exposure Pathways and Scenarios

An exposure scenario is defined as the combination of potential exposure pathways that a receptor may experience over the course of a long-term exposure. Exposure pathways and scenarios for residents and workers are discussed here, with reference to particularly highly exposed populations where relevant. An investigation of every conceivable pathway, use of exposure, is not required nor would such an investigation make sense or be effective. Instead, the HHRA will include evaluation of all relevant pathways that present a reasonable potential for exposure, given current, expected and reasonably anticipated property uses.

Residents

Current and potential future residents (adults and children) may potentially be exposed to CoPCs in Study Area soil, homegrown vegetables, and in human breast milk. Because the city of Midland is located near the Tittabawassee River, Midland residents could be exposed to various CoPCs through recreational, fishing, or hunting activities on or near the Tittabawassee River. These potential exposure pathways and potential risks will be assessed under the RIWP for the Tittabawassee River as a scenario addressing risks to non-resident recreational visitors (under scenarios evaluating hunting, fishing, and other recreational uses of the river). We recognize that these potential risks should be considered as part of the process of evaluating risks to the residents of the city of Midland; however, none of these pathways will be affected directly by any response actions identified for the city of Midland. Thus, we propose including in the risk characterization portion of the Midland Area Soils RI a section reporting the results of the assessment of the recreational user scenario from the Tittabawassee River Floodplain RI for consideration in conjunction with the risks estimated specifically for exposures in the city of Midland.

Exposure to CoPCs in Soil

Current and future residents in the Midland Study Area might be exposed to CoPCs through incidental contact with soil on their property. This contact includes incidental ingestion of soil, or dermal contact with soil. These potential exposure pathways will be incorporated in the HHRA for adults and for young children (ages 1 to 6). Inhalation of airborne dust arising from soil has been evaluated in conjunction with other practices and found not to present a significant source of exposure and will not be explicitily evaluated in

the risk assessment for Midland or the Tittabawassee River Floodplain (Section 6.4.3 and Appendix E-1 memorandum on vegatables and agricultural dust). These potential exposure pathways will be incorporated in the HHRA for adults and for young children (ages 1 to 6).

Unusual High Ingestion of Soil by Children

The potential for ingestion of unusually high amounts of soil by a child will be considered in the HHRA. However, the approach to assess this potentially distinct receptor population has not been completely formulated at this time. Inputs for soil ingestion will be developed through a meta-analysis of soil ingestion studies by the University of Massachusetts (the above mentioned UMass Soil Ingestion Project). In addition, USEPA risk assessment guidance provided in USEPA's *Exposure Factors Handbook* (USEPA, 1997a) and the external review draft *Child-Specific Exposure Factors Handbook* (USEPA, 2006) will generally be followed, supplemented by analyses of the scientific literature on this subject.

The literature examined will include (but is not limited to) the following: Binder et al., 1986; Calabrese et al., 1989a,b; 1990; 1991; 1996; 1997a, b, c; Calabrese and Stanek, 1991; 1992; 1995; Clausing et al., 1987; Davis et al., 1990; 2006; Bothe, 2004; Stanek and Calabrese, 1991; 1995a, b; 2000; Stanek et al., 1999; 2001a, b; van Wijnen et al., 1990; Wong, 1988; Wong et al., 1988; 1990; 1991; Alexander et al., 1974; Beaver, 1975; Juqdaohsinqh et al., 2002; Lawson, 1977; Popplewell et al., 1998; and Reffitt et al., 1999. In addition, the raw data from the mass-balance tracer studies by Calabrese et al., 1989b; 1997b; Davis et al., 1990; 2006; Bother, 2004, and any other available raw data will be examined for relevant information to this receptor population. The UMass Soil Ingestion Project also is expected to provide additional information and guidance on how to address unusually high child soil ingestion estimates reported in a limited number of studies.

While USEPA (2006) states that "the recurrent ingestion of unusually high amounts of soil (i.e., on the order of 1,000 to 5,000 milligrams per day)" is defined as soil pica, these relatively higher child soil ingestion estimates were reported in only one study, and are not clearly known to be attributable to soil pica. USEPA (2006) noted that although information regarding the incidence of soil pica is limited, soil pica appears to be less common based on soil ingestion data from the five key tracer studies (Binder et al., 1986; Clausing et al., 1987; Van Wijnen et al., 1990; Davis et al., 1990; and Calabrese et al., 1989) in which only one child out of 600 children from these studies ingested an amount of soil significantly greater than the range for other children. USEPA (2006) notes that while these studies represent only short-term soil ingestion and do not include data for all populations, "It can be assumed that the incidence rate of the recurrent ingestion of unusually high amounts of soil in the general population is low." Consequently, USEPA suggests developing a site-specific incidence rate estimate for this potential receptor population.

For the PRA, the incidence of unusually high soil ingestion events and the quantities of soil ingested will be estimated from the available information in soil ingestion studies, mineral balance studies, and any other literature information that may be available and relevant (see the soil ingestion references cited above). Included in this evaluation will be an assessment of both the likely frequency and duration of this behavior. Relevant information generated through the UMass Soil Ingestion Project also will be considered.

Baseline Diet

Background dietary exposures to and risks from dioxin-like compounds are not included in the HHRA RIWP for the following reason:

> The purpose of the remedial investigation is to **assess site conditions** in order to select an appropriate remedial action, if one is required, that adequately **addresses those conditions**. The remedial investigation identifies the source or sources of any contamination and defines the nature and extent of contamination **originating from that source** (Mich. Admin. Code R. 299.5528(1) [emphasis added]).

Ingestion of Home-Grown Produce

Current and future residents in the Midland Study Area may grow their own vegetables and may potentially ingest CoPCs by ingesting homegrown foods. However, soil to plant uptake of PCDD/F-like compounds is generally considered to be a minimal or insignificant (McCrady et al., 1990), with atmospheric deposition being the more important means of exposure (Hites, 1991; NAS, 2006). Although there are published literature on plant uptake (Hulster and Marschner, 1993; Bacci et al., 1992; Hulster et al., 1994; Muller et al., 1994; Muller et al., 1993) these data are insufficient to estimate uptake into vegetables. In the 2003 exposure assessment component of the USEPA Dioxin Reassessment, USEPA did not include exposure through fruits and vegetables, as this exposure was considered insignificant (USEPA, 2003; Volume II).

The UMDES evaluation of the influence of vegetable consumption determined that consumption of fruits and vegetables was actually associated with lower serum concentrations of PCDD/Fs and PCBs (UMDES brochure[13] 2006, page 17 and followup calculations from UMDES and discussion from Dow provided on April 11, 2007, in Appendix E-1). Specifically, the UMDES evaluated the effect of eating vegetables on blood concentrations of PCDD/Fs and PCBs, and found that "[i]n general, people who ate more fruit and vegetables have similar or lower levels of PCDD/Fs in their blood as compared to people who eat fewer fruit and vegetables" and that this "is largely true whether or not the fruit and vegetables come from the contaminated areas or are bought from a store." In particular "[p]eople who ate root vegetables from the Tittabawassee River, Saginaw River, and Saginaw Bay floodplains do not have higher levels of dioxins in their blood" (University of Michigan, 2006; Findings). Quantitatively, for TEQ and the seven specific congeners so far reported, for potentially non-random correlations between blood levels and consumption of fruits and vegetables, there were "[g]enerally negative associations for fruits, vegetables, and root vegetables, whether raised in the contaminated areas or raised elsewhere" although there were "[a] few positive associations for store bought fruits, vegetables, and root vegetables." These initial results were re-affirmed in subsequent analysis by UMDES evaluating just the PCDD/F congeners as described in Appendix E-1.

The data reviewed indicate that the exposure pathway from ingestion of homegrown vegetables does not contribute significantly to exposure to soil-bound residues. Specifically, the UMDES biomonitoring data indicated that serum TEQs in individuals who consume homegrown vegetables (or store-bought vegetables) are lower than those who do not. Moreover, the April 2007 additional analyses indicated that serum TEQs were not related to soil TEQs in those who consume homegrown vegetables. Thus, neither garden soil nor the

[13] http://www.sph.umich.edu/dioxin/PDF/UMDES%20Brochure_FINAL_08042006.pdf

vegetables grown in these gardens result in any significant PCDD/F exposure for consumers. Prior mitigations of a number of area gardens conducted after the UMDES biomonitoring was completed have now functionally interrupted this potential pathway in many existent gardens and eliminated the opportunity for collection of garden soils and vegetables that would be needed to further study the relationship in these cases. Additionally, such action appears not to have been needed in retrospect based on lack of significant exposure.

The UMDES finding is consistent with the conclusions of prior regulatory bodies that determined the vegetable garden pathway is not a primary contributor to PCDD/F exposures. Therefore, we do not believe further qualitative or quantitative analyses of this pathway is warranted and do not propose to consider this pathway further in the quantitative portions of the risk assessment. This is discussed further in Attachment E-1. A prior draft HHRA work plan included a sampling plan for collection of garden vegetables which is included unchanged in this HHRA work plan. However, as indicated in Appendix E-1, the available data indicate that such collection should not be necessary.

Human Milk

The developing offspring exposed *in utero* and postnatally through lactation, are the most sensitive receptors identified in laboratory (non-human animal) studies of PCDD/F. This was explicitly recognized by all of the agencies that have derived noncancer criteria for TCDD and related compounds. Each of the available criteria was derived based on observed effects in offspring exposed to TCDD while *in utero* and postnatally via lactation. The criteria were all derived for chronic exposure scenarios with the goal of maintaining adult maternal exposures and body burdens below levels that could result in unacceptable exposures to the fetus *in utero* and the nursing infant. Because of this, these criteria are, by definition, protective of the nursing infant. Any criteria chosen or developed for a noncancer evaluation would include these considerations.

No explicit quantification of the daily intakes of PCDD/Fs through breast milk is therefore required because that intake would be accounted for by maintenance of maternal intake and body burdens below the levels identified in any noncancer toxicity criteria developed for the purposes of this risk assessment, and application of additional criteria to estimated intakes by infants would be redundant and inappropriate. This issue is discussed in more detail in Section 6.5.2. Further discussion on the means by which the human milk pathway will be evaluated in the assessment is provided in Appendix E, Attachment E-4.

Worker

A worker scenario evaluating potential exposures specific to adult workers will be conducted for areas that have land uses consistent with Commercial II, III, and IV and Industrial land uses as these land uses are identified during land use mapping to be conducted in the RI. Exposure pathways to be considered are incidental ingestion and dermal contact with soil, and inhalation of soil particulates.

6.3 Analytical Chemistry Data Analysis and Identification of CoPCs

This section describes the process used to screen analytical chemistry data to identify CoPCs to be carried through the HHRA. These processes are necessary to ensure that appropriate and reliable data are carried through the quantitative steps of the HHRA. This section discusses the sources of sampling and analytical data, and the criteria that will be considered in selecting the CoPCs for the risk assessment. The analytical data will be grouped according to exposure media (such as soil) and land use, and then evaluated through a stepwise process described here to select the appropriate CoPCs to be assessed for each exposure scenario.

6.3.1 Summary of Concentration Data to Be Used for Identification of CoPCs

The HHRA will summarize all TAL data in tabular form (these data will be made available both in hard copy and electronically). The data will be categorized according to environmental medium, location, and land use (current and potential future). Primary reliance will be placed on data to be gathered during this RI as described in prior work plan sections and in Appendix HHRA C, but the HHRA also will include review of historical data once these data are reviewed by Dow and determined to be representative and accurate for use in the HHRA. Site-specific data to be considered include the following:

- Soil—site-specific data available include:
  - CH2M HILL. 2006. Sampling and Analysis Plan in Support of Bioavailability Study, Midland Area Soils (Pre-RI Study).
  - Agin et al., 1984. Point Sources and Environmental Levels of 2378-TCDD (2,3,7,8-Tetrachlorodibenzo-p-Dioxin) on the Midland Plant of The Dow Chemical Company and in the City of Midland, Michigan. November (Dow 1984 Study).
  - USEPA. 1985. Soil Screening at Four Midwestern Sites. June.
  - MDEQ. 1997. Summary of 1996 Midland Dioxin Study Results. Working Draft of Document for Public Release. Waste Management Division. March.
  - Dow. 2000. Soil Sampling Summary Report (Revised). March.

6.3.2 Methods for Screening of TAL to Determine CoPCs

The CoPCs will be selected through comparison of the TAL data to be gathered in the RI and any relevant data summarized in Section 6.3.1 to available media and exposure pathway-specific screening concentrations to identify chemicals that exceed those values. Concentrations of each target analyte in each exposure medium will be compared with the applicable and relevant Michigan and USEPA human health-based cleanup values and metals concentrations will be compared to background concentrations. The purpose of the screening process is to focus the quantitative assessment on the chemicals that are site related (that is, not background), on the exposure pathway(s) that might pose a significant risk, and on the compounds that exceed the appropriate screening criteria.

Comparison to Background Concentrations

The first screening step will be to compare Study Area soil data for metals to state of Michigan derived background concentrations (MDEQ, 2005b). Background concentrations will only be used if the location where they were collected is determined to be representative of Study Area soils in terms of both the soil type and the area land use.

Comparison to MDEQ Benchmarks or USEPA Risk-based Concentrations

Contaminants detected in soil at concentrations greater than background will be compared with the MDEQ or other generic cleanup criteria for soil. As noted in Section 6.1.2, the HHRA will derive a site-specific residential DCC for PCDD/F if not already established under the Direct Contact Criteria Report. Once this process is completed, it is anticipated that this value would be used to screen site data for PCDD/Fs. Target analytes with a sample result greater than the applicable MDEQ pathway criteria or, where MDEQ criteria are not available, greater than USEPA risk-based concentrations, will be carried forward in the HHRA as CoPCs. If a health-based cleanup or benchmark value is not available under Part 201, health benchmarks will be considered from the following USEPA sources:

- USEPA Region 9 PRG tables. These values can be accessed on the Internet at: http://www.epa.gov/region09/waste/sfund/prg/index.htm.
- USEPA Region 6 human health media-specific screening levels. These values can be accessed on the Internet at: http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm.

Where chemicals do not have risk-based concentrations or cleanup criteria available in any of the above resources, the HHRA will attempt to identify appropriate risk-based concentrations based on toxicological literature or suitable surrogate chemicals for comparison (in that order). Where such risk-based concentrations are derived, the HHRA will provide all assumptions and data used. Specifically, consistent with requirements in MDEQ Rule 706(3), Part 201, the HHRA will provide the necessary data to calculate a criterion unless, through coordination with MDEQ, it is determined that a numerical criterion is not required to assure the corrective action will be protective.

6.4 Exposure Assessment

Exposure assessment is the process of identifying human populations that could potentially contact CoPCs and estimating their exposures, doses, exposure rates, or dose rates through evaluation of the magnitude, frequency, duration, and route(s) of potential exposures. Specifically, quantitative exposure estimates for the RME will be derived for all complete exposure pathways identified above and summarized in Section 6.4.1. Section 6.4.1 provides an overview of proposed methods to use exposure data from UMDES in deriving exposure estimates. The proposed means to quantify exposures in the SLRA are provided in Section 6.4.3 and for the PRA in 6.4.4, with details regarding chemical-specific parameters provided in Section 6.4.5. Sections 6.4.1 through 6.4.6 provide the proposed parameters to be applied in the HHRA. Dow will refine the approach to exposure assessment including prioritizing data collection efforts and selecting appropriate exposure parameters for the assessment as the process develops.

In the HHRA, potential site risks will be estimated using conservative exposure assumptions (that is, assumptions designed not to underestimate risks, and which may overestimate risks). As described above in Section 6.1.1, two tiers of risk assessment are proposed:

- **SLRA:** The first tier risk assessment will use RME variables (that is, assumptions representing high end exposure and toxicity assumptions) that will be used to evaluate which CoPCs/receptor/pathway combinations to carry forward into the second tier assessment. Proposed risk targets to be used in deciding what will be further evaluated in the PRA are described above in Section 6.1.1.
- **PRA:** The second, more refined tier of the risk assessment will incorporate the distributions of inputs on all relevant exposure variables in order to better characterize both the variability and uncertainties in the risk estimates. The PRA also will encompass RME assumptions, but includes additionally the whole range of population and individual risks to better illuminate the influence of various exposure pathways and behaviors.

The SLRA and PRA will use the same basic algorithms for calculations, but will carry out estimates as point estimates (SLRA), or as distributions of risk estimates (PRA). As a starting point, the algorithms to be applied in exposure estimates draw from the methodology and apply the variables used in MDEQ Part 201 Administrative Rules cleanup criteria for pathways where cleanup criteria have been identified. For site-specific exposure data, the HHRA proposes to draw from the UMDES data (see Section 6.4.1) as supplemented by additional analyses by UMDES and by data to be gathered in the course of RI and other area studies.

6.4.1 Receptors and Exposure Pathways

Receptors

The draft HHRA will initially examine the following receptors:

- **Residents (Adults and Children):** Residents involved in activities within the Study Area boundaries, including activities around their homes and yards
- **Workers (Adults):** People who currently work within the Study Area, or reasonably anticipated future workers will be considered

Complete Exposure Pathways to be evaluated in the SLRA

For evaluation in the SLRA, each exposure pathway risk will be evaluated separately. The object of the SLRA is to identify receptor and pathway combinations that need to be more fully evaluated. Individual pathway/receptor combinations will, therefore, be evaluated, rather than attempting to combine multiple pathways. The following exposure pathways will be examined in the SLRA:

- Resident exposure to soil (adults and children)
  - Soil and dust ingestion (associated with the residence)
  - Soil dermal contact (associated with the residence)

- Worker exposure to soil (adults)
  - Soil and dust ingestion (associated with the workplace)
  - Soil dermal contact (associated with the workplace)

Combinations of Receptors and Pathways for the PRA

Receptor/pathway combinations that are not shown to be negligible in the SLRA will be incorporated in the PRA in a manner consistent with USEPA risk assessment guidance. In the PRA, multiple combinations of pathways will be combined for single receptors, taking account of the correlations between exposure variables that are present and that occur in the population as observed in the UMDES and an Activity Survey, if one is necessary.

6.4.2 Proposed Use of UMDES Data

Many of the parameters needed for exposure assessment were measured in a subset of the target population by the UMDES. Future discussions and interaction with the University of Michigan researchers will be used to develop exposure assessment inputs from the current UMDES data. While confidentiality requirements preclude obtaining individual and/or property-specific data from the UMDES, these data are the best available for exposure assessment in the Study Area, since they were obtained from a stratified random sample from the local population with known probability weights for selection. They, therefore, represent the entirety of the population including highly exposed portions of the population. The UMDES data so far published are limited in their detail, although in most cases they may be sufficient to define the upper end of exposure distributions.

Dow will work with the UMDES researchers to develop these data for use in the HHRA. Such data will be publically available for review on the UMDES Web site as well as in the HHRA. More detailed (but still anonymous) information will be requested on selected UMDES exposure parameter distributions in the population in or near the contaminated area (excluding the Jackson/Calhoun County control area) for use in the SLRA and PRA. It is expected that the full distribution of the measured parameters, together with uncertainty estimates, can be obtained either in the form of percentiles (Dow will use the 1 percent, 99 percent, and multiples of 5 percent; see also Footnote 13), or as parametric estimates for fits to distribution shapes. In the former case, parametric forms will be fitted to the percentiles for use in the PRA. In either case, the parameter estimates obtained will be accompanied by uncertainty estimates and correlation matrices for the parameter and uncertainty estimates to ensure that the correct error and correlation structure is maintained. Parametric distributions will be used to ensure that potentially long tails to the distributions (not reflected in available percentiles, for example) are taken into account. Table 6-2 summarizes proposed types of information from the UMDES data to be applied in the HHRA. For a further discussion of the UMDES data, and how the HHRA proposes to use these data, see Section 6.1.3.

6.4.3 Quantification of Exposure Variables in the SLRA

General Treatment of Variables with Known Distributions in the SLRA

The SLRA is designed to be a screening level assessment, so exposure variables will be evaluated using an approach designed to evaluate RME receptors. To this end, two of the exposure variables (excluding the concentration term) in the exposure algorithms for each

pathway will be selected at the mean of the uncertainty distribution of the 5th or 95th percentile value of their variability distributions, whichever corresponds to estimating higher risk. The variables to be selected will be chosen, as far as possible, to have a logarithmic sensitivity[14] of +1 (that is, to be direct multipliers of the dose estimate), otherwise to have as high a sensitivity as possible; and to have the largest relative variability.[15]

The exposure concentration term will also be selected at the upper 95th percentile of both its uncertainty and variability distributions (USEPA, 1989).[16] All other exposure variables will be chosen at the mean of the uncertainty distribution for the mean of the variability distribution (that is, to represent central tendency values). The "mean" is understood to indicate an estimator of the mean value, chosen either to be as unbiased as available or to be a selected nominal value, and similarly as unbiased estimator of the 95th percentile as available will be chosen, or again a selected nominal value.[17] The most likely candidates for selection at upper 95th percentiles are: for cancer estimates, the exposure period and contact rate or frequency; for noncancer estimates, the contact rate and frequency.

The following sections describe the proposed approach to quantifying all complete exposure pathways within the SLRA including proposed exposure algorithms, and input variables, or the means to derive input variables.

Common Receptor Characteristics – Body Weight, Averaging Time, and Exposure Duration

Since the approach to evaluation of body weight and averaging time is common to all pathways, the proposed approach to these elements is described here.

Body Weight Assumption in SLRA

The nominal body weights of a 70-kilogram (kg) adult and a 15-kg child, as identified in the Part 201 soil direct contact criteria (R 299.5720), are proposed for use in the SLRA.

Averaging Time

As is typically done and scientifically required, the inputs and outputs for the algorithms are proposed to be time averaged as appropriate for evaluations of the adverse effects evaluated (USEPA, 1989). Thus, for example, cancer risk estimates for most CoPCs require dose rate estimates averaged over a lifetime, while estimates of acute risks require dose rates or total doses averaged or cumulated over periods ranging from minutes to years or longer, depending on the adverse effect and the CoPC in question.

Except as noted below, the averaging period for the SLRA are proposed as 30 years for noncarcinogens (corresponding to the exposure period of 30 years, 6 years as a child and 24 years as an adult), and 70 years for carcinogens (corresponding to the nominal lifetime used in extrapolation of carcinogenicity results to humans).

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[14] That is, the derivative of the logarithm of dose with respect to the logarithm of the variable, evaluated at the mean values of all variables.

[15] This is necessarily a somewhat imprecise concept, since various useful measures (for example, the ratio of 95th to 5th percentile) might be zero or infinity or not exist. For definiteness, the coefficient of variation (standard deviation divided by mean), or an estimate of it, will be used. For the variables used in risk assessment, this is expected to always exist.

[16] In many cases, the appropriate concentration term is itself a time or space average; such averaging will be taken into account in defining the variability and uncertainty distributions.

[17] Selected nominal values will be used where these are specified by MDEQ for use in particular pathways; the same nominal values may also be used in other pathways for the same parameter.

Where adverse effects occur only in particular sensitive subpopulations (or to a greater extent in such a subpopulation), such as fetuses, neonates, or children, the appropriate averaging time will be used to obtain the relevant dose metric that is causally connected to the relevant adverse effect. However, the averaging time and estimated intakes will be chosen to be consistent with the evaluation of the underlying toxicity criteria. For example, the current WHO tolerable daily intake (TDI) is specifically targeted at limiting long-term adult intake of PCDD/Fs to levels that will maintain maternal body burdens below levels of concern in order to protect the developing fetus and nursing infant. Therefore, these sensitive subpopulations (fetus, infants and children) are already accounted for in exposures that culminate in maternal body burdens. In this context, a risk assessment using this criterion should be based on long-term adult intake rates, not infant or childhood intake rate (except to the extent that such intake rates affected adult body burdens).

Exposure Duration

Exposure duration estimates in the SLRA are proposed to be those identified in the MDEQ cleanup criteria including 24 years for an adult and 6 years for a young child.

Incidental Ingestion of Soil/Dust

Incidental ingestion of soil/dust by adults and children occurs presumably by mouthing hands, objects, and surfaces, including food and cigarettes that have soil or dust on them. Exposures via the incidental ingestion pathway are expected to be higher in young children because childhood hand-to-mouth behavior is more frequent, and because on a body weight basis the amount of soil or dust ingested is greater than in either older children or adults.

Estimates of Incidental Ingestion of Soil/Dust for Residents and Workers

Assessment of the soil/dust ingestion pathways in the SLRA is proposed to be based on the exposure terms in algorithms identified in MDEQ R 299.5720 as follows:

Equation 2

$$\text{Average Daily Dose (ADD)} = (Cs \times CF \times IR_s \times EF \times ED \times AE_i)/\ (AT \times BW)$$

ADD	=	average daily dose (mg/kg-day)
Cs	=	chemical concentration in soil (mg/kg)
CF	=	10^{-6} conversion factor: per kg soil to per mg soil
IRs	=	ingestion rate for soil (mg/day)
ED	=	exposure duration (years)
EF	=	exposure frequency (days/year)
AE_i	=	chemical specific or default ingestion absorption efficiency as specified in R 299.5720(3) except as noted in Section 6.4.5
BW	=	body weight (kg)
AT	=	averaging time (days)

For the SLRA, exposure to CoPCs through incidental soil ingestion is proposed to be calculated for each of the following receptors: child residents ages 1 to 6 years, adult residents, and adult workers using the following exposure terms as applied by MDEQ in the soil cleanup criteria. This includes assumed exposure frequencies for the resident or worker of 350 days per year for an adult or a child resident, 245 days per year for a worker consistent with the MDEQ default assumptions as shown in Table 6-3.

Residential Dust Findings from UMDES

People in the Study Area contact household dust within their residences and some part of this material could be ingested as part of soil ingestion rates. The TEQ concentration of dioxins, furans, and PCBs combined in dust is lower, on average, than soil around houses within the Tittabawassee River Floodplain (University of Michigan, 2006) although the pattern for individual congeners is mixed; the mean concentrations of all PCDF congeners except octachloro dibenzofuran (OCDF) are lower in dust than in house perimeter soil, while the mean concentrations of all PCDD congeners except TCDD are higher in dust. Soil ingestion and contact rates include any household dust ingestion or dust contact so the soil ingestion and soil contact pathways already incorporate dust ingested or contacted; and within the Study Area, the soil ingestion and contact pathway algorithms will likely, therefore, on average overestimate ingestion of and contact with TEQs of dioxins, furans, and PCBs combined from household dust.

The UMDES results (University of Michigan, 2006) find no correlation between household dust concentrations and blood concentrations of any evaluated PCDD/F congeners. Thus while some individuals may be mis-specified by treating the soil and household dust pathways together, the population distribution of total intakes through soil and dust is likely to be overestimated by the soil ingestion and contact pathway calculations. Residential dust ingestion, therefore, is assumed to be included with soil ingestion; and for non-residential receptors, there is no distinction between soil and dust.

Dermal Contact with Soil/Dust

Individuals in the Study Area could be exposed to CoPCs by dermal contact with soil or dust. These pathways will be evaluated for residents and workers. Assessment of dermal contact with soil in the SLRA is proposed to be based on the exposure terms in algorithms identified in MDEQ R 299.5720 as follows:

Equation 3

Average Daily Dose (ADD) = (Cs x CF x SA x EV x EF x AF x ED x AE)/ (AT x BW)

Cs	=	chemical concentration in soil (mg/kg)
CF	=	10^{-6} conversion factor: per kg soil to per mg soil
SA	=	surface area for dermal exposure (cm^2/event)
EV	=	event frequency (1 event per day)
EF	=	exposure frequency (days/year)
AF	=	adherence of soil mg/cm^2
ED	=	exposure duration (years)
AE	=	dermal absorption fraction from soil (unitless) 10% for organic CoPCs 1 percent for inorganics, the defaults of R 29.5720(3), except as indicated in Section 6.4.5
BW	=	body weight (kg)
AT	=	averaging time (days)

The event frequency is set to be one event per day in all scenarios, to be consistent with the methodology adopted for evaluation of event frequency, adherence of soil, and the dermal absorption fraction.

Dermal contact with soil for residents and adult workers

Table 6-4 provides proposed exposure variables to be used for the SLRA for dermal contact with soil and dust for residential and worker receptors. These values are all consistent with the Part 201 exposure variables.

Inhalation of Dust

There is potential for exposure to CoPCs in soil following resuspension of dust from soil; however, much of the dust that is inhaled is ultimately swallowed, so soil ingestion estimates may already incorporate some inhaled dust. Soil ingestion studies that will be used in the HHRA are of this nature. Insofar as tracer concentrations are the same in soil and dust, soil ingestion studies necessarily cannot distinguish dust inhalation from soil ingestion. Similarly, because exposure point concentrations of CoPCs in the study area are similar to exposure point concentrations used for soil and dust ingestion, soil and dust ingestion estimates will already incorporate inhalation dust exposures similar to those occurring during the ingestion studies that form the basis for soil ingestion rate estimates.

In normal circumstances where CoPC concentrations in soil and dust are likely similar, and dust generation is not excessive, dust exposures are much smaller than those due to soil ingestion, so the preceding argument becomes somewhat academic. This much smaller exposure is apparent in the MDEQ screening values for soil, where it is possible to compare such screening values for soil direct contact (ingestion plus dermal contact) versus dust inhalation. For 2,3,7,8-TCDD, the MDEQ Table 2 (R299.5746) shows the residential particulate soil inhalation criterion (PSIC) as a concentration of 71 micrograms per kilogram (μg/kg) for 2,3,7,8-TCDD, while the corresponding footnoted criterion for the residential direct contact pathway is 0.09 μg/kg. A recent re-evalaution of this dust pathway for an agricultural scenario confirms that this pathway is not a significant source of exposure and will not be expressly developed in the quantitative risk assessments (Appendix E-1).

6.4.4 Quantification of Exposure Distributions in the PRA

Selection of Exposure Variable Values for Use in the PRA

The discussion provided here should be considered to be the proposed PRA methodology planned for the second tier risk assessment. In the PRA, all variables will in general be treated as having both uncertainty and variability distributions, although the estimate for the variance of either one may be zero in particular cases either through a formal analysis of data or by choice. Technically, every potentially nonconstant input to a PRA is or may be considered as a (mathematical) distribution, even though some nonconstant inputs may be approximated as point distributions (that is, even a point estimate for a nonconstant input may be considered a distribution, both mathematically and in some practical implementations). PRA implementation methodology is available that is capable of handling arbitrary numbers of distributions; and every input to such implementations can be (although it need not be) defined to be a distribution, even if that distribution is represented at run time as a point distribution (see, for example, the Risk Assessment for *Clostridium perfringens* in Ready-to-Eat and Partially Cooked Meat and Poultry Products [2005], and the associated model files and source codes, http://www.fsis.usda.gov/Science/Risk_Assessments/index.asp).

MDEQ requested a sensitivity analysis of the exposure pathways and inputs be completed in advance of the actual risk assessment. Typically, such sensitivity analyses are completed at the end of the process and therefore, this evaluation can only be considered tentative since some data are lacking or will change as the RI process continues; however, the sensitivity analysis completed does provide useful insight to some of the issues of concern. For instance, consistent with the UMDES results, the sensitivity analysis suggests that soil exposure is not an important contributor to risk while ingestion of homegrown animal products would be if such sources existed in the area.

The results of this sensitivity analysis are provided in Table 6-5, which shows the mean ADD estimates for each of the exposure pathways, in decreasing order of size, and as such shows the relative importance of these pathways given the assumptions applied and concentration estimates based on currently available data. Table 6-6 shows such a 95th percentile estimate. The entire sensitivity analysis is provided in Attachment E-1. The sensitivity analysis findings will be used to refine the HHRA and particularly the PRA and again be used to reconcile the results of the hypotethical risk assessment with those measured results obtained from the UMDES.

It is anticipated, however, that variables that are shown by sensitivity analysis to have little effect on the variability or uncertainty distributions of the risk estimate (see Section 6.4.4) may be input to the PRA as point estimates with respect to variability or uncertainty or both. The methodology proposed by the HHRA work plan does not depend on such prioritization, so if scientifically justifiable distributions are readily available, they may be used even if they are of low priority. Thus, if it is simpler to implement such variables as distributions, and the data are readily available to support the use of such distributions, they will be input as distributions (see also Footnote 4). This approach is consistent with the USEPA guiding principles on probabilistic risk assessment (Guiding Principles for Monte Carlo Analysis, EPA/630/R-97/001, March 1997b) and includes prioritization for development of probability distributions based on the sensitivity of the results to the inputs, and on the resource costs of developing such distributions. The HHRA will include identification of variables that would benefit from the evaluation of distributions as well as those that would not and streamline this process.

Each exposure variable will be placed into a category to clearly identify the type of investigation needed to develop a distribution for each:

(a) Parameters having a quantitative variation that is expected to be well known or of relatively low uncertainty (such as body weight variation) for which published data are readily available and collection of site-specific data is not needed.

(b) Parameters having a quantitative variation that is less well known or may be subject to significant uncertainty, therefore, requiring an extensive literature review; or a combination of published literature values, default values, or professional judgment.

(c) Parameters for which the quantitative variation is intended to be fully described by site-specific data or information and, therefore, will require collection of field data and a specific plan for field data collection.

The data sources for any input distributions to be developed and the methodology that will be applied to obtain variability and uncertainty distributions from those data sources will be

described and justified. That explanation will include specification of the type of investigation that is needed to provide the data, and the subsequent analysis of the data obtained. The descriptions will incorporate and will be in some cases more graded than the categorical specification suggested here, since some parameters may involve aspects of more than one category. For example, a parameter such as length of residence may be considered type (a), since the quantitative variation of length of residence is well known and there are readily available published data for this parameter; however, site-specific information may be used to confirm that length of residence for the affected population does not differ significantly from published information on larger populations that include the affected population. Nevertheless, a table of the recommended categories will be developed in conjunction with the development of the PRA.

Input Variable Sensitivity Analysis

For each exposure pathway included in the PRA, a formal sensitivity analysis will ultimately be performed on all the variables involved. A measure of the importance of each variable for both variability and uncertainty in the overall dose estimates will be evaluated by computing the product of a relative variability or uncertainty (see Footnote 15),[18] the logarithmic sensitivity (see Footnote 14) for each pathway,[19] and a risk estimate obtained using the SLRA procedure with mean estimates for all variables for each pathway,[20] and summing across pathways for each receptor.[21] Where necessary, approximate and in some cases subjective estimates for the relative variability or uncertainty will be used in this sensitivity analysis (since the object of the exercise is partially to determine which variables need further analysis, accurate estimates for the relative variability or uncertainty may not be available).

The variables will be ordered by the resultant measure to indicate the relative importance of obtaining variability and/or uncertainty distributions for use in the PRA, and most effort will be devoted to developing distributions for the variables at the top of this list (see also Footnote 4).

Common Receptor Characteristics – Body Weight, Averaging Time and Exposure Duration

Body Weight in the PRA

For the PRA, the UMDES data have been preliminarily reviewed to evaluate any differences between the local population and national population. The distribution of BMI in the UMDES study population (UMDES Questionnaire results, A4) is essentially identical to that in the corresponding U.S. population as a whole, as measured by the National Institute of Health National Health and Nutrition Examination Survey (NHANES) (2003-2004; http://www.cdc.gov/nchs/about/major/nhanes/nhanes2003-2004/nhanes03_04.htm) (Figure 6-2; no statistical test for similarity have yet been performed). The U.S. distribution of body weight with age and sex will be used for the whole population in the area unless further analysis shows significant differences. In particular, the U.S. distribution will be used for those aged less than 18.

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[18] This accounts for the size of the variation or uncertainty of the individual variable.

[19] This accounts for the standardized effect of the particular variable on the particular pathway.

[20] This accounts for the relative size of the risk from a particular pathway to a particular receptor.

[21] This takes account of the occurrence of the same variable in multiple pathways; if that variable does not occur in a particular pathway, the logarithmic sensitivity for the variable in that pathway is zero.

Averaging Time

As described in Section 6.4.3, the inputs and outputs for the algorithms are proposed to be time averaged as appropriate for evaluations of the adverse effects evaluated. In the PRA, the averaging period for carcinogens will be the age range 0 to 70 years, and longer exposure durations will be truncated at 70 years. For noncarcinogens, the averaging period will be ages 0 to 30 years, and longer calculated exposure durations will be truncated at 30 years of age. In a sensitivity analysis, the averaging period for exposure durations shorter than 30 years (and occurring below age 30) will be set equal to the larger of the exposure duration or 7 years, to evaluate the intake rates during exposure, but averaged over at least 7 years.

Exposure Duration in the PRA

For several of the receptor/pathway combinations, exposure duration will be set equal to duration of residence. In the PRA, to evaluate duration of residence, the UMDES data on residential history (UMDES Q results, B1 and B4b2-B4b1 together with more detail expected to be obtained by requests to UMDES) will be compared with similarly censored (lived greater than 5 years in current residence and aged 18 or more at the time of the interview) versions of similar statistics from the whole U.S. population, or from a more local subset population (see below for available datasets). If they are similar, the U.S. distribution for residential period will be used. If distinct, a suitably rescaled version of the U.S. distribution for the population censored below 5 years residence period and below age 18 will be added to the UMDES distribution. If there are significant differences between the UMDES data and U.S. distribution data, a draft approach will be provided for review by MDEQ.

From these distributions of residence times in current residences (or within Midland/ Saginaw/Bay counties), the distributions of total residence times will be derived using the same methodologies as used for the U.S. population (Israeli and Nelson, 1992; Johnson and Capel, 1992). These publications are those used by USEPA (1997a). The values obtained in the two references cited are now more than 19 years old (the first used data from 1985 and 1987, and the second from 1987), so the methodologies will be applied to more current data and any differences in results obtained using the two methodologies (which use independent survey data) will be reconciled. Those references also used summary data from, respectively, the American Housing Survey and the Current Population Survey, whereas now microdata are more readily available (http://www.census.gov/hhes/www/housing/ahs/nationaldata.html and http://dataferrett.census.gov/, respectively) so such microdata will be used to refine the distributions obtained. Additional site-specific information may be obtained from the Activity Survey. By examining any changes since around 1985, it should also be possible to evaluate the fundamental assumptions made by the two methods (stability of the distributions over calendar time) in the first reference, and constancy of probability to move in the second reference); such an evaluation will be made.

Incidental Ingestion of Soil/Dust

It is considered likely that the ingestion of soil or dust is a pathway that will be considered in the PRA and if so it will be evaluated using the algorithm provided in Equation 2 in all cases.

Soil Ingestion Rates for Residents and Workers in the PRA

Exposure frequency assumptions for residents and workers are proposed to be those shown in Table 6-3, unless scientifically defensible relationships can be developed between exposure opportunities and weather variables like temperature, rainfall, or soil conditions (like snow cover or freezing temperatures). In the latter case, such relationships would be used to select exposure frequencies, with weather data from MBS International Airport (Weather Bureau, Air Force, and Navy [WBAN] 726379 14845[22]). Although the soil/dust ingestion pathway includes dust, the lack of any correlation between concentrations of PCDD/F in blood and household dust (albeit in adults) in the UMDES study suggests that soil would be the major contributor to intake, so that outdoor weather and soil conditions will be controlling factors; the sensitivity of the UMDES study to detect a difference between household dust and soil will be examined.

Exposure durations are proposed to be the same as duration of residence (Section 6.4.4).

Dermal Contact with Soil/Dust in the PRA

Any evaluation of exposures to CoPCs through dermal contact with soil or dust will be evaluated using the algorithm shown in Equation 3. The exposure frequency, duration, and body weights to be applied in assessment of dermal contact are the same as described above (Section 6.4.3) for evaluation of incidental ingestion of soil and dust. Additional values needed for the dermal contact algorithms are skin surface area (SA), event frequency (EV), and soil adherence (AF).

Skin Surface Area per Event (SA) (cm^2/event)

To obtain surface area estimates for the PRA, the age variation of height from the NHANES 2003-2004 examination will be used, using the covariance of weight and height obtained from these U.S. population data. The distributions of weights and heights at any age are indistinguishable from lognormal based on preliminary analysis of these NHANES data (see also Burmaster [1998] and Burmaster and Crouch [1997a]). Median weights and heights, and the standard deviations of their logarithms, will be parameterized by age and sex using suitable formulae, and the variance co-variance matrix of the distributions about these medians similarly parameterized. The height squared will act as a surrogate for body surface area using standard correlations between surface area, body weight, and height (Burmaster, 1998; USEPA, 1997a, Appendix 6A).

The fraction of skin surface area exposed is proposed to be hands only at 45°F, increasing linearly to hands, lower legs, forearms, and face for adults and children at 70°F+ in the residential and recreational scenarios, where the temperature is based on the maximum daily temperature. Surface area fractions corresponding to particular body parts will be taken from the *Exposure Factors Handbook* (USEPA, 1997a). Weather records will be obtained for MBS International Airport (WBAN 726379 14845[23]).

The approach taken to exposed fractions of various body parts are proposed to be similar to that used in the USEPA Stochastic Human Exposure and Dose Simulation (SHEDS) model

[22] Hourly records from 1973 to the present are available through http://www.ncdc.noaa.gov/oa/climate/climatedata.html. Incomplete records may be augmented by reference to other Michigan weather records.

[23] Hourly records from 1973 to the present are available through http://www.ncdc.noaa.gov/oa/climate/climatedata.html. Incomplete records may be augmented by reference to other Michigan weather records.

(Zartarian et al., 2005). For children, Wong et al. (2000) provide a default estimate for surface areas exposed during play, and such information will be augmented, if possible, by other relevant data. The methodology to be adopted for estimation of average soil adherence is one recommended in USEPA (1997a). Measured values for soil accumulation on all the appendages are summed.

Event Frequency

The event frequency will be set at one per day during actual exposure periods for all types of events. This approach is consistent with the methodology used in dermal contact pathways that use the AF (MDEQ, 2005a), so it will be used for both SLRA and PRA.

Soil Adherence Factor for this Event

Long-term average mean values are proposed to be estimated from the measurements of Kissel et al. (1996, 1998) and Holmes et al. (1999), as also reported in USEPA (1997a). There are insufficient data to evaluate whether long-term mean soil adherence factors differ between individuals, so no variability will likely be incorporated in the analysis. The derivation of a representative range of adherence factors for use in the probabilistic assessment is described in Appendix HHRA E, E-4. Raw data will be obtained from Prof. Kissel's Web site (http://depts.washington.edu/jkspage/index.html).

6.4.5 Chemical-specific Parameters

Chemical-specific parameters used in risk assessment include data for the degree of cooking and preparation loss for foods, oral absorption from soil, dermal absorption from soil, and other physical-chemical parameters. These are discussed below.

Cooking and Preparation Loss

If any further evaluation of vegetables is necessary, Tsutsumi et al. (2002) provides a basis for evaluation of cooking loss from vegetables. If additional CoPCs are identified, appropriate cooking loss assumptions will be derived.

Ingestion Absorption Efficiency

The HHRA proposes to develop a bioavailability value (or probability density function [PDF]) based on the currently available swine and rat data, the bioaccessibility data, and information available in the published literature from other dioxin-related bioavailability studies.

For the SLRA, as described in Appendix E-1 in the memorandum on bioavailablilty, site specific bioavailability and bioaccessibility studies conducted using Midland soil support the use of a 25 percent relative bioavailabililty factor for PCDD/Fs. This will be applied for evaluation of PCDD/Fs in the algorithm for soil ingestion, Equation 2. For ingestion from foods in the other algorithms, no explicit ingestion absorption efficiency is incorporated, because the absorption efficiency is considered to be equivalent to that used for derivation of toxicity values based on intake. Subject to the possible use of additional "best available information", for CoPCs for which no site-specific data are available, the ingestion absorption efficiencies used in the SLRA will be the default values specified by the Part 201 regulations (Table 4 of R299.5752), and for chemicals not listed, the default values specified at R299.5720(3) will be used.

The Dow-sponsored pilot bioavailability study and follow-up study evaluated the bioavailability of PCDD/F from area soils. The results of the pilot study are available on the MDEQ Web site[24] and the results of the follow-up study are provided in Appendix E, Attachment E-3. For the PRA, these results will be used to derive uncertainty distributions for the site-specific ingestion bioavailability of the PCDD/PCDFs from Midland soil, and the resulting uncertainty distributions used. Uncertainty distributions for other CoPCs (if any) will be obtained from literature studies of bioavailability from soil, or the default values of the SLRA (Section 6.4.3) used if no published studies are located.

Dermal Absorption Efficiency from Soil

There are no site-specific studies of the dermal bioavailability of PCDD/Fs from Midland soil. In a letter, MDEQ (1999) recommends using a dermal absorption efficiency of 1.75 percent, based on an USEPA study of dermal absorption in rats (USEPA, 1991) cited in USEPA's Dermal Exposure Assessment document (USEPA, 1992). The USEPA (1991) study resulted in adjusted dermal absorption efficiency values for TCDD across human skin of 0.95 and 2.5 percent for low organic carbon content soil similar to typical Michigan soil (except for high organic carbon content soils present as sediments or wetland soils). MDEQ's recommended value of 1.75 percent represents the midpoint of the two values from the USEPA study and this value is proposed for use in the SLRA.

For analyses in the PRA, USEPA's *Draft Dioxin Reassessment* (2003) and the Dermal Exposure Assessment document (USEPA, 1992) cite additional studies of dermal absorption of TCDD across rat skin. Poiger and Schlatter (1980) concluded that approximately 2 percent of the administered dose of TCDD in a soil/water paste was found in the liver of the rats. Shu et al. (1988) find that after 24 hours of contact with rat skin, the degree of dermal uptake from contaminated soil was approximately 1 percent of the administered dose. A limitation of these studies is the extrapolation of experimental results in the rat to absorption across human skin. Rodent skin is about ten times more permeable than human skin, and the duration of exposure in these experiments is typically longer than the exposure duration in human exposure scenarios. USEPA (2003) notes that *in vitro* permeation of TCDD across human skin was significantly lower than in mouse skin. USEPA (2003) also cites one study of 1,2,3,7,8-PeCDF in monkeys that concluded that less than 1 percent of the administered dose was absorbed after 6 hours. A distribution for dermal absorption efficiency will be developed based on the studies cited above and on any further studies of PCDD/F absorption from soil identified in the literature; alternatively the default value of 1.75 percent will be used. The distribution will be primarily an uncertainty distribution reflecting the uncertainty in the true value for the dermal absorption efficiency of PCDD/Fs from Study Area soil.

For CoPCs for which no further data are available, the dermal absorption efficiencies used in the SLRA will be the default values specified by the Part 201 regulations (Table 4 of R 299.5752), and for chemicals not listed, the default values specified at R 299.5720(3) will be used.

[24] http://www.deq.state.mi.us/documents/deq-whm-dioxin-PilotStudyReportFINALFeb24.pdf

Physical Properties of CoPCs

The following hierarchy of sources is proposed as resources to gather chemical specific data on physical properties needed for the HHRA: first, the National Institute of Standards and Technology (NIST) Webbook[25] for properties that have been critically evaluated (for properties with reference collations only in the NIST Webbook, such as Henry's law values, see the subsequent hierarchy). Second, review articles that critically assemble and evaluate original data, and provide recommendations. Third, original published articles reporting experimental results. Finally, for properties with inadequate or absent information in these sources, values will be inferred from structure-activity relationships, with preference given to those structure-activity relationships included in critical review articles that assemble and evaluate original data.

6.4.6 Exposure Point Concentrations

An exposure point concentration (EPC) is an estimate of the appropriate average chemical concentration in a medium that a receptor is likely to contact over their exposure duration. Typically for SLRAs, an appropriate estimate is the 95 percent upper (uncertainty) confidence limit on a mean concentration (USEPA, 1989), since the mean (such as over an area, for soil contact scenarios) usually adequately represents the time average; and taking an upper uncertainty confidence limit gives a conservative estimate. Where there is a distribution of exposures across a population, the appropriate 95th confidence percentile should (for SLRAs) be on an upper percentile of that population variation. In SLRAs, however, selecting subpopulations expected to have high exposures may substitute for selection of an upper percentile of the population variation.

As mentioned, due to the uncertainty associated with estimating a true average concentration, USEPA recommends calculating the 95 percent upper confidence limit (UCL) of the arithmetic mean concentration in an exposure unit (USEPA, 1992). The methods that will be considered for calculation of the 95 percent UCLs are provided in *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (USEPA, 2002). Sampling data from previous and ongoing studies and investigations as explained in Section 6.3.1 will be considered for calculation of the media- and exposure pathway-specific EPCs.

The distributional shape of the concentration datasets can be tested using the Shapiro-Wilk 'W' Test or other appropriate test as described for example by Gilbert (1987) or USEPA (2000) if particular (mathematical) functional forms are selected as potentially representing the empirical distributions. Generally, functional form fits to such distributions will be used to adequately represent them, and statistical methods used to estimate confidence limits. In the SLRA, if the estimated 95 percent UCL on the mean of the appropriately selected data distribution is lower than the maximum concentration, the 95 percent UCL will be used as the EPC; otherwise the maximum value will be used as the EPC. The method for calculating the 95 percent UCL will depend on the distribution of the dataset. When the data are normally distributed, the Student's *t*-statistic can be used to calculate the 95 percent UCL. The *H*-statistic will be used to calculate the 95 percent UCL for log-normally distributed

[25] http://webbook.nist.gov/chemistry/

datasets. For datasets that fit neither lognormal nor normal distribution curves, parametric or non-parametric methods described by USEPA (2000) or others will be employed.

6.5 Toxicity Assessment

The toxicity assessment will quantitatively evaluate the hazards associated with CoPCs in Study Area media using the best available information and science. For noncarcinogenic chemicals, USEPA has developed a specific toxicity value called a reference dose (RfD). USEPA defines an RfD as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." Noncancer risk assessment can also consider using a TDI or margin of exposure (MOE) approach for characterizing risk. Potential carcinogenic effects are evaluated through application of a carcinogenic slope factor (CSF). This work plan is currently focused on the identified CoPC for the Study Area, the PCDD/Fs. Any additional CoPCs identified in the screening process will be considered in the risk assessment through application of toxicity values available from the following sources (shown here in priority of use), or other sources as appropriate:

- USEPA's Integrated Risk Information System (IRIS; www.epa.gov/iris)
- USEPA's provisional peer reviewed toxicity values (PPRTVs)
- Additional USEPA sources (for example, the historic, HEAST and NCEA provisional values as they are summarized in the USEPA Region 9, USEPA [2006][26]) and non-USEPA sources of toxicity values (such as California EPA toxicity values)
- Other guidance as appropriate

As recommended by USEPA Region 9, all values will be checked against the original sources to verify their correctness. All toxicity values used in the assessment will be clearly identified and provided in tabular form in the HHRA.

6.5.1 Toxicity Values for PCDD/Fs

Based on review of the sources listed above, there are no current USEPA toxicity criteria for PCCD/Fs for use in either cancer or noncancer risk assessment. The CSFs previously available for TCDD are based on a 30-year old study (Kociba et al., 1978) and do not reflect current scientific understanding or substantial additional available data on cancer risk. Thus, toxicity criteria for PCDD/Fs, including a CSF and an RfD will be derived for use in the risk assessments in the Study Area. This derivation will be aided by recent scientific reviews—the NAS committee review of USEPA's reassessment has been completed (NAS, 2006), and in addition, WHO has completed a review of the TEFs for dioxin-like compounds, which also are integral to the risk assessment process for PCDD/Fs other than TCDD (van den Berg et al., 2006).

Michigan Part 201 rules provide that the best available information is to be used as the basis for derivation of toxicity criteria for use in risk assessment (Part 201, Rule 701(c)). The

[26] See http://www.epa.gov/region9/waste/sfund/prg/whatsnew.htm

recent expert consensus reviews by the NAS and WHO-International Program on Chemical Safety (IPCS) committees should be given significant weight and credibility in the derivation of toxicity values for use in the risk assessments of the Study Areas because they represent the current state of the science for toxicity of PCDD/Fs. Given the primary focus in this risk assessment on PCDD/Fs and the lack of MDEQ or any currently recommended USEPA toxicity values for cancer or noncancer assessment of PCDD/F toxicity, the remainder of this section is focused on approaches to derive appropriate and representative toxicity values for PCDD/Fs to be used in the HHRA.

Currently, a 30-year old study (Kociba et al., 1978) is used by USEPA as the sole basis for cancer potency estimates. USEPA has no national standards or toxicity criteria for PCDD/Fs aside from the 1,000 ppt soil level used at some CERCLA sites[27]. Independent derivation of toxicity values for PCDD/Fs by states, other countries, or other organizations has been ongoing. Numerous other states (including California) develop and utilize their own toxicity criteria. The HHRA will include proposed cancer and noncancer toxicity values for purposes of assessing local risks.

As indicated above, substantial new information and scientific guidance has become available since the development of the CSF for 2,3,7,8-TCDD based on Kociba et al. (1978) and even since the comments made by the regulatory authorities in the March 2006 Notice of Determination (NOD). These include the recently published NTP cancer bioassays on 2,3,7,8-TCDD and 2,34,7,8-PeCDF which provide state-of-the-art cancer bioassay information for determining cancer potency values, and also allow a direct evaluation of the TEF value for 4-PeCDF (Walker et al., 2005; Budinsky et al., 2006). NAS (2006) provided numerous and extensive recommendations to USEPA directed at increasing the scientific content of USEPA's risk characterizations for dioxin. The WHO-IPCS expert committee has published an update to their recommended TEFs (van den Berg et al., 2006) and simultaneously provided further guidance on their intended range of uses in PCDD/F risk assessment, and desirable extensions of the methodology to include a probabilistic treatment of the TEFs. Additional publications have addressed appropriate use of TEFs in risk assessment and evaluation of impacts of uncertainty in TEFs (Haws et al., 2006; Finley et al., 2003).

Discussion over derivation of toxicity criteria was deferred until the NAS review of the USEPA Dioxin Reassessment was completed in the hopes that it would eliminate the need to pursue an independent derivation of the CSFs and RfDs for PCDD/Fs. However, the NAS review was critical of USEPA's efforts, suggested major revisions of the document, but did not derive toxicity criteria for TCDD. Because it is unknown whether USEPA will respond to the NAS criticisms soon enough to be useful in this HHRA, the HHRA will include derivation of the toxicity criteria values taking into account the recommendations of the NAS and the specific characteristics of the local PCDD/F profile. The important issues raised by the NAS 2006 review included use of a non-linear (threshold) dose-response model in development of estimates of the CSF; use of different dose metrics (for example, body burden, organ doses) that incorporate the kinetics of the PCDD/Fs; incorporation of probabilistic techniques for estimating uncertainty and variability in the values derived

[27] Timothy Fields, Jr. Acting Administrator's Office of Solid Waste and Emergency Response "Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites" (April 13, 1998) OSWER Directive 9200.4-26. http://www.epa.gov/superfund/resources/remedy/pdf/92-00426-s.pdf

(including TEFs); development of a RfD based on appropriate endpoints; and taking into account human and animal data, relevant dose-response models and use of appropriately defined uncertainty factors. Concurrent with release of the NAS report, WHO published an update on their TEF estimates (van den Berg et al., 2006) and simultaneously provided useful guidance on the use of TEFs in dioxin risk assessment complementary to other publications regarding the use of TEFs in risk assessment (Haws et al., 2006; Finley et al., 2003). As with the cancer and noncancer toxicity criteria, the incorporation of new data and best information into the TEFs may be subject to future ISAP reviews.

The HHRA proposes to include development of deterministic toxicity criteria through consideration of the scientific recommendations of the NAS (2006) and WHO TEF (van den Berg et al., 2006) reports as well as all relevant literature; however, it remains possible that a probabilistic derivation may be necessary to address the complexity and uncertainty inherent in the PCDD/F database. Regardless of how they are derived, the final toxicity criteria value or values will subject to third-party external review to ensure transparency of the process and quality of the values. The following discussion provides an overview of the scientific issues that need to be considered in derivation of appropriate toxicity criteria for cancer, noncancer and TEFs.

- Critical effect/data set
- Dose measure
- Response measure
- Dose-response model
- Point of departure (POD)
- Extrapolating to low doses
- Inter-species extrapolation (if necessary)
- Presentation of toxicity value

Where possible, information regarding the mode of action (MOA) for the chemical will be used to guide the decisions made at each point (Cohen et al., 2004; Cohen et al., 2003; Bolt et al., 2004; Butterworth, 2006; Meek et al., 2003; Byrd et al., 1998 Purchase and Auton, 1995; Dellarco and Baetcke, 2005; Holsapple et al., 2006). Also, because the seven steps are common to noncancer and cancer risk assessment, efforts to harmonize both assessments will be pursued in the HHRA.

Cancer Dose-Response Assessment

Although PCDD/Fs, and particularly 2,3,7,8-TCDD, are known to be carcinogenic in animal bioassays and are suspected to be human carcinogens based on limited evidence in human populations (Kociba et al., 1978; NTP, 2004; Cole et al., 2003), there has been considerable debate since the mid 1980s regarding the most appropriate data set(s) and methodology to apply in evaluating carcinogenic risks associated with PCDD/Fs in risk assessment (NAS, 2006; Starr, 2001; 2003).

The NAS review rejected USEPA's proposed CSF ("Use of this approach was not supported by a scientifically rigorous argument, nor was there a balanced presentation of arguments using the same data to support the calculation and interpretation of an MOE" [NAS, 2006; Conclusions and Recommendations, p. 186]), urged USEPA to consider non-linear extrapolation methods to extrapolate to low-dose exposures ("The committee unanimously

agrees that the current weight of evidence on TCDD, other dioxins, and dioxin-like compounds [DLCs] carcinogenicity favors the use of nonlinear methods for extrapolation below the POD of mathematically modeled human or animal data" [NAS, 2006; p 135]), and urged USEPA to consider the NTP studies (NTP, 2004a, 2006) that were not available to review at the time the 2003 reassessment was completed. They also emphasized the benefit of a probabilistic approach to best characterize the range of plausible values (NAS, 2006).

NAS (2006) urged USEPA to complete the derivation of toxicity values; however, this process includes several internal and external review steps and will likely not be complete by the time the HHRA for the Study Area is initiated (or even by the time it is completed). Therefore, in order to carry out the risk assessment in the Study Area, CSFs will be derived for both 2,3,7,8-TCDD and 2,3,4,7,8-PeCDF from bioassays performed by the NTP in 2004 (NTP, 2004a; 2006). In addition to standard default approaches for developing CSFs, this effort will include the development and consideration of a non-linear dose-response approach, as explicitly endorsed by the NAS committee, and which is consistent with the mode of action of dioxins leading to cancer in laboratory animals, as determined by a large body of scientific information (Popp et al., 2006). The deterministic CSFs will be used in the SLRA process to conservatively estimate added lifetime cancer risk for purposes of screening pathways or exposures that do not contribute markedly to the hypothetical risk. These deterministic CSFs also may be used in assessing cancer risks in a forward-looking PRA. However, the development and use of probabilistic CSFs to fully explore and explain the range of hypothetical cancer risks associated with site-related exposures has not been entirely ruled out based on the NAS recommendations. A number of steps are required to properly develop CSFs. These steps are discussed in more detail below.

Cancer risks associated with other identified PCDD/Fs will be estimated using the TEF approach as discussed in the recent WHO TEF revisions (van den Berg et al., 2006) and NAS recommendations (NAS, 2006) as well as Michigan's Part 201 rules. More discussion on the TEFs and the potential issues associated with their use can be found in Section 6.5.3.

Critical Effect and Data Sets

This decision point requires the selection of both an endpoint and source. The carcinogenic effects of TCDD have been well studied in epidemiological studies and animal cancer bioassays. Established quantitative dose-response data are available from cancer bioassays in laboratory animals and these serve as the current means to conduct cancer risk assessment for PCDD/Fs. The methods by which to estimate cancer potency information from the newer data also are available, and these methods include the use of non-linear estimates as recommended by NAS and other scientists. In contrast, the epidemiological data are not useful for establishing a CSF for TCDD due to large uncertainties in exposure estimates and potential confounding exposures (Aylward et al., 2005).

Epidemiological or Animal Data

Both epidemiological and laboratory animal studies have associated strengths and limitations (Cheng et al., 2006; Aylward et al., 2005; Bodner et al., 2003; Ketchum and Michalek, 2005; Walker et al., 2006, Ott and Zober, 1996; Flesch-Janys et al., 1998; Steenland et al., 1999; 2001; Fingerhut et al., 1991; Bertazzi et al., 2001). The human data sets are most certainly relevant to hazard assessment; however, the exposure estimates are highly uncertain, the modeling of "all cancer" mortality is unusual, unprecedented in its lack of

biological plausibility, and causal inference from these studies is problematic for a variety of reasons (Starr, 2003; Cole et al., 2003). In addition, use of epidemiology data generally will increase the complexity of the dose-response assessment (due to the problems involved in dose estimation).

NAS (2006) has stated: "USEPA used linear extrapolation from the POD, the ED01 [effective dose for 1 percent response], derived from the cancer epidemiological studies to calculate a CSF. The resulting cancer risk estimate of 1×10^{-3} per pg [picogram] TEQ/kg of body weight per day for both background intakes and incremental intakes above background was considered by USEPA to be the most appropriate approach. Using a linear extrapolation approach in the Reassessment was one of the most critical decisions by USEPA. Use of this approach was not supported by a scientifically rigorous argument, nor was there a balanced presentation of arguments using the same data to support the calculation and interpretation of an MOE" (NAS, 2006; p. 186). In view of the lack of scientific support for use of epidemiological data in this way, the HHRA proposes to use data from animal bioassays in a standard (default) way. Other options may be explored in sensitivity and uncertainty analyses.

A number of animal cancer bioassays are available for TCDD that describe dose-response relationships for several tissue sites, most notably in the liver (NTP, 1982; NTP, 2006; Kociba et al., 1978; Van Miller et al., 1977; Toth et al., 1979; Della Porta et al., 1987; Rao et al., 1988). As opposed to epidemiological studies exposures (or doses) are known with a high degree of certainty for the animal data sets; however, the relevance of results to human health is uncertain. Species differences in toxicokinetics and toxicodynamics complicate interspecies extrapolation, as exemplified by the well-known differences in sex and species sensitivity demonstrated by TCDD (for example, humans are known to be less sensitive to effects of TCDD than even closely related animal species[28]). Another factor to consider is the life stage at which exposure occurs. In epidemiological studies of occupationally exposed cohorts, exposure to PCDD/Fs occurs exclusively during adulthood. On the other hand, in animal cancer bioassays, exposure to these compounds begins much earlier in life. Because TCDD is widely recognized as a tumor promoter (rather than a tumor initiator), this difference in exposures may affect the occurrence of cancer and its extrapolation between species and ages. The findings from well-conducted animal studies, which included exposure during earlier life stages, suggest that the animal data are the most technically supportable basis for derivation of a CSF.

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[28] Direct comparison between laboratory animal and human sensitivity to dioxin toxicity can be made for several endpoints. The human Ah receptor (AhR) expresses a mutation that is identical to that observed in the "non-responsive" DBA mouse strain. This mutation results in reduced binding affinity for dioxin and conveys a fundamental reduction in sensitivity compared to responsive mouse and rat strains of approximately 10-fold (reviewed in Connor and Aylward, 2006). With respect to acute lethality, several poisoning incidents have resulted in measured body burdens substantially in excess of the lower end of the range of LD50 values for laboratory rodents (Geusau et al., 2001; Ryan et al., 1990; Brouwer et al., 2005). German researchers have examined the relationship between dioxin exposure and immune system endpoints in marmosets (a non-human primate) and in occupationally exposed workers. Specific alterations in lymphocyte subsets were observed in marmosets at body burdens similar to those found in the workers, who demonstrated no alterations in lymphocyte subsets related to exposures (Neubert et al. 1993, 1994a, 1994b). Human embryonic palatal shelves are several hundred times less sensitive than mouse palatal shelves to cleft palate induction from dioxin exposures (Abbot et al., 1999). Finally, induction of expression of mRNA for and induction of activity of CYP1A1 and CYP1A2 enzymes are endpoints that have consistently been observed to be the most sensitive responses to dioxin exposures. Multiple studies of exposed human populations have demonstrated that in persons with body burdens up to about 250 ng TEQ/kg (corresponding to serum lipid concentrations of approximately 1,000 ppt TEQ), no significant induction of mRNA, protein, or enzyme activity is observed, while significant changes in enzyme activity are clearly observable in laboratory rodents at body burdens below 50 ng TEQ/kg (reviewed in Connor and Aylward, 2006; see also Lambert et al., 2006).

Dose Measure

A number of decisions are necessary in selecting an appropriate dose measure for characterizing the dose-response relationship. For purposes of generating a deterministic CSF for TCDD and 4-PeCDF for this risk assessment, the dose measure selected will be the applied dose, in keeping with standard USEPA approaches to developing such toxicity criteria. However, other dose measures recommended by NAS or other authoritative bodies and discussed in the following sections may be considered in sensitivity and uncertainty analyses.

Internal or External Dose

The selection of an appropriate dose measure for the dose response assessment should consider the relevance of the endpoint, the quality of the data and the study from which the data are derived, the persistence, mode of action, and target tissue of the compound under consideration. Because of the persistence of many PCDD/Fs, use of an external dose measure (for example, lifetime average daily dose [LADD] in terms of milligrams per kilogram per day [mg/kg-day] for oral exposure; parts per million [ppm] or ppm-years for inhalation exposure) is not preferred (NAS, 2006). Instead, NAS (2006) recommended implementing pharmacokinetic modeling in the dose-response assessment to estimate internal dose measures. Internal dose measures (that is, body burden, tissue dose, etc.) can be estimated using a variety of available pharmacokinetic (PK) or PBPK models, or can be estimated based on measurements of tissue concentrations in experimental studies (for example, the recent NTP bioassays contain measured tissue concentration data at several time points during the experiments).

A wide variety of pharmacokinetic models are available to describe the behavior of TCDD in laboratory rodents and in humans. These models incorporate varying degrees of physiological representation of the phenomena that govern distribution and elimination of TCDD (Aylward et al., 2005; Carrier et al., 1995a, b; Emond et al., 2004; Kim et al., 2002; Maruyama et al., 2002, 2003; NTP, 2006). While PBPK models are useful for addressing dose- and species-dependent factors that can complicate a dose-response assessment and are considered the "gold standard" for internal dosimetry, the lack of validated models for the major congeners of interest in the Study Area may limit their usefulness in the current risk assessment. If PK models predict the relevant dose metric as well as PBPK then the relatively more straightforward PK approach will be used.

Body Burden or Tissue Dose

The NAS (2006) review recommended body burden as a better dose measure than administered dose. Body burden may be an appropriate dose measure for assessing total cancer risk or risk from combined tissue sites for PCDD/Fs, but it also has a tendency to distort the risks to human health due to species differences in distribution (that is, adipose versus hepatic sequestration). For this reason, a tissue dose (for example, liver burden may be a better internal dose measure for specific endpoints. Again, the use of a PK or PBPK model may useful to develop appropriate dose estimates for some congeners.

Dose Metric

PK and PBPK models can also be used to calculate several metrics for tissue dose including peak, average, and area under the curve (AUC). Because of its persistence in tissues, a

cumulative dose measure (AUC) is generally recommended over other measures of internal dose for dioxins and furans.

Parent Chemical or Metabolite

Based upon the current understanding of the mode of action for TCDD (involving an initial interaction of parent chemical with aryl hydrocarbon [Ah] receptors), a dose metric based on the parent chemical in tissues is recommended for cancer and noncancer risk assessments. There is some evidence to support a potential role for metabolites for some endpoints (Smith and De Matteis, 1990); however, the general scientific consensus on the mode of action for PCDD/Fs is one of parent compound binding to the Ah receptor and activating gene expression.

Response Measure

Risk can be calculated using one of several metrics:

Relative Risk = [Observed Cancer Response]/[Expected Cancer Response]
Extra Risk = [P(d)-P(0)]/[1.0-P(0)]
Added Risk = P(d)-P(0)

Where,

d = dose
P(d) = Probability of a cancer response at dose d
P(0) = Probability of cancer response at zero dose

Although information for the likely MOA might be used to support a decision for response measure (depending upon relationship between treatment related and spontaneous tumors), the default decisions for human (relative risk) and animal (extra risk) are recommended and will be used in the deterministic derivation of TCDD and 4-PeCDF CSFs. There are multiple lines of evidence indicating a threshold approach to cancer risk assessment for TCDD. These include: (1) TCDD's mode of action (ligand-AhR binding to dioxin responsive element (DRE) with recruitment of co-activators and repressor proteins), clearly a mass-action receptor phenomenon, (2) TCDD's biology of disrupting cell cycle kinetics with enhancement of cellular growth characteristics, another threshold phenomenon, (3) the histopathological time course of TCDD-induced lesions with clear progression of liver hypertrophy and accompanying necrosis into adenomas and carcinomas, and (4) the reversibility of various end points, as evidenced by the NTP Start-Stop studies. Simply put, absent cell, tissue and organ toxicity, no cancer risk appears to exist from low TCDD tissue concentrations. The same issues could be easily accounted for if a probabilistic derivation of the CSF was developed.

Animal Data

USEPA's Benchmark Dose Software (BMDS, version 1.3.2) includes a number of models available for dichotomous data collected from cancer bioassays: Multistage, Gamma, Logistic, Probit, Quantal Linear, Quantal Quadratic, Weibull. Alternative dose-response models also can be considered. The model or models used to develop the CSF for the dose-response assessment will be selected based upon a consideration of visual inspection, p-value for goodness of fit test, and Aitken information criterion (AIC) value. Preliminary

evaluation shows that selection of any particular model, provided it fits adequately, has negligible effect on estimates.

For purposes of the deterministic CSFs for TCDD and 4-PeCDF, the Linearized Multistage Model (LMS) will be used because it is the USEPA default model and it provides an adequate fit to all the animal data available for TCDD and 4-PeCDF. For threshold evaluation, approrpiate dose-response models that utilize a threshold will be exmined and selected for use per recommendations of the National Academy of Science (2006) and USEPA Cancer Risk Assessment Guidelines (2005).

Point of Departure

Consistent with USEPA guidelines (USEPA, 2005a), a point of departure is selected to separate the "range of observation" from the "range of extrapolation." The range of observation should consider both the range of doses tested, and the range where increased risk can be reliably observed as defined by specific data set. A number of response levels serve as potential candidates for the point of departure with the default for animal data being the effective dose producing a 10 percent increase in response (ED10) and its lower confidence limit (LED10). Animal data sets generally do not support points of departure lower than 5 percent, since test groups typically do not have sufficient power to detect a 1 percent increase in risk. This has been specifically shown for TCDD (Gaylor and Aylward, 2004). Lower points of departure are possible when large exposure groups are used (for example, greater than 100 tested per group) or when data sets are pooled together such as might be done in a meta-analysis or a probabilistic treatment of the CSF. The POD selected will be based on the characteristic of the data set chosen to develop the CSF.

Low Dose Extrapolation

The decision regarding the most appropriate method for extrapolating to low doses requires a careful consideration of the MOA. Options for low-dose extrapolation include linear (default), nonlinear/threshold (MOE or RfD approach), or through use of a biologically based model. USEPA (2005a) considers agents to be linear at low doses when either of the following conditions is met:

- Agents that are deoxyribonucleic acid (DNA)-reactive and have direct mutagenic activity, or
- Agents for which human exposures or body burdens are high and near doses associated with key precursor events in the carcinogenic process, so that background exposures to this and other agents operating through a common mode of action are in the increasing, approximately linear, portion of the dose-response curve.

As a matter of science, and consistent with NAS (2006) recommendations, TCDD does not meet the first requirement for linear low-dose extrapolation. However, the second requirement is subject to debate, and will depend upon the dose measure used (body burden versus tissue burden) and definition of the low end of the range of observation (ED01 versus ED10). The choice for this decision will be based on the data set and the manner in which it is to be treated. Further, substantial evidence exists that humans are fundamentally less sensitive to many biological responses to TCDD than rats and other laboratory species (see Footnote 28). Therefore, the exercise of comparing human body burdens to (animal based) no observed adverse effect level (NOAEL)/lowest observed

adverse effect level (LOAEL) body burdens derived from rat studies is likely to overestimate human risks.

USEPA may ultimately revise its assessment to include both linear and nonlinear extrapolations, which would be consistent with NAS recommendations. Popp et al. (2006) recently came to the same conclusion supporting the use of a threshold approach for TCDD carcinogenicity. Again, unless a threshold for tissue response is achieved, that is, cytochrome P450 1A (CYP1A) induction or liver injury revealed by elevated liver enzymes, a risk for TCDD-induced cancer does not exist. According to the current UMDES data, local residents do not have dioxin concentrations sufficient to elicit these basic phenomena that occur prior to downstream cellular, tissue and organ events that cause cancer (Connor and Aylward, 2005; Guzelian et al., 2006). Because this is such a critical and controversial decision point, this is an area where expert elicitation by the ISAP (consistent with USEPA guidelines) will be sought, unless Dow and MDEQ reach agreement on this in advance of the ISAP. To reiterate, in keeping with the NAS (2006) recommendations, evaluation of the CSF using a variety of dose-response models and conditions will be undertaken. The deterministic CSF developed for both TCDD and 4-PeCDF will be based on a linear, non-threshold response, as has been the standard default assumption for cancer risk assessments; however, the assumptions inherent in this choice, the impact of an alternative, more likely extrapolation, and the comparison to available site-specific data must be included in the risk characterization. If undertaken, a probabilistic treatment of the CSF would include both threshold and non-threshold models.

Low-dose extrapolation should take into account potentially susceptible subpopulations such as nursing infants. Based upon the likely MOA (tumor promotion), the additional adjustments defined by USEPA (2005a) for genotoxic carcinogens are not applicable for the PCDD/Fs (Anderson, 2006; Anderson, 2004a, 2004b; Preston, 2004; Bunin, 2004). Further, the epidemiological data do not support a need to incorporate additional uncertainty factors related to higher breast milk intake since epidemiological studies of breast fed individuals with body burdens comparable to today's young people find no evidence of increased lifetime cancer risk compared to those not breastfed (Martin et al., 2005a), a finding consistent with risk evaluations performed for both breast-fed and formula-fed infants (Maruyama et al., 2004). Epidemiological evidence shows that the incidence of childhood tumors is reduced in breast fed children (Kwan et al., 2004, Martin et al., 2005b). Therefore, these data provide no evidence to factor in either a breast milk exposure pathway or additional protective uncertainty factors when considering cancer risk and childhood exposures. This line of reasoning is further developed in Appendix D. Limited animal data are available to address early-life susceptibility in mice (Della Porta et al., 1987). However, since PCDD/Fs act as tumor promoters, late-life exposures are expected to be more important. Late-life exposures are already addressed in both epidemiological and cancer bioassay data sets. Ah receptor polymorphisms exist in humans, but most do not impact phenotype/response to ligands (Harper et al., 2002; Okey et al. 2005).

Presentation of the Carcinogenic Slope Factor

Although past dose-response assessments have relied upon deterministic point estimates for characterizing cancer potency (upper-bound estimate when based upon animal data; central tendency estimate when based upon human data), USEPA (2005a) guidelines and NAS (2006) recommendations include presentation of central tendency, upper bound, and lower

bound estimates of cancer potency. The USEPA (2005a) guidelines are intended to be flexible enough to incorporate additional approaches for characterizing uncertainty that have less commonly been used by regulatory agencies in the past. This could include presentation of a probability density function for CSF using Monte Carlo or probabilistic methods. Such methods have been applied to exposure assessment for years, and more recently to toxicity assessment (Crouch, 1996; Crouch, 2005; Crouch et al., 2005). The SLRA will use a deterministic approach (single sensitive endpoint scaled to three-fourths the body weight with the CSF determined using the LMS for both TCDD and 4-PeCDF from the recent NTP bioassays) in order to be conservative and only screen out exposures that carry a low theoretical risk. The CSF used in the forward looking PRA also will use a deterministic CSF, but then may move to probabilistic estimates of the CSF that would serve to define the full range of theoretical cancer risks and their uncertainty and variability more completely.

6.5.2 Derivation of Toxicity Values for Noncancer Endpoints

The most sensitive endpoints observed in experimental animals should be used as the basis for the derivation of cancer or noncancer toxicity criteria when adequate human data are not readily available or interpretable. Review of the animal and human data will be necessary to develop proper characterization of noncancer risks based upon concerns over sensitive subpopulations such as the fetus and infant; however, in the specific case of dioxins, numerous issues must be accounted for in selecting appropriate noncancer toxicity criteria. Some of these issues are as follows:

- The presence of an extensive database of studies using TCDD in which all studies examine the same sensitive endpoints but which identify substantially different quantitative estimates of LOAELs and NOAELs for these endpoints in the same species. A critical review of these data, evaluation of the possible sources of the discrepancies in results, and a comprehensive approach to including these data is both necessary and appropriate for a scientifically sound risk assessment.
- A review of issues related to deriving appropriate and scientifically justified toxicity criteria including endpoints of concern, species sensitivity dosimetry and kinetics, dose-response models and extrapolation, uncertainty factors (including data-derived uncertainty factors).
- A review of the available epidemiological data to determine if such data are useful for deriving toxicity criteria or for providing supporting data in a weight of evidence approach.
- The necessity and methodology for extrapolation from TCDD to other PCDD/Fs for the Study Area. Scientific evidence on specificity of particular toxic endpoints may affect such extrapolations and should be considered carefully.

These points are expanded on below, and must be resolved before development of noncancer toxicity criteria can be completed and used to assess human health risk**.**

The development of a TCDD RfD was not attempted by USEPA in its Dioxin Reassessment, and this was a source of criticism by NAS (2006). The HHRA will propose a means to scientifically address this issue and derive an RfD for use in the HHRA as well as in the development of a DCC as discussed in Section 6.1.2. The derivation of an RfD will include

identification of endpoints and data sets, application of appropriate dose-response models, and selection of appropriate uncertainty factors. The final value or values will be subject to review by an ISAP to ensure transparency of the process and quality of the results obtained.

Overview of Available Criteria

Several noncancer toxicity criteria are available for TCDD. Each of these values is conventionally applied to all PCDD/Fs by use of the TEQ method. Table 6-7 summarizes each of these criteria and describes the basis for the values. Each of these criteria was derived from animal data on effects in offspring exposed to TCDD while *in utero* and postnatally via lactation. The criteria were all derived with the goal of maintaining adult maternal exposures below levels associated with effects in offspring. While all of the major criteria are reported on an intake basis, only two of them, the ATSDR and Great Lakes criteria, were actually derived on an intake basis. The WHO/United Nations (UN) Food and Agriculture Organization (FAO) Joint Expert Committee on Food Additives (JECFA) values were derived on the basis of maternal body burden, after continuous exposure until after childbirth and lactation.

Applicability of Current Criteria

The developing offspring, exposed *in utero* and postnatally through lactation, are the most sensitive receptors identified in laboratory studies of noncancer effects of dioxin. This was explicitly recognized by all of the agencies that have derived noncancer criteria for TCDD and related compounds. All of the current criteria were derived with the goal of keeping long-term adult maternal intake levels below levels that would accumulate to body levels that could produce adverse effects in offspring. As such, these criteria should be applied to assessing maternal adult, not childhood, intakes of dioxins.

In general, children may experience greater intake rates of contaminants on a body weight basis due to a greater food intake rate and contact with the environment; however, the body concentrations of dioxins decline more rapidly in children than in adults due to both growth and dilution and faster elimination rates (Leung et al., 2006; Lorber and Phillips, 2002). This is reflected in the pattern of body burdens noted in the general population, where children demonstrate substantially lower body burdens than adults (see, for example, Link et al., 2005) despite higher daily exposure on a per kg body weight basis (Lorber and Phillips, 2002). Existing noncancer criteria are directed explicitly to protect children through preventing elevated *in utero* and breast milk exposures by controlling the ***adult*** maternal body levels of these compounds. Comparison of estimated childhood intake rates (from breastfeeding or other sources) to these criteria is inappropriate and incorrect without accounting for the more rapid elimination of dioxin and furan compounds in children.

Scientific Shortcomings of the Current Criteria

There are significant shortcomings in the scientific basis for each of the current noncancer criteria for TCDD and associated chemicals. Some of these shortcomings have particular relevance to the risk assessments for the Study Areas. The major issues are as follows:

- Rats appear to be more sensitive to TCDD than humans and this sensitivity is further complicated by the difference in rat reproductive physiology compared to humans including differences in placental biology, immaturity of birth for rat pups versus humans, and the much higher transfer of dioxins/furans to the rat pup since rat breast

milk is higher in lipid than human breast milk. Arguably, the rat reproductive/ developmental findings represent the most sensitive highly conservative animal effect known for TCDD and a risk not shared by humans to the same degree.

- A recent publication (Rier et al., 2001) presented new data that demonstrate that the major studies that underlie the ATSDR and Great Lakes criteria, Bowman et al. (1989) and Schantz et al. (1992), are critically confounded because of high co-exposure to PCBs and cannot be relied upon as the basis for quantitative risk assessment for dioxins. These data were relied upon by the European Commission Scientific Committee on Foods (ECSCF) and WHO/FAO JECFA committees in their decisions to exclude the Bowman et al. (1989) and Schantz et al. (1992) data from their quantitative assessments. With regards to past MDEQ guidance, the use of the Great Lakes reference dose of 1.3 pg/kg/day is no longer scientifically based given the confounding by PCB exposure.
- The rodent studies that form the basis for the WHO/FAO JECFA criterion used acute or repeated bolus dosing regimens that may over predict effects from the chronic environmental exposure situation. The fact that some of the rat studies reporting developmental effects relied upon acute gavage dosing to achieve a body burden a young woman would achieve over 20 to 30 years of daily, dietary ingestion of much smaller dosages, raises serious questions about the relevance and validity of the rat data in predicting human risk. It is expected that these bolus body burden dosages achieve higher short-term levels of TCDD in the fetal compartment than would occur following low-level chronic exposures leading to the same maternal body burdens. The WHO/FAO JECFA committee acknowledged this shortcoming and adjusted their assessment to partially account for this issue, but the full impact may not have been accounted for.
- The endpoints of concern identified in the small rat studies that underlie the WHO/FAO JECFA criterion have been examined in much greater detail in more recent studies (including one evaluated in the WHO/FAO JECFA process, Ohsako et al., 2001). The original endpoint of concern, effects on spermatogenesis in male rats exposed in utero, have not been confirmed in the more recent studies which used larger numbers of animals and modern sperm counting and evaluation techniques (Ohsako et al. 2001; Bell et al., presentation at Michigan State University, July 18, 2006). Other, subtle effects of questionable biological relevance have been observed in these studies at similar dosages, but the original more adverse findings of Gray et al., 1997; Mably et al., 1992; and Faqi et al., 1998 have not been confirmed in these larger, more recent studies.

All of the available studies examined the effects of TCDD. However, other TEQ-contributing compounds are distinctly different from TCDD in their ability to distribute to the developing fetus or the developing animal. Figure 6-3 shows the ratio between rat fetal and maternal body burdens for different dioxin-like compounds that were studied in a mixture. While the rat fetus experienced body concentrations of TCDD nearly 10 percent of those in the maternal animal, other compounds were overwhelmingly sequestered in the maternal liver and were not available for distribution to the fetus. In particular, 2,3,4,7,8-PeCDF (4-PeCDF) and 2,3,7,8-TCDF were less than one-tenth as available to the fetus as TCDD. In a risk assessment in which the predominant exposures are to these compounds rather than TCDD, an evaluation based on TCDD-derived criteria may

significantly overestimate the risk of adverse effects. However, because no comparable animal studies have been done with either 4-PeCDF or TCDF, this hypothesis cannot be evaluated at this time. It is of note that the WHO-IPCS committee (van den Berg et al., 2006) cautioned about the use of TEFs in application to body burden and tissue concentration-based assessments because of their failure to take account of pharmacokinetics. 4-PeCDF and TCDF, in particular, do not distribute to the fetal compartment to the same extent as TCDD. One could argue that the TEF value for noncancer risk assessment for 4-PeCDF and TCDF should be adjusted 10-fold lower based on this knowledge of tissue distribution kinetics. A 10-fold reduction in the current WHO TEF for 4-PeCDF from 0.3 to 0.03 is consistent with the approximate 0.03 TEF for 4-PeCDF when derived with internal dose metrics of liver concentration and body burden (Budinsky et al., 2006; Gray et al., 2006).

Noncancer Criterion for the SLRA

As discussed above, all available noncancer criteria suffer from scientific shortcomings that limit their validity for the application to the HHRA. Despite these shortcomings, for the purposes of the SLRA, the WHO/FAO JECFA provisional tolerable monthly intake of 70 pg TEQ/kg/month (WHO/FAO JECFA 2001) will be used as the noncancer toxicity criterion along with further information used to update this value including the published epidemiological data.

Development of a Noncancer Criterion for the PRA

The following section describes the proposed approach for development of a noncancer toxicity criterion (RfD) for use in the full risk assessment and discusses the available data sets for this process.

Selection of Toxicity Endpoints and Studies

Human Developmental Effects Data. The endpoints of concern for noncancer risk assessment of dioxins are focused on potential developmental effects in infants exposed *in utero* and lactationally (Table 6-8). Numerous human data sets are available for evaluating dose-response for potential developmental effects on the immune, hematological, hormone, neurological, and other organ systems in children after perinatal (*in utero*, lactational, or childhood) exposure to TCDD and related compounds. These studies are identified in Table 6-6 and include the following:

- Two longitudinal cohort studies of children examining a variety of developmental endpoints to *in utero* and/or lactational exposures to dioxin and furan compounds in the Netherlands (the Rotterdam/Groningen and the Amsterdam cohorts; together, the "Dutch studies")
- A recent study of German infants (the "Duisburg cohort")
- Studies of children exposed to TCDD in Seveso examining developing teeth (a sensitive endpoint in rodent studies) age at puberty (also a sensitive endpoint in rodent studies), and menstrual cycle characteristics after puberty
- Studies of infants from Japan with quantified dioxin and furan exposures

The Dutch and Japanese studies provide quantitative measures of exposure in terms of prenatal exposures (estimated from measurements in milk samples from the mother, which,

on a lipid basis, have been shown to be highly correlated with maternal serum lipid dioxin TEQ levels; Wittsiepe et al., 2004) and postnatal exposures due to breastfeeding estimated by multiplying the concentrations of "dioxin-like" compounds (PCDDs, PCDFs for all studies, and including non-ortho PCB compounds for the Rotterdam/Groningen cohort and the Japanese studies) in human milk by the duration of breast feeding.

The data from these studies will be described, tabulated, and extracted to identify candidate data sets with information on responses observed consistently in response to dioxin exposures and that provide sufficient detail to allow identification of NOAEL/LOAELs and benchmark dose analysis of the observed responses. Existing reviews of these data will be utilized (for example, Schantz et al., 2003; Giacomini et al., 2006) to streamline this process where appropriate.

Dose Metric and Point of Departure Selection

In several studies, exposure to all TEQ-contributing congeners was not measured (for example, studies of the Amsterdam cohort, which evaluated only PCDD and PCDF congeners and studies from Seveso, in which only TCDD exposure was quantified). For these studies, exposure estimates reported in the study will be adjusted to account for missing TEQ-contributing congeners based on contemporaneous data sets. For example, data from the Rotterdam cohort will be used to estimate PCB contributions to the Amsterdam cohort, and data reported by the Seveso researchers on non-exposed Italian controls will be used to estimate non-TCDD contributions to body burdens in Seveso residents.

For all studies other than the Seveso reports, the dose-response data available in the study will be used to identify a point of departure (NOAEL, LOAEL, or benchmark dose if supported by the reporting of data). This point of departure will be converted to an equivalent maternal serum lipid TEQ concentration, and then to an equivalent long-term adult maternal TEQ intake rate associated with that point of departure using first-order kinetic assumptions (see, for example, Lorber, 2002).

For the Seveso data set(s), the point of departure for each endpoint will be identified in terms of peak and average serum lipid TEQ concentrations. Childhood intake rates associated with the identified point(s) of departure will be identified using age-specific first-order kinetics (Kerger et al., 2005, Leung et al., 2005; 2006).

Additional Data for Consideration

Because existing noncancer criteria for TCDD TEQs have been based on animal data, the relevant animal toxicology data will also be evaluated in this effort and the results will be compared to those obtained from the human data sets.

For TCDD TEQs, the UN FAO/WHO JECFA (2002) estimated a tolerable (human) monthly intake value of 70 pg/kg, corresponding effectively to an RfD of about 2.3 pg TEQ/kg-day. The approach and experimental data selected by JECFA will be evaluated in this analysis, augmented by accounting for variability and uncertainty and the inclusion of data published since their review. The studies to be evaluated include those examining adverse effects on male rat reproductive system development and immunological deficits after *in utero* and lactational exposure. These include studies by: Mably et al., 1992a, b, c; Gray et al., 1995; Gehrs and Smialowicz, 1997; Gehrs et al., 1997; Gray et al., 1997a, b; Faqi and

Chahoud, 1998; Faqi et al., 1998; Gehrs and Smialowicz, 1999; Ostby et al., 1999; Ohsako et al., 2001; Chen et al., 2001; Hamm et al., 2003; and Bell et al., 2005, 2006. These studies will be evaluated for relevant points of departure for the endpoints of interest using appropriate dose-response models and recommendations for dioxins and reproductive endpoints (NAS, 2006; Allen et al., 1994a, 1994b; Gaylor and Aylward, 2004). POD estimates from the available animal data will be developed based on these studies. The initial studies on developmental neurobehavioral effects and endometriosis in monkeys (Schantz et al. 1992; Rier et al., 1993) will not be considered, in view of the later findings of unexplained high PCB exposures in these monkeys (Rier et al., 2001).

Other data that will be considered in assessing risks of PCDD/F exposure in children and adults include the following:

- Data regarding the relative expression of the aryl hydrocarbon receptor (AhR) in fetal and adult tissues (Yamamoto et al., 2004)
- Data regarding the intrinsic function of the AhR in healthy reproduction (Baba et al., 2005)
- Data regarding the intrinsic structure and binding affinity of the human AhR compared to the AhRs in laboratory rodents used as the basis for risk assessment (Connor and Aylward, 2006)
- Data regarding the expression of key, early biological responses to binding to the AhR in humans and rodents (Guzelian et al., 2005)
- Studies of potential health effects in highly and moderately exposed human populations (for example, Bacarelli et al., 2005)
- Data regarding measured body burdens in adults in the Study Area from the UMDES in the context of current and historical data on body burdens in the general U.S. population and in the context of exposed study groups from other areas

Data-derived Uncertainty Factors for Generation of Reference Doses

Appropriate uncertainty factors will be identified and applied to the points of departure identified from the available human or animal data to derive safe intake levels for adults (to prevent maternal body burdens exceeding levels that are safe for infants exposed *in utero* or through breast feeding) and safe childhood exposure intake rates. This will take advantage of the increased knowledge of inter- and intraspecies sensitivity, mechanisms of action, and detailed evaluation of databases to develop "data-derived" uncertainty factors that result in better overall confidence in the risk assessment. USEPA and Health Canada have employed such techniques to support the selection of uncertainty factors other than the default value of 10 (Dourson et al., 1996; Pelekis et al., 2003; Dorne and Renwick, 2005; WHO, 2005). In such cases, the types of data that are used to support a change in the default value would be explicitly reviewed to determine why the data support a different uncertainty factor, how the uncertainty is reduced, and what assumptions have been satisfied or replaced.

6.5.3 Toxicity Equivalency Factors for PCDD/Fs

The HHRA proposes to evaluate risks for PCDD/Fs using the WHO (2005) TEF values recently updated by the WHO-IPCS committee (van den Berg et al., 2006) to comply with

Part 201 regulatory requirements. As stressed by that committee and by the NAS committee (NAS, 2006) the use of these TEFs can only by justified for dietary exposures, so their use in assessing risks from non-dietary exposures must be done carefully, if at all. Further, there are substantial uncertainties inherent in the TEF values that need to be taken into account (Finley et al., 2003; Haws et al., 2006; van den Berg et al., 2006; NAS, 2006). The use of the WHO (2005) TEFs without such scrutiny would not reflect utilization of the best information in the HHRA. Therefore, the HHRA will incorporate a thorough review, discussion and presentation of the variability and uncertainty (as well as their underlying and supporting relative potency [REP] factors) of the TEFs that are of principal importance in the Study Area. Applying the best science and information into the HHRA will be of prime consideration throughout the process and validated by use of ISAPs.

For Midland, the TEQ-contributing congeners are predominantly dioxins (specifically, TCDD and 1,2,3,7,8-PeCDD) with 4-PeCDF being the one furan contributing significantly. Since the toxicity of the non-TCDD congeners is conventionally estimated from the toxicity of TCDD by use of the TEFs, any bias or uncertainty in such TEFs will contribute directly to the overall bias and uncertainty of the HHRA. Uncertainty enters into the picture through the uncertainty in the derivation of the TEFs, and also when rodent or other data are extrapolated to humans since it is largely unknown if the same relative potencies for PCDD/Fs found in rodent or other studies apply to humans. The TEFs presented by van den Berg et al. (1998) were based on a subjective evaluation of multiple end points measured in many organisms or experimental systems, notably excluding (because data were not available) the end points and organisms that are of direct interest in a risk assessment. The values presented by van den Berg et al. (2006) also are somewhat subjective, although objective initial selections were made. The subjectivity and the lack of rigorous mathematical and statistical analyses in developing the WHO TEFs is a problem with the use of these values in risk assessment. For any particular congener, there is a substantial variation in the values of REP obtained for different experimental systems, a variation that translates into a substantial uncertainty in the value of the TEF that is most representative of potential human toxicity for various end points. The WHO (1998) committee selected point estimates based on the multiple REP values available, using a subjective system and acknowledging the large uncertainties. Finley et al. (2003) illustrated the large uncertainties involved, and demonstrated how the original data used by the WHO committee could be used to define uncertainty distributions for TEFs, hence potentially leading to an objective estimate for TEFs.

The WHO-IPCS committee made several suggestions for improvement of the process used to estimate or use TEFs, including the use of probabilistic methods advocated by Finley et al. (2003) and Haws et al. (2006) and the evaluation of systemic (body burden based, or tissue concentration based) TEFs in addition or alternatively to the current system based on intakes. The committee also considered the possibility of using (even for the derivation of the WHO 2005 system) a weighted version of the REP distribution to set a single TEF value, but it decided that it would require more effort than was available to obtain a consensus on weighting methodology and method of selection of the point value. In addition, neither the WHO–IPCS committee nor Haws et al. (2006) re-evaluated the REPs given in literature sources (or derived internally in 1998) to ensure that they were consistently, systematically and correctly derived.

The NAS Committee (NAS, 2006) examined the use of TEFs and, while agreeing "that the TEF method is reasonable, scientifically justifiable, and widely accepted for the estimation of the relative toxic potency of TCDD, other dioxins, and DLCs" (NAS, 2006; p 14), did point out various shortcomings, including the necessity of careful evaluation before applying the intake-based TEFs to body-burden-based measures of toxicity ("it remains to be determined whether the current WHO TEFs, which were developed to assess the relative toxic potency of a mixture to which an animal is directly exposed by dietary intake, are appropriate for the assessment of internal TEQ concentrations and potential toxic effects" [NAS, 2006; p. 67]). However, the NAS Committee specifically recommended "[US]EPA should acknowledge the need for better uncertainty analysis of the TEF values and should, as a follow-up to the Reassessment, establish a task force to begin to address this uncertainty by developing 'consensus probability density functions' for TCDD, other dioxins, and DLCs" (NAS, 2006; page 14). The NAS committee recommendation could eliminate some of the concerns raised by the WHO-IPCS committee on the use of TEF in risk assessment involving contaminated soils and sediments and application of TEFs to body burden-based assessments (van den Berg et al., 2006). In particular, the NAS Committee recommended, "that USEPA clearly address TEF uncertainties in the Reassessment." In a related activity, a recent ToxForum workshop discussed issues related to TEFs with discussion identifying the problems and future directions needed for improving TEFs and their application (Budinsky, 2005)

TEFs are required under the Part 201 regulations for characterizing exposure and risk for the 2,3,7,8-chlorinated PCDD/Fs other than 2,3,7,8-TCDD. However, currently available TEFs do not always represent the best information for scientifically assessing the risk from exposure to these PCDD/Fs. Current TEF values for the PCDDs/Fs generally represent a fairly conservative deterministic estimate of relative potency based on a wide range of relative potency factors derived from the available toxicological studies comparing specific PCDD/Fs to TCDD. These relative potency factors can represent a diverse collection of endpoints, some related to toxic end points, and some not. Furthermore, the TEF estimates are not currently derived using robust criteria, dose-response modeling or statistical assessments. The lack of objective criteria, dose-response modeling and statistical assessment undermines the scientific validity of TEFs for accurately depicting risks from exposure to PCDD/Fs mixtures. It could be argued that relative potency estimates from specific studies are in fact superior to the TEF estimate for a specific PCDD/Fs congener. The TEF values can be considered expedient but not necessarily the best science or the best information for conducting a HHRA. In particular, because of the importance of the two furan congeners (TCDF and 4-PeCDF) to the Study Area, and the available scientific information available on both congeners, it is necessary to thoroughly evaluate this information to provide "best information" in the risk assessment.

6.6 Risk Characterization

In the risk characterization, quantitative exposure estimates and toxicity factors will be combined to calculate numerical estimates of potential health risk. In this section, potential cancer and noncancer health risks will be estimated assuming long-term exposure to CoPCs Study Area media. The risk characterization approaches applied in MDEQ cleanup criteria and used in USEPA guidance will be applied as appropriate to calculate potential RME and typical excess lifetime cancer risks for carcinogens and hazard indices for contaminants with

noncancer health effects. These methods to be used in both the SLRA and the PRA are described below.

6.6.1 Cancer Risk

Quantifying total excess cancer risk requires calculating risks associated with exposure to individual carcinogens (summed across pathways of exposure) and aggregating risks associated with simultaneous exposure to multiple carcinogenic CoPCs. Of course, consideration of additional chemicals in the cancer risk assessment is dependent on what is found in the TAL analyses and eliminated in the SLRA. A cancer risk estimate for a single carcinogen will be calculated by multiplying the lifetime average daily intake of the contaminant by its carcinogenic slope factor:

Excess lifetime cancer risk = Intake x Cancer slope factor

Cancer risks are assumed to be additive, so risks associated with simultaneous exposure to more than one carcinogen in a given medium can be aggregated to determine a total cancer risk for each exposure pathway. However, exposure and risk *estimates* are not necessarily additive; this is true for the exposure and risk estimates obtained in the SLRA, since they are all upper bound estimates. Thus risk estimates obtained in the SLRA will not be summed across pathways or chemicals, but used solely to select pathway/receptor combinations for inclusion in the PRA. Exposure estimates obtained in the PRA will be additive, so they will be summed across pathways to produce total exposure estimates for each receptor; risk estimates from these total exposures may then be obtained by multiplying by cancer slope factors (although strictly a probabilistic product is required to maintain the correct probability interpretations).

For the SLRA cancer risk estimates, the likelihood that actual risks are greater than estimated risks is very low because of the conservative assumptions used to develop both exposure and cancer slope factor estimates; in fact, actual risks may be significantly less than predicted values and may be zero. USEPA's *Guidelines for Cancer Risk Assessment* state "…the linearized multistage procedure (typically used to calculate CSFs) leads to a plausible upper limit to the risk that is consistent with proposed mechanisms of carcinogenesis…The true value of the risk is unknown, and may be as low as zero" (51 FR 185:33992, 33998). For the PRA, if a probabilistic approach is used for the cancer slope factor, the known uncertainties will all be incorporated in the estimates, so the degree of conservatism may be chosen. There will still be uncertainties due to lack of knowledge, and they will be described in the uncertainty assessment (Section 6.7). With a deterministic cancer slope factor applied in the PRA, however, the risk estimates at any given percentiles of the distributions obtained will all be upper bounds, since the deterministic CSF is itself an upper bound.

6.6.2 Noncancer Risk

Intakes of a given CoPC by various pathways may be additive, although once again exposure estimates may not be (and in particular, SLRA exposure estimates are not additive). A hazard quotient (HQ) less than 1 for a given CoPC implies that exposure is below a level that is expected to be free of any deleterious effect with high probability. An HQ greater than 1 does not necessarily mean that an effect would occur; rather that

exposure may exceed a level that calls for more investigation of potential health effects in sensitive populations. Exposures resulting in an HQ less than or equal to 1 are very unlikely to result in noncancer adverse health effects. USEPA states that the range of possible uncertainty around RfDs is "perhaps an order of magnitude" (USEPA, 2006).

Because the SLRA intake estimates are not additive, HQs for individual CoPCs will not be summed across pathways. Instead, the values for each pathway will be used to determine whether to evaluate that pathway more fully in the PRA. Intakes estimates evaluated in the PRA will be additive, so will be added across pathways to evaluate a total hazard index for each CoPC. If the RfD estimates are derived deterministically, they are lower bounds, so the resultant distributions of HQ will all be upper bounds; but if the RfD estimates are evaluated probabilistically, the HQ distributions will have probabilistic interpretations (subject, as always, to the unknown uncertainties to be listed in the uncertainty evaluation)

6.6.3 Screening Level Deterministic Risk Assessment

As described in Section 6.1.1, all potentially complete exposure pathways will be evaluated in the SLRA. The SLRA will be conducted to determine which require more thorough evaluation, which ones can be eliminated completely from further consideration because their contribution to potential risk is negligible (lifetime carcinogenic risk estimate less than 10^{-7}, or HI less than 0.001), and which ones will be incorporated in further refinement using screening level methods because their contribution is minor (lifetime carcinogenic risk estimate less than 10^{-6}, or HI less than 0.01).

6.6.4 Probabilistic Risk Assessment

Methodology

PRA generally characterizes and describes variability and uncertainty, as opposed to deterministic or point-estimate methods of assessing that generally can only be used to evaluate bounding estimates of risk. Therefore, following discussions with MDEQ, the HHRA proposes to use PRA as appropriate to inform risk decisions. The PRA will be carried out using the Monte Carlo methodology based on selection of random individuals in a (synthetic) population designed to match the whole population of individuals ("receptors") potentially exposed to CoPCs in site media now or in the future, or some specific subset of that population defined by their characteristics. These specific subsets include the resident or worker populations described above. The algorithms given in previous sections allow calculation of dose rates during exposure and an effective lifetime average dose rate for the selected individual (and any other dose metric may also be computed from the dose rate and characteristics of the individual). For any individual, however, any or all the terms (for example, body weight, soil ingestion rate) in these algorithms are likely to be uncertain, and that uncertainty is measured by the uncertainty distributions associated with each term.

The Monte Carlo methodology takes into account such uncertainty by sampling multiple times from the uncertainty distributions for all the terms. On each (uncertainty) iteration of the Monte Carlo procedure the uncertainty distribution for each of the terms in all the algorithms applicable to any calculation of dose is sampled to obtain a value (it may be necessary to also incorporate other characteristics of the individual, such as age and

location, that do not explicitly appear in the algorithms but may affect the selection of random values for the terms), and all the calculations of doses performed to obtain one estimate in the uncertainty distribution for dose which, when combined with a toxicity estimate provides one estimate in the uncertainty distribution for risk. Sufficient repetition of this procedure allows evaluation of the uncertainty distribution for doses and risks, building them up one-by-one from those estimates.

Each term in the algorithms may, however, also vary between individuals. The variability of individual terms is measured by the variability distributions calculated for each such term. Any particular individual is then distinguished by the characteristic set of values for all those terms (and possibly other characteristics, like age and location, that do not appear explicitly but may affect the distributions for each term). Variability is also handled by a Monte Carlo procedure either wrapped around or packaged within the Monte Carlo procedure for uncertainty. On each of the variability iterations, some individual is selected by random sampling from the variability distributions for the characteristics of that individual (taking account of any correlations between the characteristics sampled); and the characteristics of the individual are, in most part, just the terms of the algorithms (there may be other characteristics that affect the terms). For each selected individual, a dose and risk estimates are calculated using the algorithms; and the whole procedure is repeated many times to build up a picture (variability distribution) of how the dose varies between individuals in the population.

The usual approach for this two-dimensional type of Monte Carlo procedure, and which will be used here, is to perform the variability loop inside the uncertainty loop. That way, a set of values is selected from the uncertainty distributions, then the complete variability distribution describing how doses or risks vary across the population may be obtained using a one-dimensional Monte Carlo procedure; and population parameters (like expected values of dose, or the total expected number of effects in the population) may be obtained by integrating over the variability distribution (summing over the selected synthetic individuals). Repeating the procedure multiple times builds up an uncertainty distribution for the variability distribution and the uncertainty distribution for the derived population parameters.

In the PRA, the uncertainty and variability distributions for each exposure term will be evaluated as described in the preceding sections, keeping track of any correlations between the various distributions (there may even be correlations linking the uncertainty and variability distributions; for example, the parameters describing an uncertainty distribution may depend on the parameters describing the variability distribution for the same term).

The Monte Carlo algorithm for the combined uncertainty and variability analysis can then be summarized, using a simple pseudo-computer-language in which each pair of braces {} indicates a block of operations, as:

Repeat a large number of times: (start of outer, uncertainty, repetition)

- Choose a sample from the uncertainty distribution for each term in the algorithms, taking account of correlations

Repeat a large number of times (start of inner, variability, repetition)

- Choose a sample from the variability distribution of each term in the algorithms taking account of correlations
- Calculate the corresponding sample value for dose rate, any other required dose metric, and risk
- Calculate any required averages of dose rates (such as lifetime average dose rate) or other dose metrics (such as body burdens)
- Store the calculated values

(end of the inner repetition)

From the stored values, construct the variability distributions for average dose rates, other dose metrics, and risks.

- Calculate population averages from the variability distribution
- Store the variability distribution (for example, store a set of percentiles of the distribution), and the population averages

(end of outer repetition)

From the stored variability distributions for average dose rates, construct the uncertainty distribution for those distributions (for example, construct the uncertainty percentiles for each stored variability percentile), and for the stored population averages.

- Calculate any desired averages over the uncertainty distributions
- Print out the results in a convenient way and interpret them

Probabilistic Risk Assessment Means to Present Findings

The results of the probabilistic methodology are distributions of results, the distributions showing both variability and uncertainty. Risk estimate results will be presented using graphs of the cumulative distributions, graphs of (smoothed versions of) the differential distributions, and tables showing percentage points of the distributions. Results will be presented for individuals (variability and uncertainty distributions) and for the population as a whole (uncertainty distributions) – the population values are obtained by integrating over the variability distributions. The risk assessment output useful to risk managers will be presented.

6.7 Uncertainty Assessment

The uncertainties present in any HHRA are of at least three forms—uncertainties that are known to exist, and whose size can be estimated; uncertainties that are known to exist, but whose size cannot be estimated; and unknown uncertainties. To the extent possible, the first category has been incorporated in the SLRA (but using upper bound values) and in the probabilistic assessment (using distributions of values). This section of the HHRA will discuss the uncertainties that are known to exist but that are of unknown size, indicating why they are known to be uncertainties, whether anything is known about the direction and

size of the uncertainty, and any potential effect on the HHRA. Uncertainties related to exposure assumptions, toxicity assumptions and risk characterization will be addressed.

TABLE 6-1
Potential Information that May be Gained by an Activity Survey
Midland Area Soils Remedial Investigation Work Plan

Presence or absence of young children (except noncontact presence) in the Study Area
Recreational time spent in the Study Area by children/teens
Numbers of children/teens visiting recreational areas throughout the year
Direct observation of soil contact behavior by children in the Study Area
The fraction of the year with children/teens/adults performing activities with the potential for direct soil contact
Types of clothing (including footwear) observed throughout the year in residential and recreational areas and during residential and recreational activities

TABLE 6-2
Proposed Types of Information from the UMDES to be Applied in the HHRA
Midland Area Soils Remedial Investigation Work Plan

Question(s) or Derived Results	**Summary of Information, and Potential Inferences (Other Information or Assumptions may also be Necessary)**
AA1; A1	Age and sex distribution.
A3; A4; BMI	Height, weight, BMI distribution. Height vs. weight distribution.
B1	Years lived in Midland County, Saginaw County, or Williams Township in Bay County. Residence period in local neighborhood.
B4b2-B4b1	Number of years in current residence. Distribution of residence periods.
C3	Vegetable gardens identified by participants. Distribution of period eating homegrown vegetables.
C5; C6; C6a	Current vegetable/flower garden present. Fraction of population actively using garden.

TABLE 6-5
Summary of Mean Exposure Estimates for all Pathways Evaluated
Midland Area Soils Remedial Investigation Work Plan

Mean Estimate (mg/kg-day)	Pathway
2.3E-09	Eggs_C: Consumption of eggs
1.8E-09	Eggs_A: Consumption of eggs
1.5E-10	Milk_C: Consumption of dairy products
1.2E-10	Milk_A: Consumption of dairy products
4.3E-11	Fish_C: Consumption of sport-caught fish
3.9E-11	Fish_A: Consumption of sport-caught fish
1.8E-11	Hunt_A: Consumption of wild game
1.6E-11	Hunt_C: Consumption of wild game
6.8E-12	Teen: Soil contact (muddy hands)
6.6E-12	Meat_A: Consumption of farm-produced meat
6.3E-12	Meat_C: Consumption of farm-produced meat
6.2E-12	child: Soil contact (muddy hands)
3.6E-12	Worker: Soil ingestion
3.1E-12	Fish_A: Soil contact (muddy feet)
3.1E-12	Hunt_A: Soil contact (muddy hands)
2.5E-12	Res_C: Soil ingestion
2.5E-12	teen: Soil ingestion
1.7E-12	teen: Soil contact (regular)
1.6E-12	Worker: Soil contact
1.3E-12	Fish_A: Soil contact (muddy hands)
1.1E-12	Fish_A: Soil ingestion
8.0E-13	Res_A: Soil ingestion
7.7E-13	child: Soil ingestion
7.1E-13	Res_C: Soil contact
5.0E-13	Hunt_A: Soil ingestion
2.9E-13	Fish_A: Soil contact (regular)
2.4E-13	Recreate: Soil ingestion
2.1E-13	child: Soil contact (regular)
2.1E-13	Res_A: Soil contact
1.3E-13	Hunt_A: Soil contact (regular)
1.2E-13	Recreate: Soil contact (muddy hands)
6.3E-14	Recreate: Soil contact (regular)
0	All surface water pathways

TABLE 6-6
Summary of 99th Percentile Estimates for all Pathways Evaulated
Midland Area Soils Remedial Investigation Work Plan

95th Percentile Estimate (mg/kg-day)	Pathway
7.4E-09	Eggs_C: Consumption of eggs
5.4E-09	Eggs_A: Consumption of eggs
5.1E-10	Milk_C: Consumption of dairy products
3.6E-10	Milk_A: Consumption of dairy products
1.6E-10	Fish_C: Consumption of sport-caught fish
1.5E-10	Fish_A: Consumption of sport-caught fish
6.8E-11	Hunt_A: Consumption of wild game
5.8E-11	Hunt_C: Consumption of wild game
2.6E-11	teen: Soil contact (muddy hands)
2.4E-11	child: Soil contact (muddy hands)
2.0E-11	Meat_C: Consumption of farm-produced meat
1.9E-11	Meat_A: Consumption of farm-produced meat
1.4E-11	Worker: Soil ingestion
1.0E-11	Hunt_A: Soil contact (muddy hands)
1.0E-11	Fish_A: Soil contact (muddy feet)
8.9E-12	Res_C: Soil ingestion
7.8E-12	teen: Soil ingestion
6.3E-12	teen: Soil contact (regular)
6.1E-12	Worker: Soil contact
5.0E-12	Fish_A: Soil contact (muddy hands)
4.3E-12	Fish_A: Soil ingestion
3.0E-12	child: Soil ingestion
2.5E-12	Res_A: Soil ingestion
1.9E-12	Hunt_A: Soil ingestion
1.8E-12	Res_C: Soil contact
1.0E-12	Fish_A: Soil contact (regular)
9.0E-13	Recreate: Soil ingestion
7.6E-13	child: Soil contact (regular)
5.0E-13	Res_A: Soil contact
4.5E-13	Recreate: Soil contact (muddy hands)
4.5E-13	Hunt_A: Soil contact (regular)
2.1E-13	Recreate: Soil contact (regular)
0	All surface water pathways

TABLE 6-7
Overview of Noncancer Toxicity Criteria
Midland Area Soils Remedial Investigation Work Plan

Organization	Value	Toxicity Study/Endpoint	Comment
Great Lakes Acceptable Daily Exposure (ADE) (1995)	1.3 pg/kg/d	Bowman et al. (1989). Reproductive toxicity in rhesus monkeys.	Estimate of maternal intake rate of 0.13 ng/kg/d NOAEL, interspecies and intraspecies uncertainty factors of 10 each for a total factor of 100.
ATSDR Minimal Risk Level (MRL) (1998)	1 pg/kg/d	Schantz et al. (1992). Neurobehavioral changes in offspring.	Estimate of maternal intake rate of 0.12 ng/kg/d LOAEL. Uncertainty factors of 3 for minimal LOAEL to NOAEL, 3 for interspecies extrapolation, and 10 for intraspecies sensitivity, for a total of 100.
WHO/FAO JECFA (2001) Provisional Tolerable Monthly Intake (PTMI)	70 pg/k/month (2.3 pg/kg/d)	Gray et al. (1997); effects on male rat reproductive system development following in utero exposure (decreases in sperm counts)	Background body burden in rats was accounted for in the evaluation. Dose metric used was maternal body burden after acute administration, adjusted for differences in distribution to fetus after chronic rather than acute administration. Committee judged that humans were likely to be no more sensitive than the most sensitive laboratory rodents to the effects of dioxin. Value was judged to be protective for carcinogenesis as well based on an assumed threshold mechanism. Total uncertainty factors were: 3.2 (inter-individual variability) * 3.2 (sensitive endpoint, considered close to a NOAEL for a marginal effect, LOAEL to NOAEL factor) * 1 (interspecies toxicokinetic factor because of use of body burden) * 1 (interspecies toxicodynamic factor, humans no more sensitive than most sensitive animal) = 9.6.
ECSCF (2001)	14 pg/kg/week (2 pg/kg/d)	Male rat reproductive system developmental effects	Similar to JECFA derivation.

TABLE 6-8
Developmental Endpoints Evaluated in Human Studies with Quantified Dioxin TEQ Exposures
Midland Area Soils Remedial Investigation Work Plan

Endpoint Description	Study	Dose Metric
Thyroid hormone alterations in infants	Koopman-Esseboom et al. 1994	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
	Pluim et al. 1993	Infant dioxin intake
	Nagayama et al. 1998	Infant dioxin intake
	Matsuura et al. 2001	Maternal serum lipid TEQ (estimated from human milk lipid concentration)
	Nagayama et al. 2004	Infant dioxin intake
	Wilhelm et al. 2006	Maternal serum lipid TEQ concentration; milk lipid TEQ concentration; Infant dioxin intake
Neurodevelopmental effects	Huisman et al. 1995	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration)
	Lanting et al. 1998	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
	Patandin et al. 1999	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
	Ilsen et al. 1996	Infant dioxin intake
	Wilhelm et al 2006	Maternal serum lipid TEQ concentration; milk lipid TEQ concentration; Infant dioxin intake
Infant growth and development	Ilsen et al. 1996	Infant dioxin intake
	Pluim et al. 1996	Infant dioxin intake
	Patandin et al. 1998	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
Platelet alterations in infants	Pluim et al. 1994	Infant dioxin intake
Lymphocyte subset alterations	Nagayama et al. 1998	Infant dioxin intake
	Weisglas-Kuperus et al. 1995	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
	Kaneko et al. 2006	Maternal serum lipid TEQ (estimated from human milk lipid concentration)

TABLE 6-3
Exposure Assumptions for Residents' and Workers' Incidental Ingestion of Soil
Midland Area Soils Remedial Investigation Work Plan

Exposure Terms	Receptors		
	Child Resident (ages 1-6)	**Adult Resident**	**Adult Worker**
IR_S - Soil ingestion (mg/day)	200 mg/day	100 mg/day	100 mg/day
EF – Exposure frequency (days)	350 days	350 days	245 days
ED - Exposure duration (years)	6 years	24 years	21 Years

Source MDEQ Part 201 Rule R 299.5720

TABLE 6-4
Exposure Assumptions for Residents' and Workers' Dermal Contact With Soil
Midland Area Soils Remedial Investigation Work Plan

Exposure Terms	Receptors		
	Child Resident (ages 1-6)	**Adult Resident**	**Adult Worker**
SA – Skin surface area (cm^2)	2,670 cm^2	5,800 cm^2	3,300 cm^2
EF – Exposure frequency (days)	243 days	243 days	160 days
AF – Soil adherence factor (mg/cm^2)	0.2 mg/cm^2	0.07 mg/cm^2	0.2 mg/cm^2 (industrial and commercial)
ED – Exposure duration (years)	6 years	24 years	21 Years

Source MDEQ Part 201 Rule R 299.5720

TABLE 6-8
Developmental Endpoints Evaluated in Human Studies with Quantified Dioxin TEQ Exposures
Midland Area Soils Remedial Investigation Work Plan

Endpoint Description	Study	Dose Metric
Other immune system endpoints	Weisglas-Kuperus et al. 2000	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
	Weisglas-Kuperus et al. 2004	Maternal serum lipid TEQ concentration (estimated from milk lipid concentration); Infant dioxin intake
ALT and AST alterations	Pluim et al. 1994; Ilsen et al. 1996	Infant dioxin intake
Developmental dental enamel anomalies	Alaluusua et al. 2004	Peak childhood body burden of TCDD
Age at puberty	Warner et al. 2004	Peak childhood body burden of TCDD
Menstrual cycle characteristics	Eskenazi et al. 2002	Peak childhood body burden of TCDD
Existing reviews of these data will be utilized (for example	Schantz et al. 2003; Giacomini et al. 2006) to streamline this process where appropriate.	Existing reviews of these data will be utilized (for example

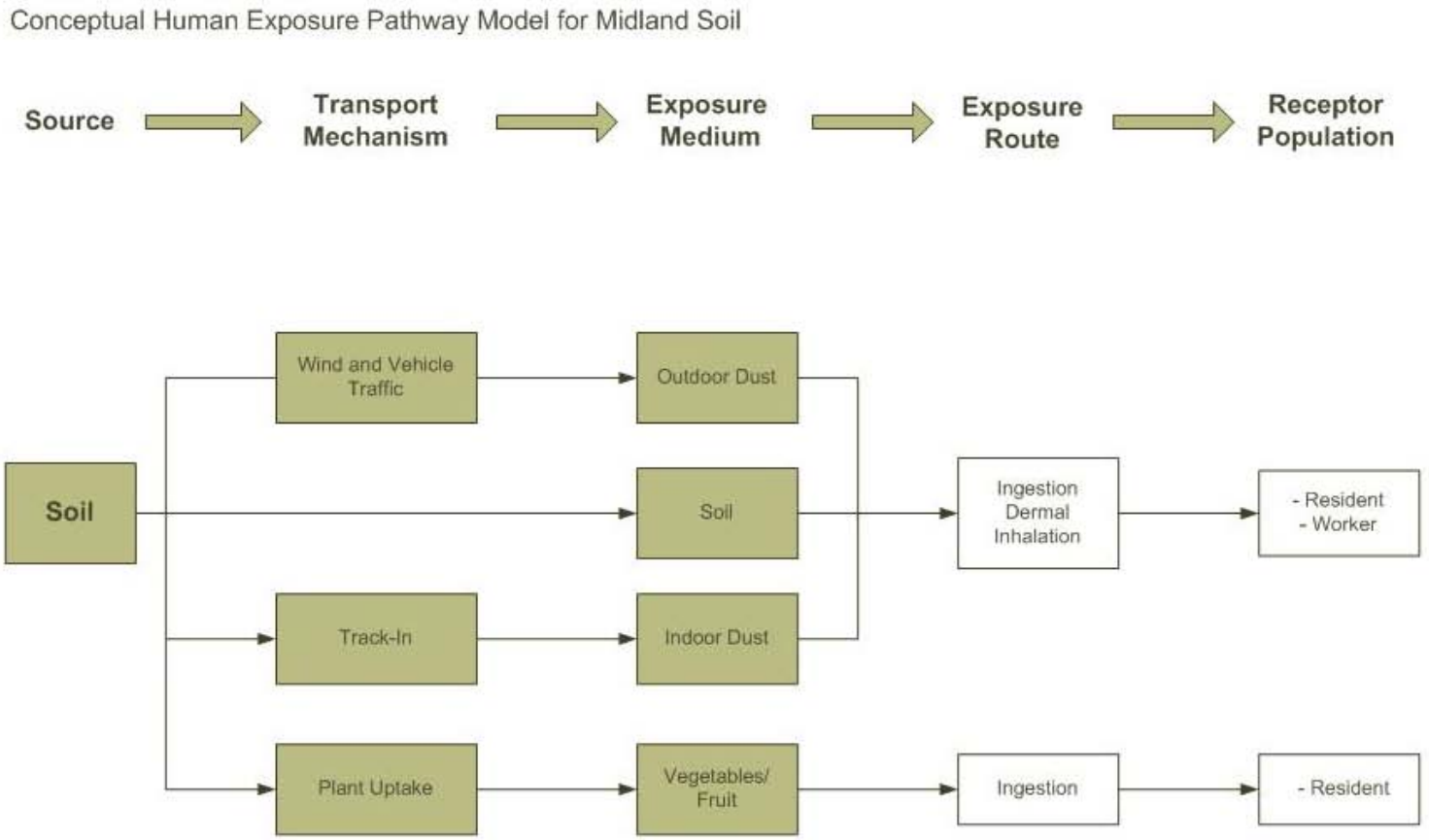
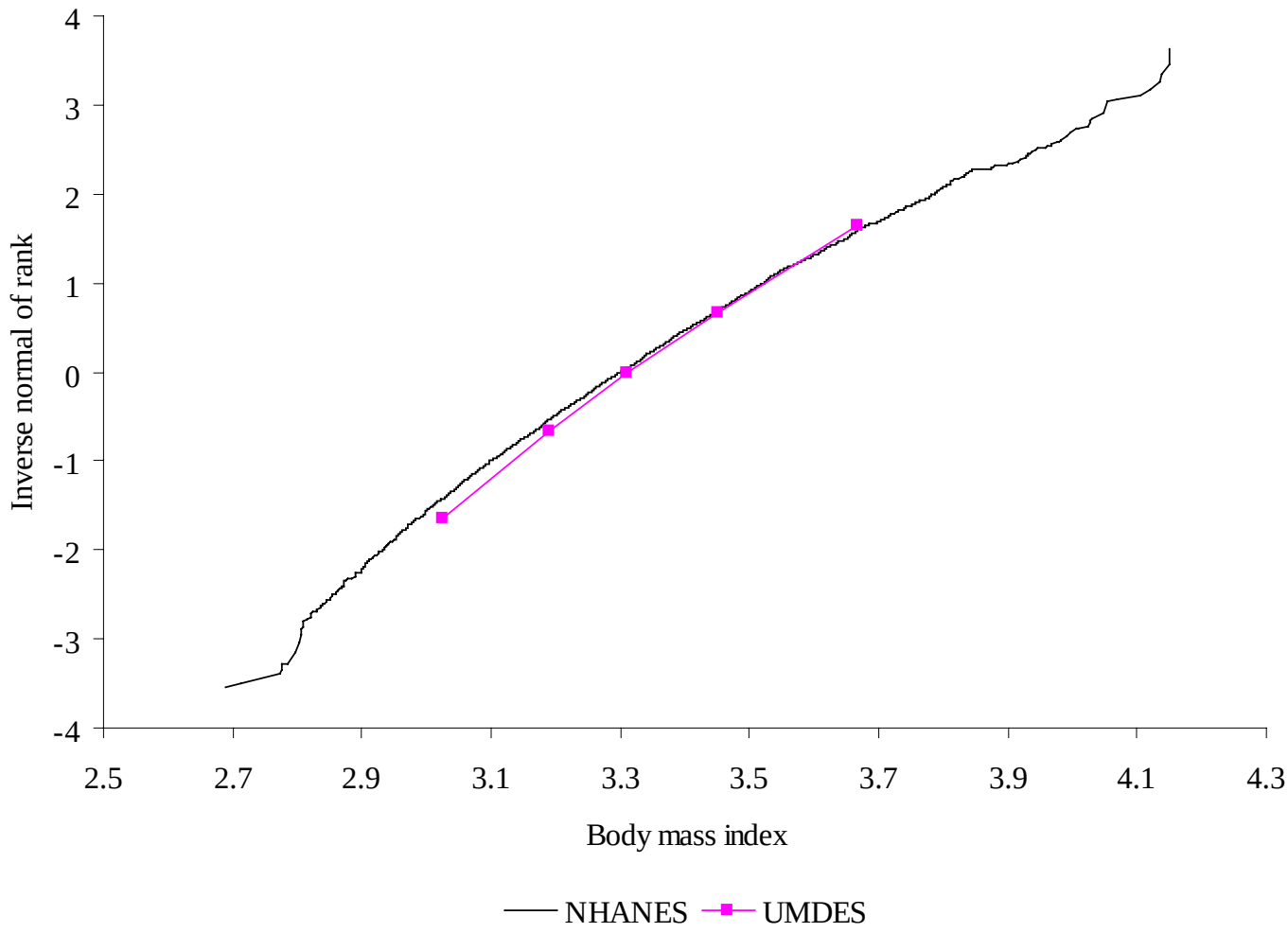


Figure 6-1
Conceptual Human Exposure Pathway Model for Midland Area Soils
Midland Area Soils Remedial Investigation Work Plan



Body mass index observed in NHANES (2003-2004) for the 18+ population (weighted), and in the UMDES study (weighted).

Figure 6-2
Distribution of Body Mass Index for the U.S. Population
Midland Area Soils Remedial Investigation Work Plan

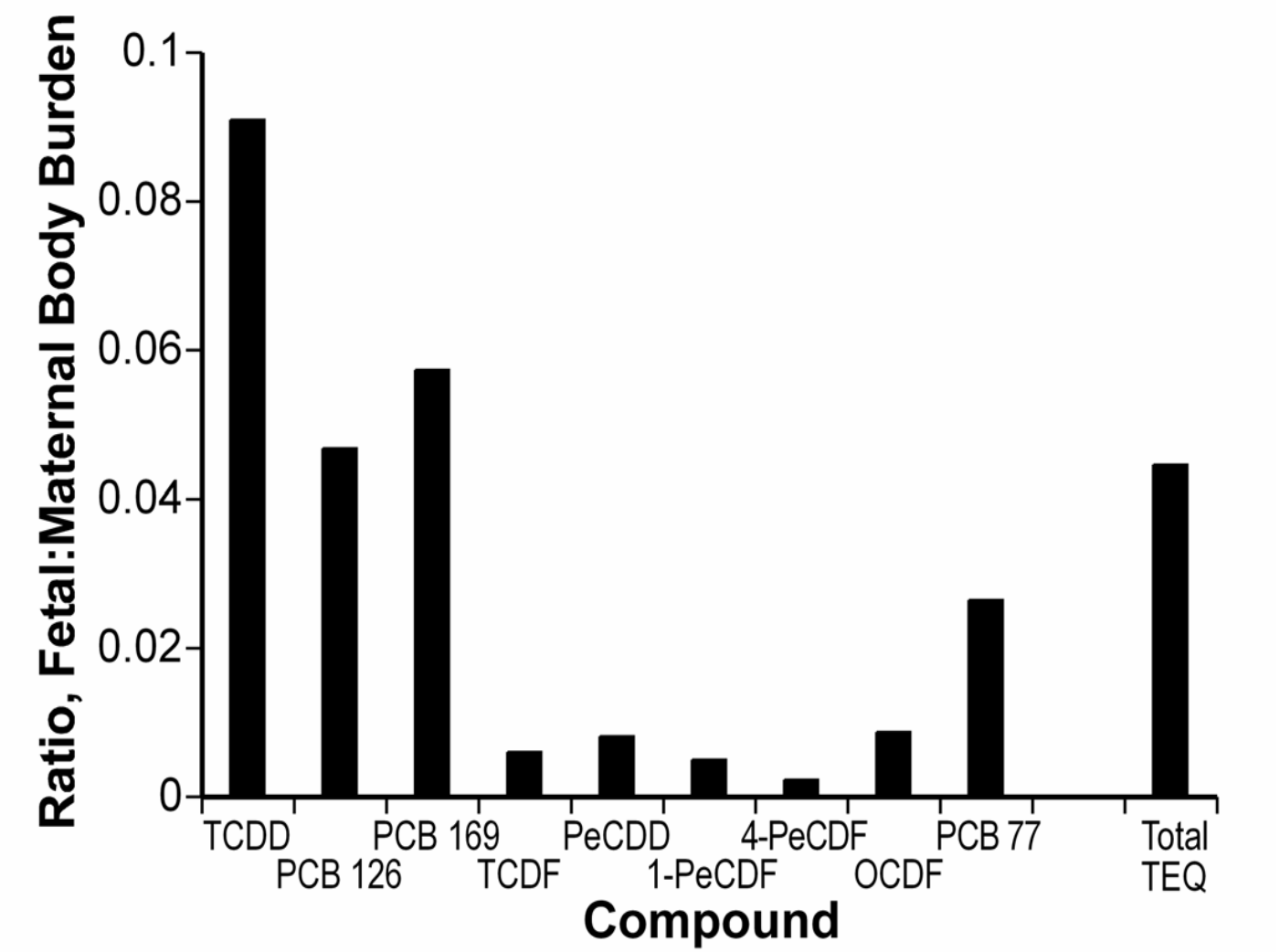


Figure 6-3
Ratio of Fetal to Maternal Body Burden of Dioxin-Like Compounds in a Rat Mixture Study
Midland Area Soils Remedial Investigation Work Plan

Source - *Data from Chen et al., 2001; figure from Aylward et al., 2005*

SECTION 7

Ecological Risk Assessment

7.1 Introduction

As described in Section 1, the Study Area for the Midland Area Soils RI does not overlap with the Tittabawassee River Study Area, which is addressed in a separate RIWP. Thus, the portion of the Tittabawassee River Study Area adjacent to and downstream of the Midland Plant is excluded from this RI, and thus this ERA. In addition, potential offsite migration of hazardous substances from the Midland Plant via groundwater or windblown dust is being addressed by onsite corrective action activities, as detailed in Section 1.1. As a result, the focus of this ERA is limited to soil-based exposure pathways to terrestrial wildlife inhabiting the Study Area.

An ERA will be conducted to characterize COPECs that may be present in soils of the Study Area relative to risk posed to terrestrial based wildlife inhabiting these areas. As described below, the Midland Area Soils ERA will follow a tiered approach with multiple decision points.

This work plan is based upon USEPA ERA guidance (USEPA, 1997; USEPA, 1998; USEPA, 1999a; USEPA, 2001a and 2001b), applicable state regulatory guidance including Part 201 of Act 451, and the conditions of the License. Although the Study Area is not a Superfund site, the general proposed approach for this ERA will follow USEPA ERA guidance for Superfund (USEPA, 1997) because this guidance is detailed and well accepted among ecological risk assessors. The eight-step process within the USEPA ERA guidance for Superfund sites is designed to focus resources on key chemicals, pathways of exposure, and receptors and to eliminate from further consideration those chemicals, pathways, and receptors that are not at risk.

The SLERA will be used to identify COPECs, potential receptors, and potential exposure pathways. This will entail the use of existing data to develop descriptions of the environmental settings, habitat characteristics, and the presence of potential wildlife receptors. Available GIS data will be used to consider factors such as land use, tree cover, and size of contiguous suitable habitat areas. This information can be combined with knowledge of minimum habitat requirements and known presence of potential receptors to develop potential ecological exposure pathways that are relevant to the Study Area. In addition, available data for chemicals in Midland area soils will be compared to screening level ecological benchmarks to identify COPECs. The decision point that is reached at the conclusion of the SLERA will consider if there is sufficient potential for harmful exposure of receptors to COPECs to continue further evaluations in a BERA.

The first tier of the BERA builds upon the study of both the terrestrial and aquatic food webs in the Tittabawassee River Study Area that has been undertaken to understand the relationships between potential stressors and receptors of concern. The Tittabawassee River Study Area assessment is designed to gain an understanding of food chain transfer and effect levels, specifically for furans and dioxins. When established, these congener-specific

relationships will also apply to the wildlife habitat and receptors that are present in the urban landscape of Midland. Application of the effects levels determined in the Tittabawassee River Study Area assessment will take into consideration the uncertainties associated with current TEFs and the different congener distributions for the Tittabawassee River Study Area relative to the Midland Study Area. Overall, the Midland Study Area is expected to provide less ecologically diverse wildlife populations than the Tittabawassee River Study Area. Therefore, the issues related to ecological risk in Midland are expected to be similar to those in the Tittabawassee River Study Area. Following the application of the Tittabawassee River ERA findings to the Midland Study Area, there may be sufficient information to proceed with risk management decisions. However, if the remaining uncertainty is too great to support risk management decisions, then the second tier of the BERA would proceed to develop and implement site-specific studies of unique COPECs, receptors, or exposure pathways within the Study Area.

7.2 Screening Level Ecological Risk Assessment

As specified by USEPA guidance, the first step in the ERA process is a screening-level or Tier I ERA in which the objective is to identify and document conditions that do *not* warrant further evaluation in a more refined BERA. As defined by USEPA, a SLERA is a simplified risk assessment that can be conducted with limited data where site-specific information is lacking and assumed values are used to evaluate potential exposure and effects (USEPA, 1997). For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists, that is, the technique assures that the probability of a Type II error (false negative) is very low. Thus, for exposure and toxicity or effect parameters for which site-specific information is minimal, assumed values, such as area use and bioavailability, should be consistently biased in the direction of overestimating risk. This ensures that sites that might pose an ecological risk are studied further; that is, a SLERA is deliberately designed to be protective in nature, not predictive of effects.

7.2.1 SLERA Purpose and Scope

The overall purpose of this portion of the RIWP is to present the approach for conducting a SLERA for the Study Area. While the scope of these SLERA evaluations are confined to the Study Area, the approaches and methodologies outlined in this RIWP also are being used to evaluate COPECs that may be present in the Tittabawassee River Study Area, downriver of Midland. Results from this SLERA will be used for the following:

- Provide a rational basis and documentation for retention of COPECs for further consideration
- Provide a rational basis and documentation for exclusion of other potential contaminants from further consideration
- Provide a rational basis and documentation for evaluation of habitat and receptor presence in the Study Area
- Make objective decisions on whether there is the potential for unacceptable risks to the environment presented by COPECs in the soils and biota of the Study Area

- Evaluate the need for further study or risk assessment for COPECs in the Study Area
- Focus any future data collection to fill relevant data gaps

7.2.2 SLERA Problem Formulation

In this phase of a SLERA, the study site is characterized by examining the habitat, species present and available chemical information. These pieces of information help to shape potential exposure pathways that will be preliminarily investigated in the SLERA. A significant purpose of the SLERA will be to identify COPECs, potential ecological receptors, and potential exposure pathways. In addition, the SLERA will be conducted to identify and document conditions that do *not* warrant further evaluation in a more refined BERA.

Development of Screening-Level Data Quality Objectives

The DQO process is a planning tool involving a series of steps designed to ensure that the type, quantity, and quality of environmental data used for decision-making purposes are appropriate for the intended application (USEPA, 2000a and 2000b). The DQO process, as defined by USEPA, is "...a strategic planning approach based on the Scientific Method that is used to prepare for a data collection activity. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the tolerable level of decision errors for study, and how many samples to collect." The preliminary questions to be answered in this phase of the SLERA are as follows:

- Is there a potential for ecological risk from contaminants in soil in this Study Area?
- What are the COPECs in the Study Area that should be considered in the BERA?
- What is the spatial distribution of these COPECs?
- What wildlife receptor species are present in the Study Area that are expected to be significantly exposed to COPECs and can be used in the BERA?

For the purposes of this SLERA work plan, it is assumed that all data used in the SLERA will be of adequate quantity and quality. In addition, it is assumed that the detection limits for analytes to be evaluated in media collected from the site are sufficient such that they allow for the evaluation of potential risk when compared to the appropriate benchmarks. If after a review of the data, deficiencies are identified, then further data collection may be undertaken or other means employed to more fully characterize exposures.

Environmental Setting and Habitat Characteristics

The Study Area encompasses approximately 11,620 acres and includes portions of the city of Midland and some surrounding agricultural land (Figure 7-1). The Tittabawassee River Study Area was excluded from the acreage calculations because it is being evaluated in a separate investigation. The Midland Plant area was also excluded. Using ArcGIS Spatial Analyst, user experience, and knowledge of biological systems along with aerial information, various habitats have been differentiated and quantified within the Study Area. The relative percentages of areas and acreages to be found within the Study Area are presented in Table 7-1. The information compiled in this analysis will be verified in the field as part of the Phase I RI.

While approximately 27 percent of the land in the Study Area is composed of residential land use types that may provide habitat opportunities, due to human disturbances and the fragmented nature of this habitat, it could be expected that less wildlife diversity exists at these locations. In addition, approximately 20 percent of the Study Area was classified as "no habitat," which includes industrial sites, commercial areas within the City of Midland, and impervious surfaces such as parking lots and roads. Again, these areas most likely contain marginal habitats that are not suitable for many wildlife receptors. The remaining portion of the Study Area consists of habitat types that include managed recreational land, such as parks; unmanaged recreational lands, such as forests; and agricultural land.

Overall, five major contiguous areas within the Study Area were identified using aerial photographs, field notes and ArcGIS (Figure 7-2). The total area of these five "contiguous" areas is approximately 3,800 acres, or 32 percent of the Study Area. The five contiguous areas range in size from 248 acres to 1,852 acres. In general, the northern third of the Study Area is largely residential and consists of roads, utilities, homes, and broken habitat. Those areas where contiguous habitat was observed are on the eastern, southern, and western portions of the Study Area (Figure 7-2). All other portions of the property are areas that are not considered part of this investigation (that is, Midland Plant, open water, river, floodplain).

Each of these habitat types (contiguous and noncontiguous) also is represented on the Tittabawassee River Study Area, where a comprehensive BERA is being conducted. In addition, there is a very diverse group of wildlife receptors present in the Tittabawassee River Study Area that includes or can be directly related to receptors found within the Midland Study Area. Thus, the Midland Study Area is expected to provide less ecologically diverse wildlife populations than the Tittabawassee River Study Area. Therefore, the issues related to ecological risk in Midland are expected to be similar to those in the Tittabawassee River Study Area.

Contaminants Known or Suspected to be at the Site

Historical information for the area under investigation is an important consideration when attempting to identify COPECs in environmental media. Data from the Pre-RI Study and Phase II RI will provide the basis for the COPEC evaluation. The SLERA will evaluate all chemicals on the TAL including dioxins and furans such that there is a consistent approach applied to identifying COPECs in the Study Area.

7.2.3 Screening Level ERA Analysis Phase- Exposure and Effects Assessment

During the analysis phase, exposure to stressors and the relationship between stressor concentrations and ecological effects are evaluated. Maximum concentrations in Study Area soils will be compared to corresponding media-specific conservative effects benchmarks in the SLERA. In the case where a benchmark is unavailable for a detected compound or the case where a compound is determined to have sufficient potential to be persistent and bioaccumulative, it may be necessary to generate estimates of exposure and or effects for receptors of interest as described in the following sections.

Screening Level Estimates of Exposure

For most COPECs, exposure to receptors will not be calculated during the SLERA, rather the maximum Study Area concentration in soil will be compared to an appropriate screening level benchmark. However, for some COPECs, the exposure pathways for ecological receptors may be considered based on the absence of suitable media specific conservative benchmarks. In order to estimate exposures when site-specific information is lacking, conservative exposure assumptions are made in order to minimize the chance of concluding there is no risk when risk may exist. These conservative assumptions include (1) ecological receptors are present within the contaminated area 100 percent of the time, (2) contaminants at the site are 100 percent bioavailable to biota, (3) the most sensitive life stage of the organism is being exposed to contaminants, and (4) the species in question feeds entirely upon the most contaminated food source. In addition to these assumptions, estimates of bioaccumulation, body weight, and ingestion rates are made in a conservative fashion in order to estimate exposure.

Exposure point concentrations of COPECs will be determined and compared to toxicity reference values (TRVs) in order to calculate the potential for adverse effects. In general, there are two primary approaches, dietary-based and receptor tissue-based, for assessing exposure and effects of persistent, bioaccumulative COPECs in wildlife assessments (Fairbrother, 2003; Millsap et al., 2004). The dietary-based method is the most widely used approach to assess wildlife exposure, ranging from simplistic to complex. In general, an average daily dose is calculated by food web modeling in which one makes assumptions regarding dietary composition, applies bioaccumulation models (if necessary), and utilizes concentrations of residues measured at lower levels of the food chain, soil, and sediment. In a SLERA, this can be based on very limited data and in many cases is based on default assumptions regarding dietary preferences, food ingestion rates, and other biological parameters. The exposure that is calculated from this dietary exposure-based approach can then be compared to dietary-based TRVs derived from dietary exposures.

When it is necessary to identify receptors for an exposure analysis, characteristics of key receptors will be presented in the SLERA, including exposure assumptions for body weight, ingestion rate, dietary composition, area use factor, etc. Exposure analyses will be conducted with receptor species selected from specific foraging guilds. The selected species within these foraging guilds will be those species that demonstrate high exposure tendencies relative to their exposure to soils. The primary source of exposure assumptions is the USEPA Exposure Factors Handbook (USEPA, 1993). Additional sources of information include primary peer-reviewed scientific literature, site surveys, and professional judgment, and other compendia of region-specific and species-specific information (Sample and Suter, 1994). Whenever available, site-specific and/or region-specific exposure information will be utilized. Exposure calculations will be conducted with exposure concentrations derived from measured concentrations of chemical stressors.

When appropriate and in addition to the dietary-based approach, exposure to some receptors for some COPECs may be evaluated based on tissue residue concentrations. For the SLERA, depending on the availability of concentration data, one of two different approaches will be used in this analysis. First, if tissue residue data are available for a specific receptor (for example, egg, liver tissue, etc.), these data will be compared to appropriate benchmark values or TRVs. The second approach will use soil concentration

data that has been modeled up into receptors of concern using literature-based bioaccumulation factors (Sample et al., 1998).

Screening Level Effects Assessment

The purpose of the effects assessment phase is to summarize available toxicological data, establish TRVs and benchmarks for COPECs for the SLERA, and present ecologically relevant field observations. Screening level benchmark values are chemical specific and can be either media specific (such as soils) or dose-specific (such as TRVs based on dietary exposure or tissue residue concentrations). In the absence of conservative media-specific screening benchmarks, the availability of both dietary exposure and tissue residue-based toxicological data will be evaluated for COPECs as needed and the limitations of these toxicity data discussed. This information will be utilized with exposure data to conduct the risk characterization.

In this step of the SLERA, the risk assessor determines, from a review of the scientific literature, the toxicity benchmark values that are protective of plants and animals present at the study site. It is important to note that these benchmarks are for screening purposes only and do not represent remedial action cleanup levels. For media-specific evaluations, the USEPA Region 5 RCRA ecological screening level benchmarks will be used as the default (USEPA, 2003b). However, the list of potentially applicable or suitably analogous toxicity benchmarks that will be evaluated in the event that a default benchmark is unavailable or otherwise inappropriate, such as for persistent bioaccumulative compounds, includes the USEPA Region 4 ecological screening values (USEPA Region 4, 2004), and the ecological soil screening levels (eco-SSLs) (USEPA, 2005b). Tissue concentrations reported in the scientific literature to be associated or potentially associated with toxic effects include the *Toxicological Benchmarks for Wildlife: 1996 Revision* (Sample et al., 1996) and the *Wildlife Toxicity Assessment Series* (Johnson et al., 2000).

In situations where chemical-specific toxicological benchmarks are not available for wildlife receptors of concern, TRVs will be derived from literature data. A TRV is a concentration of a chemical in water, food, or tissues of a receptor below which toxicological effects are not expected. Ideally, TRVs are derived from chronic toxicity studies in which a dose-response relationship has been observed for ecologically-relevant endpoint(s) in the species of concern, or a closely related species. As part of this process, it is essential to perform a critical evaluation of the applicability of the toxicological data to the site-specific receptors of concern and exposure pathways. TRVs derived in the same species are generally not available for the majority of wildlife receptors, and therefore, it is necessary to derive TRVs using toxicological data for surrogate species in combination with uncertainty factors (UFs). Uncertainty concerning interpretation of the toxicity test information among different species, different laboratory endpoints, and differences in experimental design, age of test animals, duration of test, etc., are addressed by applying UFs to the toxicology data to derive the final TRV.

In general, two approaches are used to estimate UFs, the modeled factor approach and the safety factor approach (Duke and Taggart, 2000). UFs used in the modeled approach are predictive while those used in the safety factor approach are protective. For this SLERA, the safety factor approach will be used to derive TRVs in that it treats all extrapolations in a conservative manner and reflects the amount of uncertainty in the extrapolations. Two

methodologies will be evaluated relative to selecting uncertainty factors, the procedures set out in the Great Lakes Initiative (GLI) (USEPA, 1995b) and the procedures outlined in the standard practice for wildlife TRVs from Johnson et al. (2000).

7.2.4 Screening-Level ERA Risk Characterizations Phase

Because the SLERA is designed to minimize chances of eliminating a COPEC from further consideration when it may pose an actual ecological risk, the maximum concentrations in soil and the lowest screening benchmarks will be used to identify COPECs and to characterize risk. Thus, the resulting risk calculation is expected to be an overestimate of actual risk and can not be used to derive remedial action cleanup levels (USEPA, 1997). From the available data, potential ecological risks can be estimated based upon a series of calculated HQs. In short, a HQ is calculated by dividing the estimated exposure dose or estimated environmental concentration (EEC) by a toxicity benchmark for each receptor (Eq. 7-1, Eq. 7-2).

$$HQ = \frac{\text{Dose}}{\text{Toxicity Benchmark}} \qquad \textit{Equation 7-1}$$

$$HQ = \frac{\text{EEC}}{\text{Toxicity Benchmark}} \qquad \textit{Equation 7-2}$$

Thus, if the HQ is greater than or equal to 1.0, the chemical will be retained as a COPEC, however if the HQ less than 1.0, this indicates that harmful effects are not likely and the chemical can be eliminated from further investigations. For COPECs that are retained for further evaluation, exposure pathways will be evaluated to determine which potentially significant exposure pathways require further evaluation. This evaluation will help focus resources to evaluate only those COPECs and exposure pathway combinations that exceed ecological screening benchmarks.

COPECs will be assessed by using measured concentrations in the Study Area soils. Pre-RI Study data and Phase II RI data, if collected, will be used to develop the initial list of site-related COPECs and to characterize background concentrations. COPECs will be evaluated by one or more of the following approaches:

(1) Compare maximum concentrations in the soils to corresponding media-specific conservative benchmarks

(2) If necessary, compare estimated exposure doses to TRVs for select receptors of concern

(3) If necessary, compare media-specific concentrations to background to determine potential non-site-related concentrations of COPECs (both natural and anthropogenic).

A decision tree for determining which COPECs are to be retained for further assessment will be developed. The main decisions are presented on Figure 7-3. Chemicals that exceed the ecological screening benchmarks or reported toxic doses will be carried forward as COPECs for further evaluation unless it is determined that the COPEC concentration at the

Study Area is less than the COPEC concentration at the reference area or is otherwise consistent with background levels.

7.2.5 Uncertainty in the SLERA

Because a SLERA is deliberately designed to be overly protective in nature, and not predictive of effects, it follows that there is a considerable amount of uncertainty associated with the results. Thus, to ascertain the confidence placed upon the SLERA, the potential sources of uncertainty will be evaluated within the context of the Study Area. For instance, assumptions made in estimating exposure for specific receptors will be identified and the magnitude and direction of the bias associated with each assumption will be described. For example, the exposure assumptions of 100 percent presence on a contaminated site may not be true for many species. Likewise, the assumption of 100 percent contaminant bioavailability may not be true for COPECs that are tightly bound to soils and sediments. Other sources of uncertainty to be addressed include the limitations of the data relative to understanding the spatial extent and representativeness of the samples relative to characterizing the site, uncertainty in regards to data analysis techniques, data availability, appropriateness of selected media specific benchmarks or TRVs and exposure model parameters, as well as the use of surrogate species data evaluate the potential risk to specific receptors found at the site. In addition, uncertainty and relative degree of overestimation or underestimation of exposure and effect will be examined and discussed when evaluating the results of the SLERA.

7.2.6 Scientific Management Decision Point

Following the SLERA, decisions will be made regarding the determination of potential ecological risks. At the first scientific management decision point (SMDP), the available information regarding COPECs, potential receptors, and potential exposure pathways will be evaluated. No decisions can be made regarding risk or injuries. Three possible decisions can be reached following the SLERA:

- There is enough information to conclude that ecological risks are low or non-existent and there is no need to proceed with the BERA; or
- There is not enough information to make a decision and further information will need to be gathered; or
- The information indicates a potential for adverse ecological effects and a higher tier ERA is required for these specific compounds.

This SMDP corresponds with the risk management decision described in Section 5.3.4. In the event that the SLERA indicates that additional investigation may be required to characterize potential ecological risk (as described in the second and third bullets above), a presumptive remedy could be considered at that point to offset the uncertainty associated with the SLERA.

7.3 Baseline Ecological Risk Assessment

7.3.1 Introduction

A decision may be made by the risk assessors at the conclusion of the SLERA that there is sufficient information to conclude that ecological risks are low or non-existent, and that there is no need to pursue further evaluation. In lieu of that decision, further information will need to be evaluated to reduce the remaining uncertainties.

7.3.2 Problem Formulation

Results of the SLERA analysis will be used to refine the potential exposure pathways and ecological conceptual site model for receptor exposure to the identified COPECs.

7.3.3 BERA Analysis Phase Exposure and Effects Assessment

Exposure and effects assessments from the SLERA will be refined using available site-specific information. This tier of the ERA recognizes the potential overlap between the extensive ERA being conducted in the Tittabawassee River Study Area, and the potential ERA evaluation necessary for the Midland Study Area. The Tittabawassee River Study Area assessment is designed to gain an understanding of food chain transfer and effect levels, specifically for furans and dioxins. When established, these congener-specific relationships will also apply to the wildlife habitat and receptors that are present in the urban landscape of the Midland Study Area. Application of the effect levels determined in the Tittabawassee River Study Area assessment will take into consideration the uncertainties associated with current TEFs and the different congener distributions for the Tittabawassee River Study Area relative to the Midland Study Area. Overall, the Midland Study Area is expected to provide less ecologically diverse wildlife populations than the Tittabawassee River Study Area. Therefore, the issues related to ecological risk in Midland are expected to be similar to those in the Tittabawassee River Study Area.

Baseline Estimates of Exposure

The two primary approaches for assessing exposure and effects of persistent, bioaccumulative COPECs in wildlife assessments, the dietary-based and receptor tissue-based approaches (Fairbrother, 2003; Millsap et al., 2004), were discussed above in "Screening Level Estimates of Exposure" (Section 7.2.3). The baseline estimates of exposure will differ from the screening-level estimates of exposure by incorporating scientifically based, less conservative, and more realistic information to model COPEC exposure to receptors of concern. Whenever available, site-specific and/or region-specific exposure information will be utilized. For example, congener-specific bioaccumulation factors for furans and dioxins are being established via an extensive study of the Tittabawassee River Study Area food webs. Although it is known that the congener patterns differ between the river Study Area and the Midland Study Area due to different depositional mechanisms, the food-web bioaccumulation factors from the Tittabawassee River study will be applicable within the Midland area because they are congener-specific and independent of congener patterns. Measured concentrations of furans and dioxins in Midland area soils would be used in conjunction with the Tittabawassee River Study Area congener-specific

bioaccumulation factors to model both dietary-based and receptor tissue-based exposure to receptors of concern that were identified in the SLERA.

Characteristics of key receptors will be clearly presented in the BERA, including exposure assumptions for body weight, ingestion rate, dietary composition, and area use factor. The primary source of exposure assumptions is the USEPA Exposure Factors Handbook (USEPA, 1993). Additional sources of information include primary peer-reviewed scientific literature, site surveys, and professional judgment, and other compendia of region-specific and species-specific information (Sample and Suter, 1994).

Exposure calculations will be conducted with exposure concentrations derived from either measured concentrations of COPECs or concentrations predicted from models in the relatively rare case when no measured concentrations are available. Bioaccumulation models are often fraught with uncertainty because bioavailability depends upon highly variable site-specific considerations such as soil type, pH, moisture, clay content, organic carbon, cation exchange capacity, exposure duration, and receptor-specific considerations such as uptake mechanisms. In particular, available information suggests that bioavailability from soil to biota is limited for many COPECs.

Baseline Effects Assessment

The baseline effects assessment will differ from the screening-level effects assessment by replacing conservative screening benchmarks with scientifically based, less conservative TRVs. Whenever available, site-specific and/or region-specific effects information will be utilized. For example, effect levels for receptors that are studied in the Tittabawassee River Study Area will provide a basis for evaluation of effect levels within the Study Area that may not otherwise be available from the scientific literature. However, TEQ effect levels derived from the Tittabawassee River Study Area investigation will be based on a different congener pattern than is present in the Midland Study Area; therefore, a discussion of the uncertainty associated with current TEF values will be necessary. Depending on congener specific exposures levels in the Tittabawassee River Study Area relative to Midland Study Area, it may be possible to derive congener-specific effect levels based on the Tittabawassee River Study Area investigation.

When site-specific TRVs are not available or their use is not justified, the availability of both dietary exposure and tissue residue-based toxicological data will be evaluated for COPECs and the limitations of these toxicity data discussed. Ideally, TRVs are derived from chronic toxicity studies in which a dose-response relationship has been observed for ecologically relevant endpoint(s) in the species of concern, or a closely related species. Specifically, some of the ideal characteristics of high quality toxicity studies that can be used to derive TRVs include:

- Relatedness of the test species to the receptor of concern
- Chronic duration of exposure including sensitive life stages to evaluate potential developmental and reproductive effects
- Measurement of ecologically relevant endpoints
- Minimal impact of co-contaminants

Sources of toxicological data that will be reviewed to develop TRVs include primary peer-reviewed scientific literature, pertinent reviews of TCDD and related chemicals and other COPECs, Oak Ridge National Laboratory report on benchmarks for wildlife, appropriate USEPA reports, and other relevant sources of information. In the ERA, endpoints such as effects on reproductive and developmental toxicity, reduced survival, or growth will be evaluated and used whenever possible.

Because few studies were designed to fulfill all of the ideal characteristics of a high quality study that match the needs of an ecological risk assessment, it is sometimes necessary to apply UFs or to reject a study from further consideration. In either case, the rationale will be clearly documented for applying UFs or for rejecting a study. Uncertainty concerning interpretation of the toxicity test information among different species, different laboratory endpoints, and differences in experimental design, age of test animals, duration of test, etc., are addressed by applying UFs to the toxicology data to derive the final TRV. For this BERA, general recommendations of USEPA (1995), the procedures set out in the GLI (USEPA, 1995b) and the procedures outlined in the standard practice for wildlife TRVs from Johnson et al. (2000) will be considered for the derivation and use of UFs.

7.3.4 Baseline ERA Risk Characterization Phase

The basic approach for assessment endpoints in the BERA will be an HQ approach. The calculation of an HQ assumes that there is a threshold exposure below which it is unlikely that adverse effects will occur in a receptor population. Due to the conservativeness of the exposure calculations, benchmarks, and TRVs, HQ values less than 1.0 indicate that unacceptable risks are not likely to occur. HQ values are not statistical probabilities of adverse effects; rather they are indicators of the level of concern regarding potentially unacceptable effects of chemical exposure to targeted populations. Furthermore, it is important to emphasize that the level of concern for HQ values does not increase linearly once they exceed unity (USEPA, 1997).

Risk Estimation

Dietary exposures and receptor tissue concentrations modeled using Tittabawassee River Study Area bioaccumulation factors would be compared to effect levels established in the literature, or from the Tittabawassee River Study Area, to estimate the potential for risk.

ERA guidance (USEPA, 1997 and 1998) recommends that when the HQ approach is utilized for characterizing risk to wildlife, that HQs are derived for both the LOAEL and NOAEL. Furthermore, the following guidelines provide a framework to characterize risk using NOAEL- and LOAEL-based HQs:

- When the site exposure (dose) exceeds the LOAEL and the LOAEL-based HQ is greater than 1.0, the potential for unacceptable risk cannot be ruled out and further evaluation is necessary.
- When the site exposure (dose) is less than the NOAEL and the NOAEL-based HQ is less than 1.0, the risk assessor may reasonably conclude that the quotient evaluation method does not provide evidence of potential risk.

- When the site exposure (dose) is greater than the NOAEL but less than the LOAEL, a definitive conclusion may not be reached based on the predictive method alone. As a result, additional assessment effort in cooperation with the risk manager will be necessary to determine whether there is the potential for unacceptable risk associated with exposure to the COPEC(s).

7.3.5 Uncertainty

There are several sources of uncertainties associated with risk characterization estimates that can result in under- or overestimation of risks for receptors at the site. First, there is uncertainty associated with the initial selection of COPECs based on sampling data and available toxicity information. There also are uncertainties associated with the conceptual model used as a basis to investigate the site, since the development of a conceptual model relies on professional judgments and assumptions. In addition, when estimating exposures to receptors of concern, assumptions such as ingestion rates, bioavailability, and area use factors add uncertainty to the exposure estimate. There are uncertainties associated with effect assessments when exposure data for receptors of concern are compared to literature-derived TRVs that are derived from surrogate species. Differences in study design, duration, and species studied add uncertainty to the effects assessment. Finally, there are sources of uncertainty in the application of Tittabawassee River Study Area TEQ effect levels to the Midland Study Area due to different congener patterns and the associated uncertainty in the TEFs. Sources of uncertainty will be tracked and discussed throughout the risk assessment process.

7.3.6 Scientific Management Decision Point

Following the application of Tittabawassee River Study Area ERA results to the Midland Study Area assessment, decisions will be made regarding the determination of potential ecological risks. At this SMDP, the refined exposure, effects and risk assessments will be evaluated. Three possible decisions can be reached:

- There is enough information to conclude that ecological risks are low or non-existent and there is no need to proceed with further evaluation.
- There is the potential for risk to ecological receptors and sufficient information to support risk management decisions.
- There is not enough information to make a decision and further information will need to be gathered.

This SMDP corresponds with the risk management decision described in Section 5.4. A decision may be made by the risk assessors at the conclusion of the refined exposure, effects and risk assessment, that there is sufficient information to conclude that ecological risks are low or non-existent and there is no need to pursue further evaluation or that there are potential risks and sufficient information to make risk management decisions. In lieu of those decisions, further information will need to be evaluated to reduce the remaining uncertainties. This may include site-specific field studies of receptors of concern to evaluate unique receptors or COPECs that were not evaluated in the Tittabawassee River Study Area ERA. The work plans for these studies will be developed when it is determined that they are necessary.

TABLE 7-1
Land Use within the Midland Study Area
Midland Area Soils Remedial Investigation Work Plan

Habitat Type	Acres	Percentage of Total
Open area—Agricultural and recreational areas	2,644	23 %
Forested—Also includes riparian areas	2,509	22 %
Forested wetlands	7	< 1%
Wetlands	25	< 1%
Open water	924	8%
Residential—Includes yards and houses	3,134	27%
No habitat—Includes industrial and commercial areas	2,379	20%

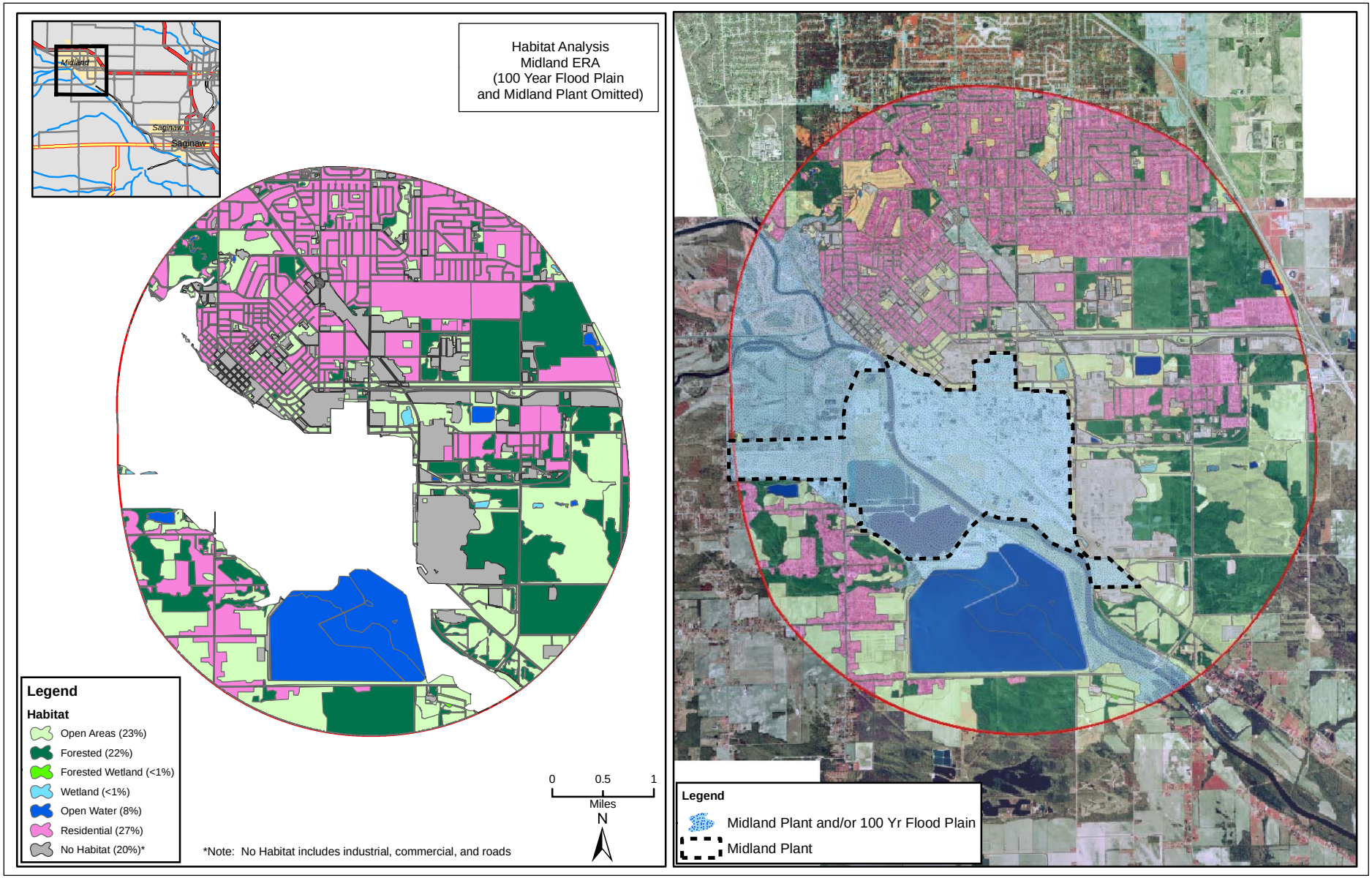


Figure 7-1
Habitat Analysis of the Midland Study Area
Midland Area Soils Remedial Investigation Work Plan

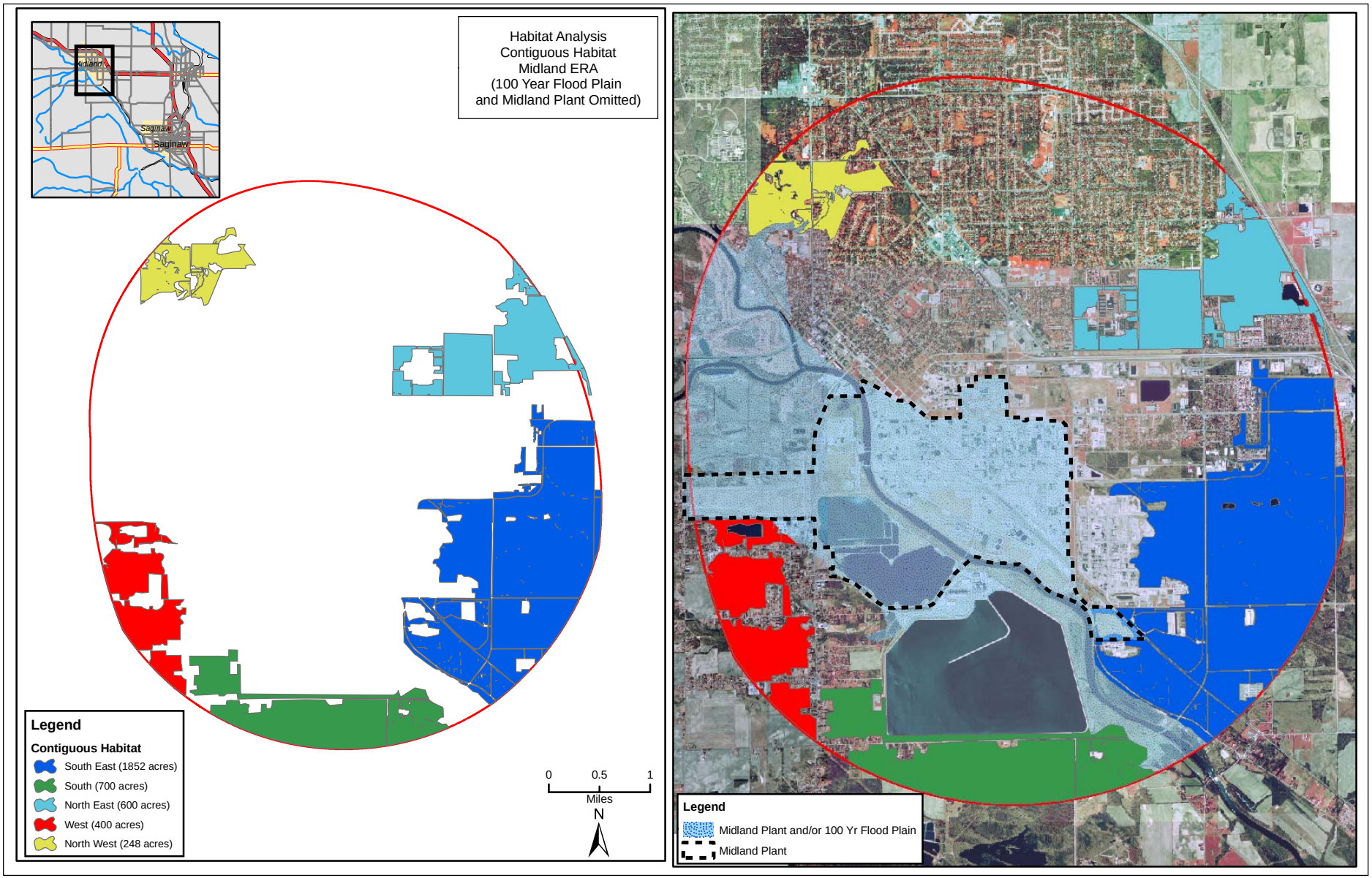
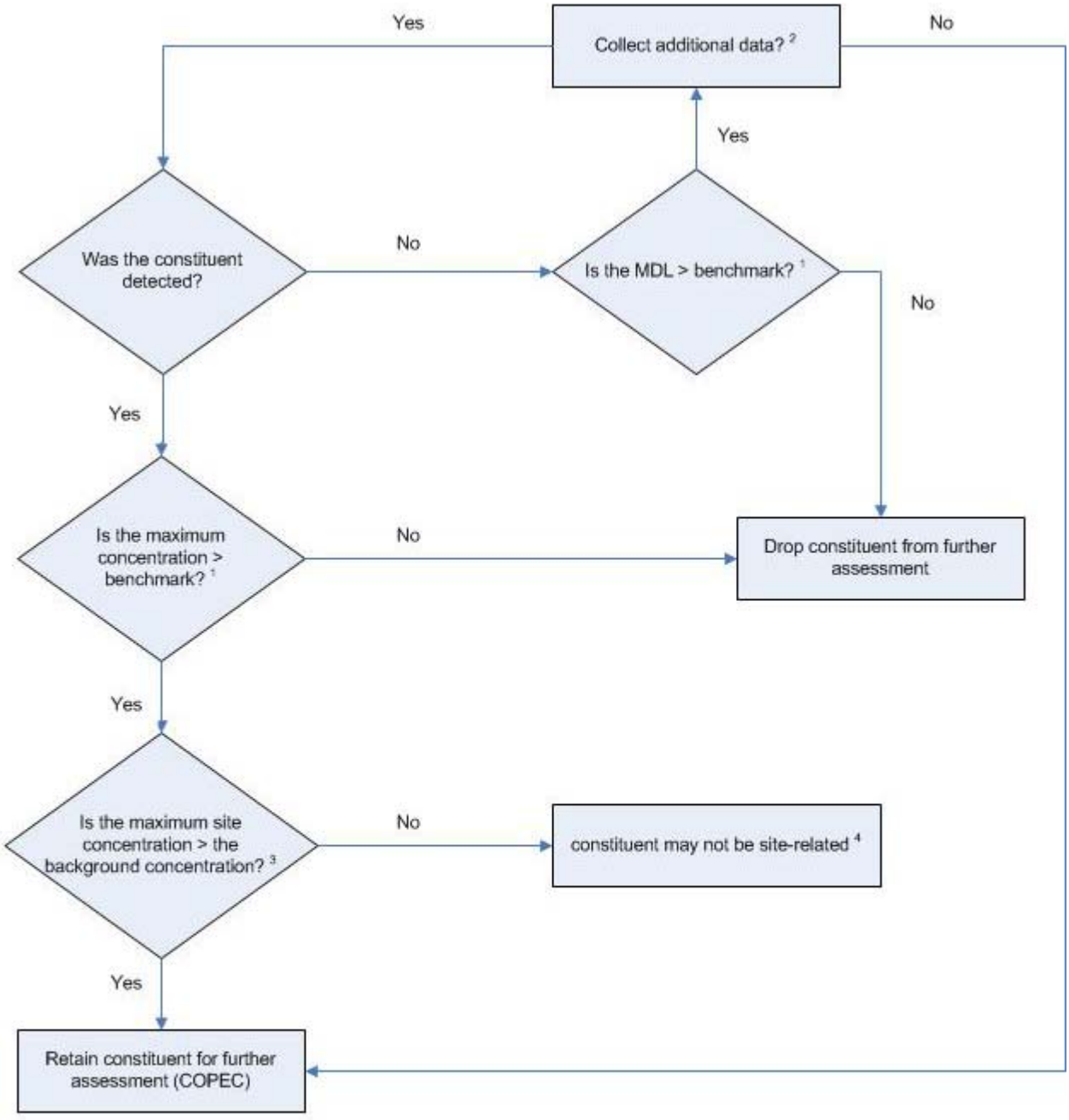


Figure 7-2
Analysis of Contiguous Habitat
Midland Area Soils Remedial Investigation Work Plan



[1] If benchmark is not available, attempts will be made to develop benchmark for constituent and/or consider other factors, which may include exposure modeling
[2] May include reanalysis of sample with lower MDL, or collection of new sample(s)
[3] If necessary, background data will be collected as part of the Phase II RI
[4] This most commonly occurs with naturally occurring inorganic constituents, but may occur with any COPEC for which additional non-site related sources are present

Figure 7-3
Decision Tree for COPEC Identification
Midland Area Soils Remedial Investigation Work Plan

SECTION 8

Public Participation Plan

8.1 Summary

The purpose of this Public Participation Plan is to outline activities that inform residents of the Midland/Saginaw/Bay City areas ("Tri-City" areas) of activities associated with Dow's offsite corrective actions, conducted pursuant to Condition IX B.3 (c) of Dow's License. The Public Participation Plan incorporates the goals and objectives previously established through the Communications IRA, the 'ongoing community involvement process' and aligns with USEPA's public participation guidelines.

The Public Participation Plan is intended to inform the tri-cities communities about the corrective action process, inform the communities about actions taken or contemplated, and solicit broad community input. With these objectives in mind, the overall goals of the public participation plan are to maintain a neutral and balanced public participation process and make information available to the public on a regular basis.

With approval of the Framework on January 20, 2005, Lt. Gov. John Cherry supported the development of a public participation process that would be broadly accepted by the community. In March and April 2005, Dow and MDEQ jointly convened stakeholders to present the Framework and receive feedback from members of the public on how best to communicate with the public on the dioxin/furan situation going forward. Public feedback culminated in the development of a Community Involvement Process that featured town hall style meetings as a communication tool to provide information to the community, among other communication mechanisms.

The first town hall meeting was held on November 9, 2005. Per the Community Involvement Process and with the assistance of a professional facilitator, the meeting provided face-to-face interaction between residents, Dow and MDEQ. It also served as a forum to provide updates on IRAs, technical issues, data gathering efforts, and obtain various community perspectives. As a major part of the Public Participation Plan, a series of quarterly town hall meetings was held in 2006 and 2007, and an additional quarterly town hall meeting is scheduled for late 2007.

This document outlines the communication methods, community perspectives, goals and objectives of this ongoing public participation process.

8.2 Goals of Public Participation Plan

Consistent with the ongoing public participation process, the overall goals of this Public Participation Plan are to:

- Solicit feedback from community stakeholders (residents, civic, educational, religious and professional leaders, associations and organizations) on various elements of Dow's offsite corrective actions

- Inform the Tri-City communities about the corrective action process
- Inform the Tri-City communities about actions to be taken or completed

Consistent with the approach of the Communications IRA, Dow will continue to:

- Provide information on the presence of and potential risks associated with exposure to dioxins/furans (and or other potential chemicals of interest) and practical measures that can be taken to mitigate those risks
- Provide information about the activities associated with Dow's offsite corrective action work performed under the License, including IRAs

8.3 Contents of the Public Participation Plan

This Public Participation Plan highlights community perspectives, outlines community involvement activities to be conducted during the ongoing and anticipated future corrective actions and identifies locations where information related to dioxins/furans can be found.

This plan is divided into the following major sections:

- Overview of the Public Participation Plan
- Public Participation Activities and Schedule

8.4 Public Participation Activities and Schedule

Public Participation Activities include both written and oral communication to residents of the Tri-City area. Residents have the opportunity to meet with MDEQ and Dow during community meetings and obtain informational materials related to dioxin/furans in local libraries, township halls and Internet Web sites managed by MDEQ and Dow.

8.5 Community Meetings

8.5.1 Community Perspectives

In March and April 2005, Dow and MDEQ held four meetings throughout the Tri-City area where the Framework was presented and the public was solicited for input on how Dow and MDEQ should communicate with the community. A summary of insights from the convening meetings is available on MDEQ's website. Several major themes emerged from these meetings:

- Information should be presented clearly and unambiguously.
- The MDEQ and Dow should use of a variety of means to convey information to the community.
- People should have meaningful input into the decisions about how historical dioxin releases in the City of Midland, Tittabawassee and Saginaw rivers, and the Saginaw Bay will be addressed.

- A town hall-style meeting would be an effective forum for communication.
- While there was some agreement that a stakeholder committee could be a valuable tool for providing community input into the decision-making process, the public ultimately decided against forming a stakeholder committee.

Ideas that received broad public acceptance resulted in their implementation:

- Periodic town hall meetings
- Technical Information Meetings
- Professional, neutral facilitator for town hall meetings
- Meetings conducted with specific agenda
- Information sheets
- Dow and MDEQ participation in community group meetings (residents, civic, educational, religious and professional leaders, associations and organizations)

The first of these periodic town hall meetings was held on November 9, 2005. Per the Community Involvement Process and with the assistance of a professional facilitator, the meeting provided face-to-face interaction between residents, Dow and MDEQ. It also served as a forum to provide updates on IRAs, technical issues, data gathering efforts, and obtain various community perspectives. A transcript of the meeting is available on MDEQ's Web site.

8.5.2 Upcoming Activities

In 2007, town hall meetings were held on February 8, May 17, and August 9 at the Horizons Conference Center in Saginaw. The last meeting will be held on November 8, 2007. The Horizons Center was chosen as a central, convenient location for Tri-City residents. Meetings are being held in the late afternoon and early evening for 2 to 3 hours. Agendas and handouts are being distributed at each meeting. Transcripts of each meeting will be posted to the MDEQ Web site. The meetings are being video-taped and aired on local cable television.

In addition to the meetings and transcripts, MDEQ and Dow may independently develop and distribute information sheets providing discussions of topics of interest to the community. Dow may elect to use publicly available mailing lists to inform residents.

8.6 Community Information Centers

CICs are located in libraries and township halls throughout the Tri-City area with the primary objectives of:

- Providing written materials to the public about dioxins and furans
- Located in high-traffic areas of each city or township in or near the areas of concern
- Open and accessible at convenient hours for the public

Publications are available from the Michigan Department of Community Health (MDCH), MDEQ, Michigan Department of Agriculture (MDA), and ATSDR at local libraries and township halls. A plan has been established to monitor the CICs at these locations and replenish documents as needed. In addition to these publications, other relevant

publications may be useful to include in the CIC. Wherever possible, MDEQ and Dow will work together to produce joint publications, however, at times MDEQ and Dow may independently develop and distribute information providing discussions of topics of interest to the community.

SECTION 9

Implementation Schedule

This section provides an overview of the schedule for Midland Area Soils project activities. The following schedule overview was developed based on the current understanding of work processes, regulatory review process, and stakeholder involvement.

2007

- October 15, 2007 – Submit Site-Specific Direct Contact Criteria Report for Dioxins and Furans to MDEQ for Review and Approval
- October 15, 2007 – Submit Fully Revised RIWP
- Fall 2007 - Empanel Independent Scientific Advisory Panel regarding the Direct Contact Criteria Report[29]

2008

- Fall/Winter 2007 – Issuance of Independent Scientific Advisory Panel Recommendations on Site-Specific Direct Contact Criteria (see Footnote 29)
- February 1, 2008 – MDEQ Approval of Site-Specific Direct Contact Criteria (see Footnote 29)
- March 1, 2008 – "Unblinding" of Pre-Remedial Investigation Data (see Footnote 29)
- May 1, 2008 - Submit sampling plan for City of Midland within 60 days after the "unblinding" of Pre-Remedial Investigation Data
- June 1, 2008 – MDEQ Approval of Sampling Plan (see Footnote 29)
- Summer 2008 – Implementation of MDEQ Approved Sampling Plan[30] (see Footnotes 29 and 30)
- September 1, 2008 – Submit Screening Human Health Risk Assessment Report for Midland for Relevant Constituents of Interest (COIs) (see Footnote 29)
- Summer 2008 If Necessary – Empanel Independent Scientific Advisory Panel regarding the HHRA for Relevant COIs (see Footnote 29)

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[29] This date and subsequent dates in this schedule related to this schedule entry are subject to timely approval by the MDEQ of submittals or proposals, agreements between Licensee and the MDEQ, or actions by third parties (such as the independent science advisory panel). If the MDEQ approval or agreement is not received or accomplished in a timely manner or if the third party does not complete their actions in a timely manner, then this date and dates for subsequent related actions do not apply. In such a case Licensee will submit a new proposed date(s) to the MDEQ for approval to substitute for this date and related dates.

[30] All reasonable efforts that can be done safely and productively will be used to complete field investigations by the dates in this schedule. However, events beyond the control of any party (such as adverse weather) could impact completion of field activities. MDEQ will be communicated with if it appears such conditions will prevent the target date from being achieved.

- September 1, 2008 – Submit Screening Level Ecological Risk Assessment Report (sSee Footnote 29)
- December 31, 2008 – Submit Human Health Probabilistic Risk Assessment for Midland, Unless Alternative Methodology and/or Time Line are Deemed Necessary and Approved by MDEQ (see Footnote 29)

2009

- Fall 2008 - If Necessary – Empanel Independent Scientific Advisory Panel for the Human Health Probabilistic Risk Assessment, if prepared (see Footnote 29)
- Spring 2009 - If Necessary – Issuance of Independent Scientific Advisory Panel Recommendations, from all ISAPs formed for scientific and technical review of previous submittals (see Footnote 29)
- May 1, 2009 - Risk Management Decision Regarding Site-Specific Clean-up Criteria (that is, human health, ecological) (see Footnote 29)
- Fall 2009 - If Necessary - Prepare Baseline Ecological Risk Assessment Report (see Footnote 29)
- December 31, 2009 - Submit Midland Soils Remedial Investigation Final Report (see Footnote 29)

2010

- March 1, 2010 – MDEQ Approval of Midland Soils Remedial Investigation Report (see Footnote 29)
- If Necessary – Submit Midland Soils Feasibility Study Work Plan, if MDEQ notifies Dow that one is required within 60 days after notification.
- Submit Feasibility Study Report, if required pursuant to XI.I to the License (see Footnote 29)

The general parameters and assumptions used for developing this schedule are noted below:

- Access agreements are needed before field activities can take place on private properties. No samples will be collected until access agreements are in place or access is otherwise lawfully obtained to permit the necessary sampling. A time frame of 60 days was assumed for obtaining these access agreements prior to sampling. This includes 30 days to pursue access to locations identified in SAPs. Dow will make its best efforts to obtain access, but cannot control the response time of the third parties involved.
- Field sample collection activities have been scheduled with consideration for seasonal factors and to maximize field activities during the summer of 2008.
- Laboratory analysis of soil and sediment (if any) environmental samples will take place in an ongoing manner throughout the sample collection event. Analytical validation of all laboratory results obtained during the implementation of this SAP also will take place on an ongoing basis.

- Information will be provided to MDEQ in accordance with the operating license or an alternative mutually agreed upon schedule. Document deliverables will be prepared in time frames that align with their content, complexity, and decision-making needs. Sufficient time is needed to conduct internal reviews/revisions and to verify the quality of all information presented.

Information exchange and MDEQ review and approval periods are considered "critical path" activities, and have the potential to affect the overall schedule because subsequent activities may not be able to start until approval for specific tasks or investigation areas is received. Refinements to schedule will be made as RIWP components have been approved by MDEQ.

Dow will make reasonable best efforts to schedule and sequence activities to complete work in a timely manner, including adjusting activities to try and compensate for delays in work due to matters outside Dow's control (for example, access agreements, force majure, seasonal effect of weather) if possible. No fieldwork will be planned for the winter months.

SECTION 10

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SECTION 11

Glossary

Aquifer: A subsurface strata or zone that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Aquitard: A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed. It does not readily yield water to wells or springs, but may serve as a storage unit for groundwater.

Benchmark value: A published generic risk-based value for human and ecological exposure.

Constituent of Interest (COI): The lists of COI for this project are derived from the potential constituent of interest (PCOI), and reflect those substances that are likely to have been released to the environment during the period of interest for the study. Because of the large number of PCOI, the COI lists have been organized by chemical class to facilitate evaluation of physical/chemical properties and selection of analytical methods. COI may or may not have suitable analytical methods, and therefore may or may not be included on the target analyte list (TAL).

Contaminant of Potential Concern (CoPC): A target analyte list (TAL) chemical present in soil or sediment at a concentration that is greater than background concentrations and relevant risk-based screening values for human health derived either by MDEQ or USEPA.

Contaminant of Potential Ecological Concern (COPEC): Any contaminant that is shown to pose possible ecological risk.

Geomorphology: The science that treats the general configuration of the earth's surface; specifically, the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures and the history of geologic changes as recorded by these surface features.

Hazardous substance: Any substance that the Michigan Department of Environmental Quality demonstrates, on a case-by-case basis, poses an unacceptable risk to public health, safety, welfare, or the environment, considering the state of the material, dose-response, toxicity, or adverse impact on natural resources.

Hydrophobic: Lacking strong affinity for water.

Lacustrine: Sediment deposited in a lake environment.

Palustrine: Pertaining to material growing or deposited in a marsh.

Photolysis: Chemical decomposition induced by light or other radiant energy.

Potential constituent of interest (PCOI): The PCOI for this project consist of those substances on the master list of chemicals submitted by The Dow Chemical Company to MDEQ on June 1, 2006, plus those substances found in biomonitoring of the Tittabawassee

and Saginaw rivers. It is recognized that not all substances on the Dow master list will have significance as environmental contaminants, nor that the substances found in biomonitoring of the two rivers are necessarily related to Dow operations in Midland.

Target analyte list (TAL): The TALs are compilations of those substances (elements or chemicals) that will be analyzed in samples from the Study Area. TALs are method specific, and are integral components of the project quality assurance project plan (QAPP) and method standard operating procedures (SOPs). Because of the large number of COI and project samples, not all samples will be analyzed for all target analytes.

Till: Unstratified drift, deposited directly by a glacier without reworking by meltwater, and consisting of a mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape.

SECTION 12

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
Act 451	Michigan Natural Resources and Environmental Protection Act (1994 Public Act 451, as revised)
ADD	average daily dose
ADE	acceptable daily exposure
AE	dermal absorption fraction from soil
AE_i	chemical specific or default ingestion absorption efficiency
AF	soil adherence
Ah	aryl hydrocarbon
AhR	aryl hydrocarbon receptor
AIC	Aitken information criterion
ALT	alanine aminotransaminase (a liver enzyme)
AST	aspartate aminotransaminase (a liver enzyme)
AT	average time
ATS	Ann Arbor Technical Service Inc.
ATSDR	Agency for Toxic Substance and Disease Registry
AUC	area under the curve
BERA	baseline ecological risk assessment
BMDS	Benchmark Dose Software
BMI	body mass index
BTU	British thermal units
BTU/hr	British thermal units per hour
BW	body weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	conversion factor

cfm	cubic feet per minute
CFR	Code of Federal Regulations
CIC	Community Information Center
cm^2	square centimeter
COI	constituent of interest
CoPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
Cs	chemical concentration in soil
CSF	cancer slope factor
CSM	conceptual site model
CWS	Chemical Warfare Service
CYP1A	cytochrome P450 1A
CYP1A1	cytochrome P450 1A1
CYP1A2	cytochrome P450 1A2
d	day
DABT	Diplomate of the American Board of Toxicology
DBA	an inbred mouse strain: "DBA mouse"
DCC	direct contact criterion
dioxin	polychlorinated dibenzo-p-dioxin
DLC	dioxin-like compound
DNA	deoxyribonucleic acid (the molecule that encodes genetic information in the nucleus of cells)
Dow	The Dow Chemical Company
DQO	data quality objective
DRE	dioxin responsive element (in nuclear genetic material)
ECSCF	European Commission Scientific Committee on Foods
ED	exposure duration
ED01	effective dose for 1 percent response
ED10	effective dose for 10 percent response
EEC	estimated environmental concentration
EF	exposure frequency
EPC	exposure point concentration

ERA	ecological risk assessment
EV	event frequency
FAO	Food and Agriculture Organization of the United Nations
FR	Federal Register
Framework	Framework for an Agreement between the State of Michigan and The Dow Chemical Company
FS	feasibility study
furan	polychlorinated dibenzofuran
Fv	fraction of pollutant air concentration in the vapor phase
GIS	geographic information system
GLI	Great Lakes Initiative
gpm	gallons per minute
HCl	hydrogen chloride
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HQ	hazard quotient
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
IPCS	International Program on Chemical Safety
IRA	interim response activity
IRIS	U.S. EPA Integrated Risk Information System
ISAP	independent science advisory panel
IWS	ionizing wet scrubber
JECFA	Joint FAO/WHO Expert Committee on Food Additives
kg	kilogram
LADD	lifetime average daily dose
LD50	lethal dose 50% (dose causing 50% mortality)
LED10	lower confidence limit on the ED10 (q.v.)
License	Hazardous Waste Management Facility Operating License

LMS	linear multistage model
LOAEL	lowest observed adverse effect level
MACT	Maximum Achievable Control Technology
MCV	Midland Cogeneration Venture
MDA	Michigan Department of Agriculture
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg	milligram
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
MGD	million gallons per day
Midland Plant	The Dow Chemical Company Midland Plant
MOA	mode of action
MOE	margin of exposure
MPH	Masters of Public Health
MRL	(ATSDR) minimal risk level
mRNA	messenger RNA (q.v.) [RNA that serves as a template for protein synthesis)
NAS	The National Academy of Sciences
NCEA	U.S. EPA's National Center for Environmental Assessment
NCP	National Contingency Plan
ng	nanogram
NHANES	National Health and Nutrition Examination Survey
NIST	National Institute of Standards and Technology
NOAEL	no observed adverse effect level
NOD	Notice of Deficiency
NO_x	nitrogen oxide
NPDES	National Pollution Discharge Elimination System
NTP	National Toxicology Program
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran

OSWER	Office of Solid Waste and Emergency Response
P(d)	probability of a cancer response at dose d
P(0)	probability of cancer response at zero dose
PAH	polynuclear aromatic hydrocarbon
PBPK	physiologically based pharmacokinetic
PCB	polychlorinated biphenyl
PCCD/F	polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PCOI	potential constituent of interest
PCSM	preliminary conceptual site model
PDF	probability density function
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzo-p-furan
pg	picogram
PK	pharmacokinetic
POD	point of departure
ppb	part per billion
ppm	part per million
PPRTV	EPA's provisional peer reviewed toxicity values
ppt	part per trillion
PRA	probabilistic risk assessment
Pre-RI Study	Sampling and Analysis Plan in Support of Bioavailability Study
PRG	preliminary remediation goal
PSIC	particulate soil inhalation criterion
PTMI	provisional tolerable monthly intake
R 299.5528	Michigan Administrative Code Rule 299.5528
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
REP	relative effect potency
RfD	reference dose

RGIS	Revetment Groundwater Interception System
RI	remedial investigation
RIWP	remedial investigation work plan
RME	reasonable maximum exposure
SA	skin surface area
SAP	sampling and analysis plan
SHEDS	(USEPA) Stochastic Human Exposure and Dose Simulation
SLERA	screening level ecological risk assessment
SLRA	screening level risk assessment
SMDP	Scientific management decision point
SOP	standard operating procedure
SOW	Scope of Work for Midland Area Soils Remedial Investigation
SO_x	sulfur oxide
SQD	(MDEQ) Surface Water Quality Division
Study Area	Midland Area Soils Study Area
SVOC	semivolatile organic compound
SWQ	surface water quality
T-pond	tertiary treatment pond
TAL	target analyte list
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TDI	tolerable daily intake
TEF	toxic equivalency factor
TEQ	toxic equivalents
TIC	tentatively identified compound
TOC	total organic carbon
TRV	toxicity reference value
TSD	technical support document
UCL	upper confidence limit
UF	uncertainty factor
UMass	University of Massachusetts

UMDES	University of Michigan Dioxin Exposure Study
UN	United Nations
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound
WBAN	Weather Bureau, Air Force, and Navy
WHO	World Health Organization
WIN	Watershed Initiative Effort
WWTP	wastewater treatment plant

Appendix A
Existing Data Quality and Usability Assessment—Midland Area Soils

APPENDIX A

Existing Data Quality and Usability Assessment – Midland Area Soils

This appendix documents the quality and usability of existing data for possible use in remedial investigation (RI) decision making. The following items are addressed in this appendix:

- Sources of analytical data incorporated into the Midland Offsite Corrective Action (MOCA) database
- Criteria used to assess the quality of the existing data sets and development of data usability categories for RI planning and data evaluation activities
- Results of the categorization process

Data Sources

A number of environmental studies and data collection activities have been completed in the city of Midland, Tittabawassee River, and Saginaw River areas since the 1970s. The purposes of these investigations varied, ranging from general characterization of sediment for dredge spoil disposal to preliminary assessments of risk posed by human exposure to hazardous substances in soil. The analytical data for a number of these studies and monitoring efforts were incorporated into the analytical database created to support The Dow Chemical Company (Dow), Michigan Operations, MOCA Program. In addition, the results of the 2006 data collection effort to support a possible bioavailability study of Midland area soils were added to the database.

The following data sources include results for samples obtained in the vicinity of the Midland Soils Study Area:

- *Point Sources and Environmental Levels of 2378-TCDD (2,3,7,8-Tetrachlorodibenzo-p-Dioxin) on the Midland Plant Site of The Dow Chemical Company and in the City of Midland, Michigan* (Agin, R.J., V.A. Atiemo-Obeng, W.B. Crummett, K.L. Krumel, L.L. Lamparski, T.J. Nestrick, C.N. Park, J.M. Rio, L.A. Robbins, S.W. Tobey, D.I. Townsend, and L.B. Westover, November 1984)
- *Soil Screening at Four Midwestern Sites* (U.S. Environmental Protection Agency [USEPA], Region 4, June 1985)
- *Summary of 1996 Midland Dioxin Study Results, 3/25/97 Working Draft of Document for Public Release* (Michigan Department of Environmental Quality [MDEQ], Waste Management Division, March 1997)
- *Soil Sampling Summary Report* (Revised; Dow, March 2000)

- *Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils* (CH2M HILL, March 2007)

Information about surface soil samples collected by MDEQ at the Midland Plant in 2005 was derived from data tables provided by Dow, and copies of analytical reports from Severn Trent Laboratories (Austin, Texas) and Eno River Laboratories (Durham, North Carolina).

Data Quality and Usability Criteria and Categories

Given the varied purposes of the above-listed investigations and the period in which some of the samples were collected, it is unlikely that these analytical data, now contained in the MOCA database, are of equivalent quality from an analytical perspective. A consistent process was employed to assess the overall quality of the historical data sets and to gauge their usability for remedial investigation decision making. This process consisted of reviewing all available documentation from the different investigation sources listed in the MOCA database, assessing its quality, and assigning a data usability category to the analytical data associated with the investigation sources.

Environmental data and reports associated with samples collected in the Midland area were identified and obtained from various sources, including Dow, Dow contractors, MDEQ, Michigan State University, the U.S. Army Corps of Engineers, and USEPA. As indicated in Table A-1 (at the end of this appendix), certain reports associated with older data could not be located or were incomplete.

Analytical data contained in the reports, work plans, and other documents were then assessed for quality using established USEPA criteria and guidelines for data quality, including information from the *Contract Laboratory Program National Functional Guidelines for Inorganic/Organic Data Review* (USEPA, 2004). The assessment considered the quality assurance/quality control (QA/QC) characteristics of the entire analytical data set associated with a data source, and did not include detailed QA/QC screening or validation of individual data points. The primary parameters used to review the quality of the data and establish categories of data usability were as follows:

- Traceability – Was chain-of-custody (COC) information available, complete, and attached to the report or supporting documentation package? Absence of COC information was not cause for rejection of the data set. If documentation other than COC was available, professional judgment was used to establish traceability. For example, references to the COC form in the text of a report or other documentation consistent with standard practices were sufficient to document traceability.
- Comparability – Were the analytical procedures or methods and detection limits identified and do they represent the accepted industry standards at the time the samples were collected? Data sets more than 10 years old were downgraded to a less usable category because of possible detection limit concerns and possible changes in hazardous constituent concentrations over time.
- Sample Integrity – Were sample holding times met? Did the sample, as received by the analytical laboratory, meet pertinent and published guidance (for example, temperature criteria, adequate sample volume, appropriate methods of preservation)?

- QA/QC – Were laboratory QC data available to assess accuracy and precision and were these data within established control limits? Following are some typical laboratory QC parameters used to assess accuracy and precision:
  - Initial and continuing calibration
  - Instrument tuning for organic compound (gas chromatography/mass spectroscopy) measurements
  - Internal standards for organic compound measurements
  - Interference checks, serial dilutions for metals measurement
  - Laboratory blank sample measurements
  - Accuracy and precision measurements, to include surrogates for organics, laboratory control standards, matrix spikes, matrix spike duplicates, and duplicates for metals
  - Laboratory-specific method detection levels and associated procedures
  - Field QC samples, including blanks and replicates

The data associated with each investigation source were then assigned one of the following categories based on the finding of the review:

- **Category 1 – Data of Known Quality.** These are data that are supported by QA/QC protocols and sampling procedures described in work plans or investigation reports, but not equivalent in scope or detail to the current quality assurance project plan (CH2M HILL, 2004). Data from sources assigned to Category 1 can be used for most RI planning and may be incorporated into RI data evaluation groups if specific analytes, detection limits, and sample locations meet the data quality objectives for specific end uses.
- **Category 2 – Data of Partially Known Quality.** These are data associated with a limited body of supporting QA/QC information. Although not sufficient to be considered Category 1, the information is considered suitable for qualitative use in RI planning.
- **Category 3 – Data of Unknown Quality.** These data include sample concentration information but lack an adequate level of supporting QA/QC information. These data sets are not considered suitable for quantitative RI uses; however, depending on the reputability of the data sources, these data sets may be used on a limited or provisional basis for qualitative comparisons with other Category 1 and Category 2 data sets.

Data Usability Category Findings

The findings of the data usability evaluation for each Midland area data source are detailed in Table A-1. This table lists the investigating agency, associated report title, MOCA database source number, media type, analytical parameters, investigation timeline, QA/QC information used in the assessment process, and assigned usability category associated with each data source. Data usability findings for any data source may be changed if additional supporting information becomes available for review.

References

CH2M HILL. 2004. Quality Assurance Project Plan. April.

U.S. Environmental Protection Agency (USEPA). 2004. Contract Laboratory Program National Functional Guidelines for Inorganic/Organic Data Review.

TABLE A-1
Historical Data Quality and Usability Assessment Summary – Midland Area

Study Year	Author	Associated Report Name	MOCA Database Data Source Number	Data Source Name	Media	Analytical Parameters	Available QA/QC Data and/or Documents	Assigned Quality and Usability Assessment Category
2007	CH2M HILL	Data Evaluation Report to Support Bioavailability Study, Midland Area Soils	None	Pre-RI Study	Soil	Dioxins and furans SVOCs, VOCs Metals PCBs Pesticides Soil parameters (grain size distribution, TOC, black carbon, and specific surface area)	Analytical data table provides reporting limits, surrogate recovery information, and results for all samples, including results for field duplicate, lab blank, equipment blank, temperature blank, and trip blank samples. Laboratory reports provide analytical narratives and QC information.	Category 1 Data of Known Quality
2005	MDEQ	None	None	2005 Split Sampling with MDEQ, Surface Soils	Soil	SVOCs, VOCs Dioxins and furans Metals PCBs Pesticides	Analytical data table provides reporting limits, surrogate recovery information, and results for all samples, including results for field duplicate, lab blank, field blank, and trip blank samples. Laboratory reports provide analytical narratives and QC information.	Category 1 Data of Known Quality
1998	Dow	Michigan Operations Soil Sampling Summary Report (March 2000)	15	Dow Chemical Company 1998 Soil Sampling Summary	Soil	Dioxins and furans	The planning document, Appendix B, "Soil Sampling Work Plan" (September 1998), provides information on sample tracking procedures (although no COC documents are attached in the final report). Appendix C, "Analytical Report," contains a discussion on analytical procedures and methods; detection limits are reported with the raw data. The associated report contains discussions on sample holding times, temperature criteria, preservation methods, and sample preparation. QC data (field duplicate, method blank, matrix spike and recovery) were available to assess accuracy and precision.	Category 1 Data of Known Quality
1996	MDEQ, Waste Management Division	Summary of 1996 Midland Dioxin Study Results, 03/25/97 Working Draft of Document for Public Release (March 1997)	14	MDEQ Summary of 1996 Midland Dioxin Study Results	Soil	Dioxins and furans	No information is available on sample traceability, analytical procedures and methods, detection limits, or QC sample data.	Category 3 Data of Unknown Quality
1985	USEPA Region IV	Study of Dioxin and Other Toxic Pollutants, Midland, Michigan (April 1985)	4	1985 USEPA Study	Soil	Dioxins and furans PCBs Pesticides	No information is available on sample traceability, analytical procedures and methods, detection limits, or QC sample data.	Category 3 Data of Unknown Quality
1984	Dow Agin, R.J., V.A. Atiemo-Obeng, W.B. Crummett, K.L. Krumel, L.L. Lamparski, T.J. Nestrick, C.N. Park, J.M. Rio, L.A. Robbins, S.W. Tobey, D.I. Townsend, and L.B. Westover	Point Sources and Environmental Levels of 2378-TCDD on the Midland Plant Site of The Dow Chemical Company and in the City of Midland, Michigan (November 1984)	13	Dow 1984 Point Sources and Environmental Levels of 2378-TCDD on the Midland Plant Site of Dow and in the City of Midland, Michigan	Soil	Dioxins and furans	The associated report provides information on analytical documentation and records retention (although no COC documents are attached in the final report). The analytical appendix contains a discussion on analytical procedures and methods.	Category 2 Data of Partially Known Quality (note age of data)

Notes:
SVOC – semivolatile organic compound
PCBs – polychlorinated biphenyl
TOC – total organic carbon
VOC – volatile organic compound

Appendix B
Interim Measures Report—Salzburg Road Area

The Dow Chemical Company
Michigan Operations
Midland, Michigan 48667

November 29, 2001

Jim Sygo
Michigan Department of Environmental Quality
Waste Management Division
P.O. Box 30241
Lansing, Michigan 48909

Excavation and Backfilling of Salzburg Road Sample SSRR-S-10 Area Near Michigan Operations, MID 000 724 724
Interim Measure Report

This Interim Measure Report is submitted as per stipulation 2 of the MDEQ Interim Measure Approval letter for the Excavation and Backfilling of Salzburg Road Sample SSRR-S-10 Area Near The Dow Chemical Company (Dow) Michigan Operations, Midland Plant MID 000 724 724, dated September 24, 2001. The Interim Measure Approval required the following:

1. A confirmation sample must be taken from SSRR-S-10 location after the contaminated soil has been removed and prior to placement of clean cover and topsoil. The sample is to verify the condition of the site after remediation activities. The confirmation sample will be compared to the Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, generic industrial criteria for dioxins and furans.(Item 1 was modified from the original September 24 2001 Approval Letter per telephone conversation between Cheryl Howe, Al Taylor, MDEQ and Todd Konechne, Dow)

2. An Interim Measure Report summarizing the work completed (including, but not limited to, photo documentation, a description of the disposition of the excavated soils, copies of manifests for the soils, and verification sampling results) shall be submitted to the WMD (one copy to Ms. Cheryl Howe, Hazardous Waste Program Section , WMD, and one copy to Ms. Trisha Peters, WMD, Saginaw Bay District) within 30 days of completion. The Interim Measure Report must provide documentation that Dow owns the subject property, the property is zoned for industrial use, and the current and reasonably foreseeable future uses of the land will be consistent with the exposure assumptions used for the development of the Part 201 generic industrial direct contact criteria.

Background:

The impacted soil on Salzburg Road was identified in a 1998 soil sampling event (Dow 1998 Soil Sampling Report, MID 000 724 724). During the 1998 sampling event, soil samples were collected at various locations near the Dow Michigan Plant site. One soil sample, SSRR-S-10 indicated dioxin levels above Part 201 industrial criteria. The source or the cause of the soil impacts was and still is unknown.

Soil sample SSRR-S-10 is located on the south side of Salzburg Road, approximately 0.5 miles east of Waldo Road (0.5 miles west of Rockwell Drive). The sampling location was referenced using a global positioning devise (GPS) and also field marked using a 3-inch steel survey nail. The 1998 soil sampling result was verified by a supplemental soil sampling event that was conducted in April 2001 and the soil impacts were further delineated. The field sampling methodology was similar to the 1998 sampling event.

During the April 2001 supplemental soil sampling, four additional soil samples were collected near soil sample SSRR-S-10. Soil sample SSRR-S-10 (2001) was collected at the same location as SSRR-S-10 (1998) to verify the 1998 result. Soil sample SSRR-S-10A was collected 25 feet due south of SSRR-S-10, toward the existing tree line. Soil samples SSRR-S-10B and SSRR-S-10C were collected 25 feet due east and west of SSRR-S-10, respectively. Salzburg Road was considered the northern extent of impacted soil for delineation of this area. The results of the April 2001 supplemental sampling indicated that the extent of soils which were above applicable Part 201 industrial soil criteria was limited to locations near soil sample SSRR-S-10.

Description of Remedial Activities:

The remedial activities to address impacted soil at the referenced site included soil excavation and were completed per the Salzburg Road Excavation Specifications (dated August 28, 2001). The approximate area of excavation (see attached Figure) was 50 feet x 65 feet. The limit of excavation extended from the April 2001 soil sampling locations that were below applicable soil standards (SSRR-S-10A, SSRR-S-10B, and SSRR-S-10C) and Salzburg Road. Prior to conducting the field activities, a permit from the Midland County Road Commission was secured and Miss Dig was contacted to locate any utilities.

The soil was removed with an excavator to at least six inches below level surface. The work was executed in a manner that minimized dust and track out. Prior to commencing the excavation, water was applied to the excavation area with a water truck. The activity commenced near the northwest portion of the removal area (adjacent to Salzburg Road) and proceeded southeast. Truck traffic on exposed subgrade was avoided to eliminate track out. The removed topsoil was loaded directly into a tandem dump truck. Access to the excavation was provided by an access road located approximately 200 feet due east of the excavation area. The excavated soil was transported to Salzburg Landfill and disposed. Manifesting procedures were employed during the activities (Attachment 1). Approximately 100 cubic yards of soil were removed and disposed during the excavation activity.

After the excavation activities were completed, a post-excavation soil sample and duplicate were collected from the exposed subgrade soils, as per stipulation 1 of MDEQ's September 24, 2001 approval letter. The confirmation samples were collected in a manner similar to the previous sampling events. Fifteen core samples were collected from equal distances (fifteen-inch intervals) around the circumference of a six-foot diameter circle. Material was removed from the

surface of the excavated area using a spoon or similar device. The 15 samples were then homogenized and submitted for laboratory analysis. The soil samples were analyzed for the 17 International Toxicity Equivalence Factor dioxin and furan isomers, for calculation of total toxic equivalents, total tetra through octa dioxin and furan congener groups, according to US EPA Method 1613B. The dioxin and furan results of confirmation sample SSRR-S-10 (October 2001) and the duplicate sample were 51.9 ppt and 49.4 ppt, respectively. The post excavation soil confirmation sample was below applicable Part 201 industrial soil criteria.

After the confirmation sample was collected, the existing shoulder on Salzburg Road was reestablished with appropriate aggregate. Topsoil that consisted of the heavy, silty/clayey loam variety was tailgate dumped. The topsoil was spread from site boundaries inward. Topsoil was placed at a nominal 6-inch thickness. The topsoil was placed to conform to existing site drainage patterns including the flow line of the drainage swale adjacent to Salzburg Road. The disturbed area was fertilized, seeded and then protected by erosion control matting.

Pictures depicting the field activities are presented in Attachment 2.

A property description and boundary are included in Attachment 3. Dow owns the property adjacent to the road right-of-way. The property is zoned Industrial, IB (City of Midland Zoning Map, 11-20-2001). The closest activity is industrial; a trucking company operation is about ¼ mile west of this site. The nearest residential use is more than a half mile from this site, to the south.

Based on the confirmation sample results, Dow requests Generic Industrial Clean-Up status of this property. If you have any questions or require additional information, please contact me at (989) 638-1639.

Sincerely,

Todd Konechne

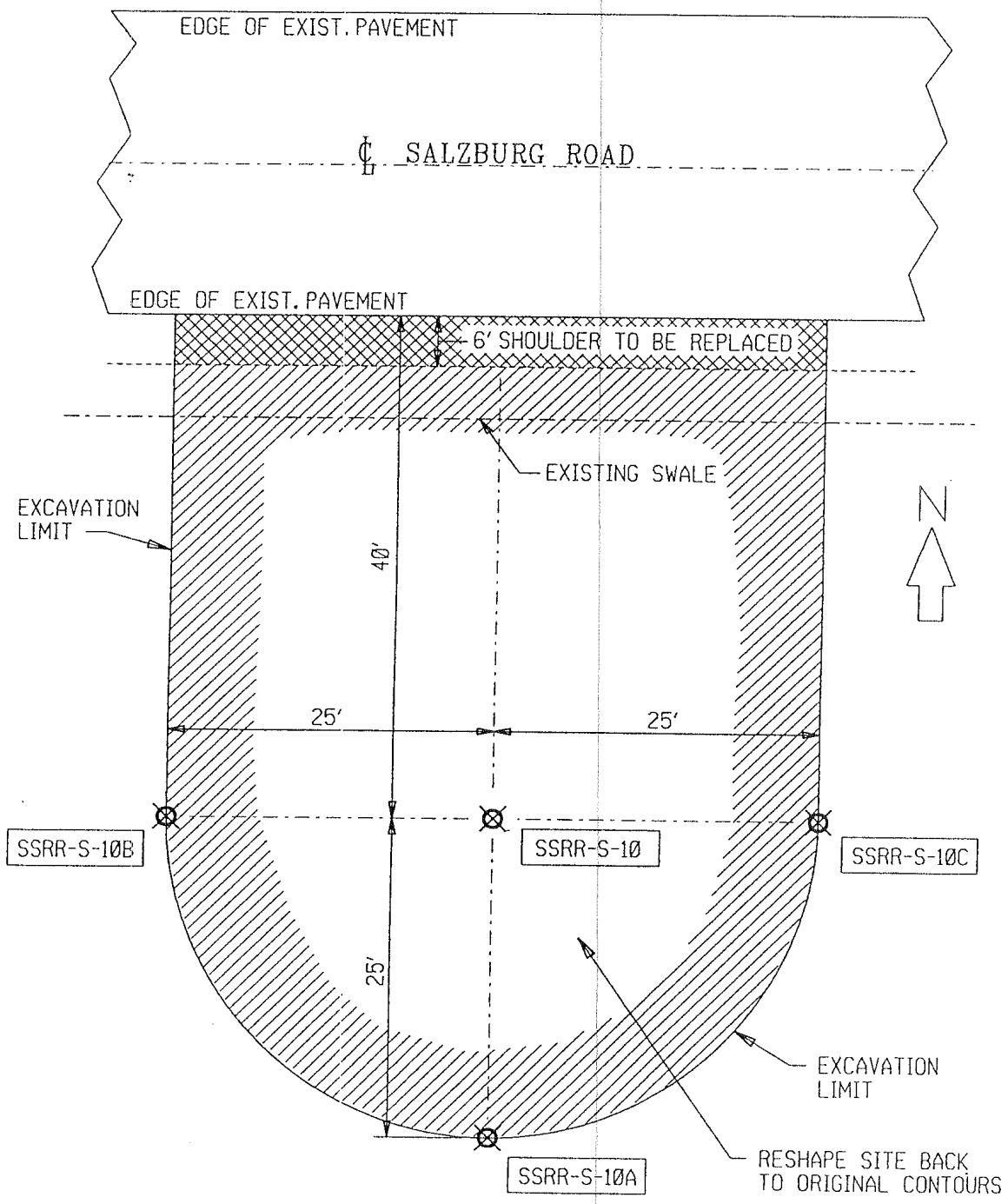
Todd Konechne
Remediation Leader
1100 Building
989-638-1639

cc: Cheryl Howe, WMD, Hazardous Waste Program Section
Trisha Peters, WMD, Saginaw Bay District
Karl Tomion, City of Midland
Charles Newell, Midland County Health Department
Jeff Feerer, Dow
Michelle Mizell, Dow

FIGURES

DIOXIN ANALYTICAL DATA - (ppt , TEQ)

LOCATION	1998	APRIL 2001	OCT. 2001
SSRR-S-10	2670	2370	50.6
SSRR-S-10A		105	
SSRR-S-10B		193	
SSRR-S-10C		58	



* SSRR-S-10 (OCT. 2001)
COLLECTED FROM EXPOSED SUBGRADE

\DUST\Scott.DGN

LEG/SM 11-29-01

ATTACHMENT 1

1SCS117758-000X205794

TREATMENT/DISPOSAL PERMIT

117758-000
ID NUMBER

205794

MATERIAL DESTINATION: X DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10-9-01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

09-10-01 P12:22 IN

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE Mike Love

RELEASE APPROVAL

This material has been determined to be non-hazardous under the criteria established by State of Michigan regulations, and is approved for release to the above material destination.

R. A. Walker
Environmental Operations Approval

6-5247
Telephone Number

10/04/2001
Approval Date

Return unused/expired permits to Environmental Operation, 1078 Building.
This Permit expires one month from the Approval Date listed above.

RELEASE INSPECTION

This material has been inspected to assure that it is as described above, has not been mixed with other materials, and the special condition, if listed below, is fulfilled.

SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

517-636-4565
Telephone Number

FORM 67000 R-8/99

REFER TO REVERSE SIDE OF PERMIT FOR INSTRUCTIONS

ENVIRONMENTAL OPERATIONS COPY

1SCS117758-000X205795

TREATMENT/DISPOSAL PERMIT

117758-000
ID NUMBER

205795

MATERIAL DESTINATION: X DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10.09.01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

09-10-01 P12:22 IN

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE K Burdett Jr Ford

RELEASE APPROVAL

This material has been determined to be non-hazardous under the criteria established by State of Michigan regulations, and is approved for release to the above material destination.

R. A. Walker
Environmental Operations Approval

6-5247
Telephone Number

10/04/2001
Approval Date

Return unused/expired permits to Environmental Operation, 1078 Building.

RELEASE INSPECTION

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SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

517-636-4565

1SCS117758-000X205790

TREATMENT/DISPOSAL PERMIT

117758-000
ID NUMBER

205790

X

MATERIAL DESTINATION: DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10-9-01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

09-10-01 P12:22 IN

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE Mike Love

RELEASE APPROVAL

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10/04/2001
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SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

517-636-4565
Telephone Number

FORM 67000 R-8/99

REFER TO REVERSE SIDE OF PERMIT FOR INSTRUCTIONS

ENVIRONMENTAL OPERATIONS COPY

1SCS117758-000X205791

TREATMENT/DISPOSAL PERMIT

117758-000
ID NUMBER

205791

X

MATERIAL DESTINATION: DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10-9-01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

09-10-01 P12:21 IN

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE Mike Love

RELEASE APPROVAL

This material has been determined to be non-hazardous under the criteria established by State of Michigan regulations, and is approved for release to the above material destination.

R. A. Walker
Environmental Operations Approval

6-5247
Telephone Number

10/04/2001
Approval Date

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RELEASE INSPECTION

This material has been inspected to assure that it is as described above, has not been mixed with other materials, and the special condition, if listed below, is fulfilled.

SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

517-636-4565
Telephone Number

1SCS117758-000X205796

TREATMENT/DISPOSAL PERMIT

117758-000 ID NUMBER

205796

MATERIAL DESTINATION: X DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10·09·01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

09-10-01 12:22 IN

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE

RELEASE APPROVAL

This material has been determined to be non-hazardous under the criteria established by State of Michigan regulations, and is approved for release to the above material destination.

R. A. Walker
Environmental Operations Approval

6-5247
Telephone Number

10/04/2001
Approval Date

Return unused/expired permits to Environmental Operation, 1078 Building.
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RELEASE INSPECTION

This material has been inspected to assure that it is as described above, has not been mixed with other materials, and the special condition, if listed below, is fulfilled.

SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

517-636-4565
Telephone Number

FORM 67000 R-8/99

REFER TO REVERSE SIDE OF PERMIT FOR INSTRUCTIONS
ENVIRONMENTAL OPERATIONS COPY

1SCS117758-000X205797

TREATMENT/DISPOSAL PERMIT

117758-000 ID NUMBER

205797

MATERIAL DESTINATION: X DOW LANDFILL MIDLAND CITY LANDFILL 1208 DEWATERING FACILITY

SHIPMENT DATE 10·09·01 BUILDING 1078 BUILD DOOR/SPOT

MATERIAL DESCRIPTION CONTAMINATED SOIL

CONTAINER TYPE/
DOW CONTAINER NUMBER Dump Truck

TOTAL
VOLUME (CU. YD.) 12

TRANSPORTER/
COMPANY NAME FISHER

TRANSPORTER
DRIVER'S SIGNATURE

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6-5247
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10/04/2001
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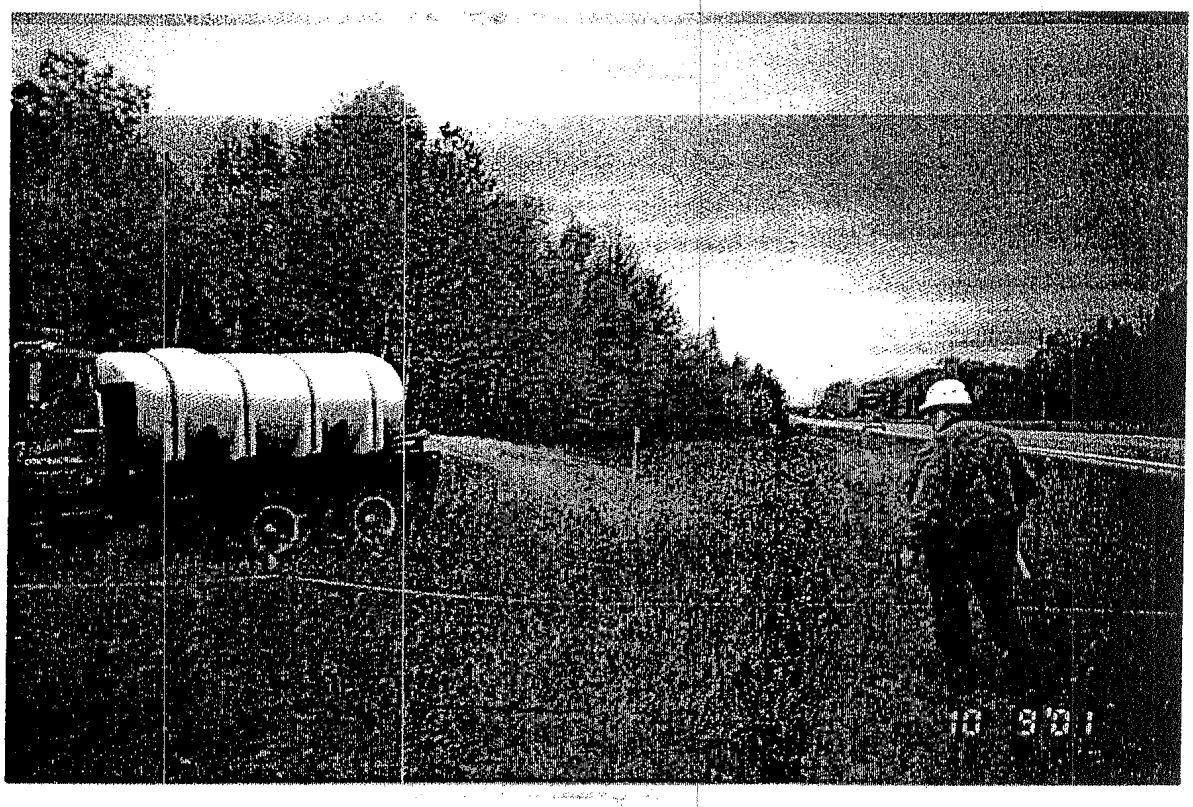
SPECIAL CONDITION: Cost Ctr: 00994070

Generator's Signature

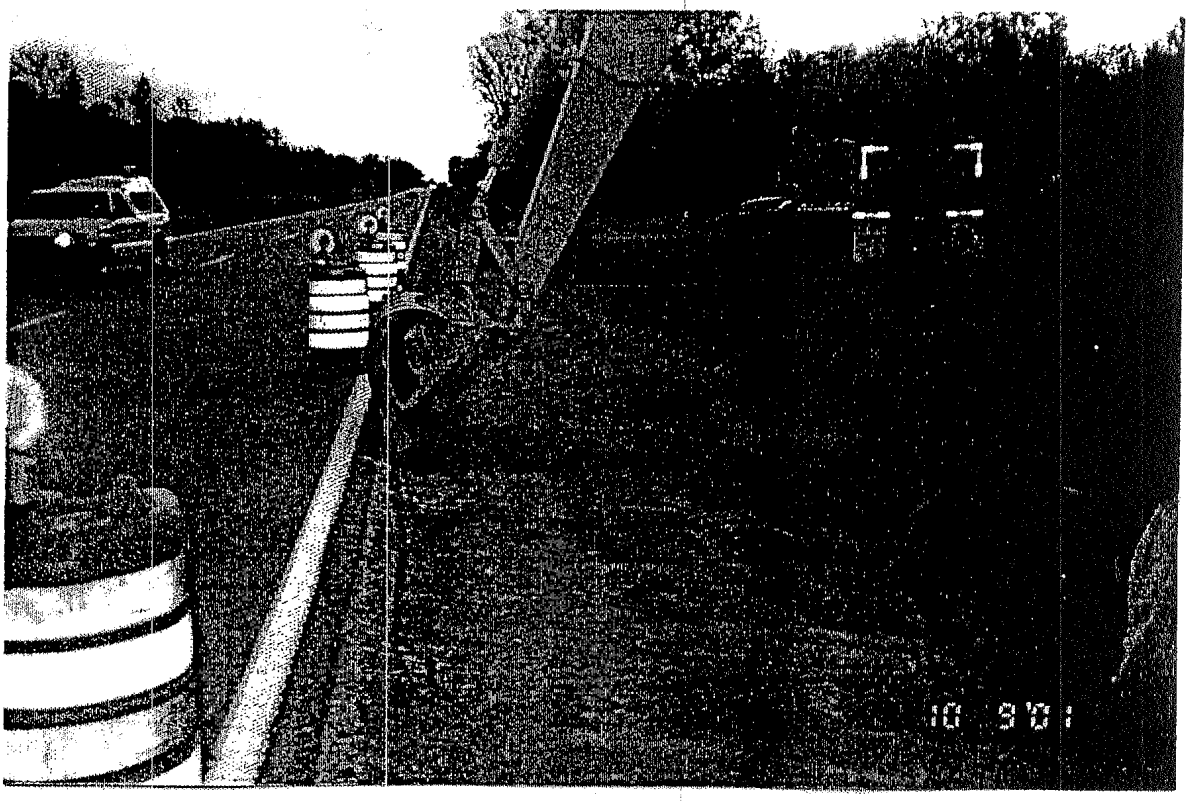
517-636-4565

ATTACHMENT 2

Salzburg Road Project



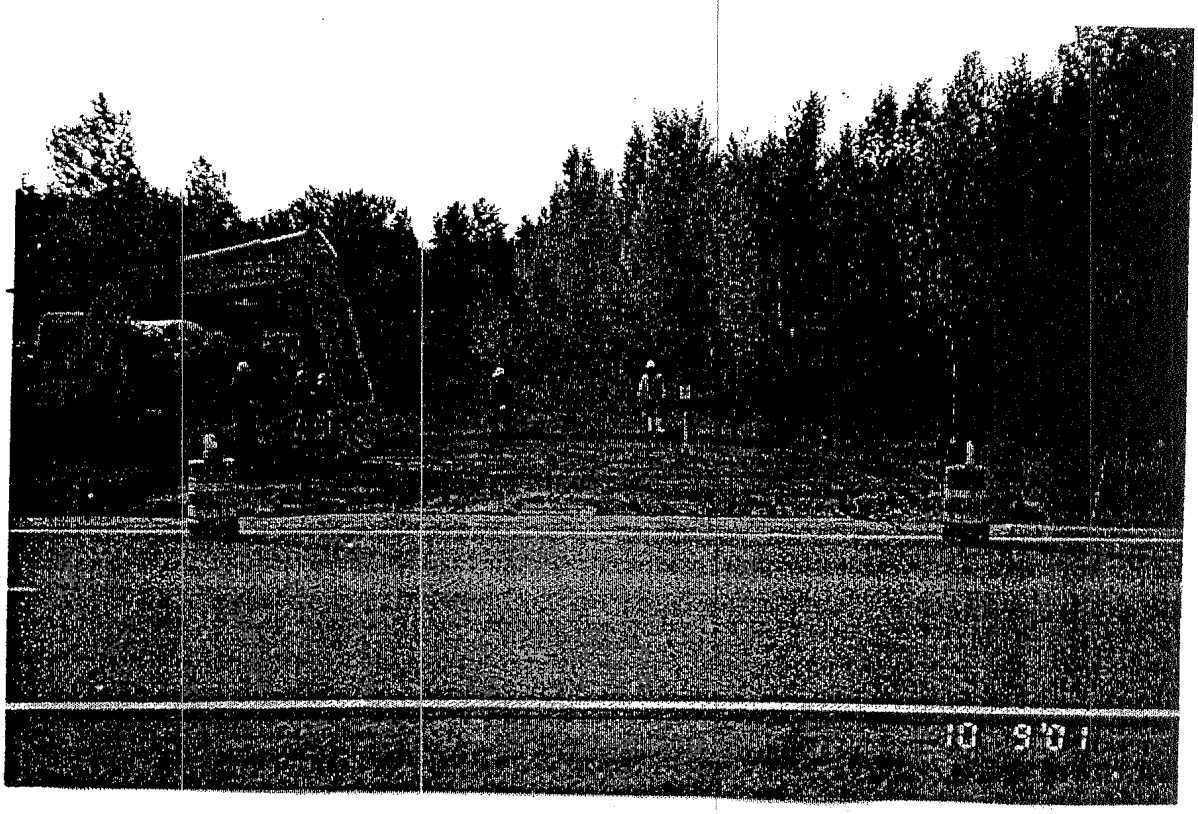
Preparing the Excavation Area



Excavation Adjacent to Salzburg Road

Salzburg Road Project

Completing Excavation



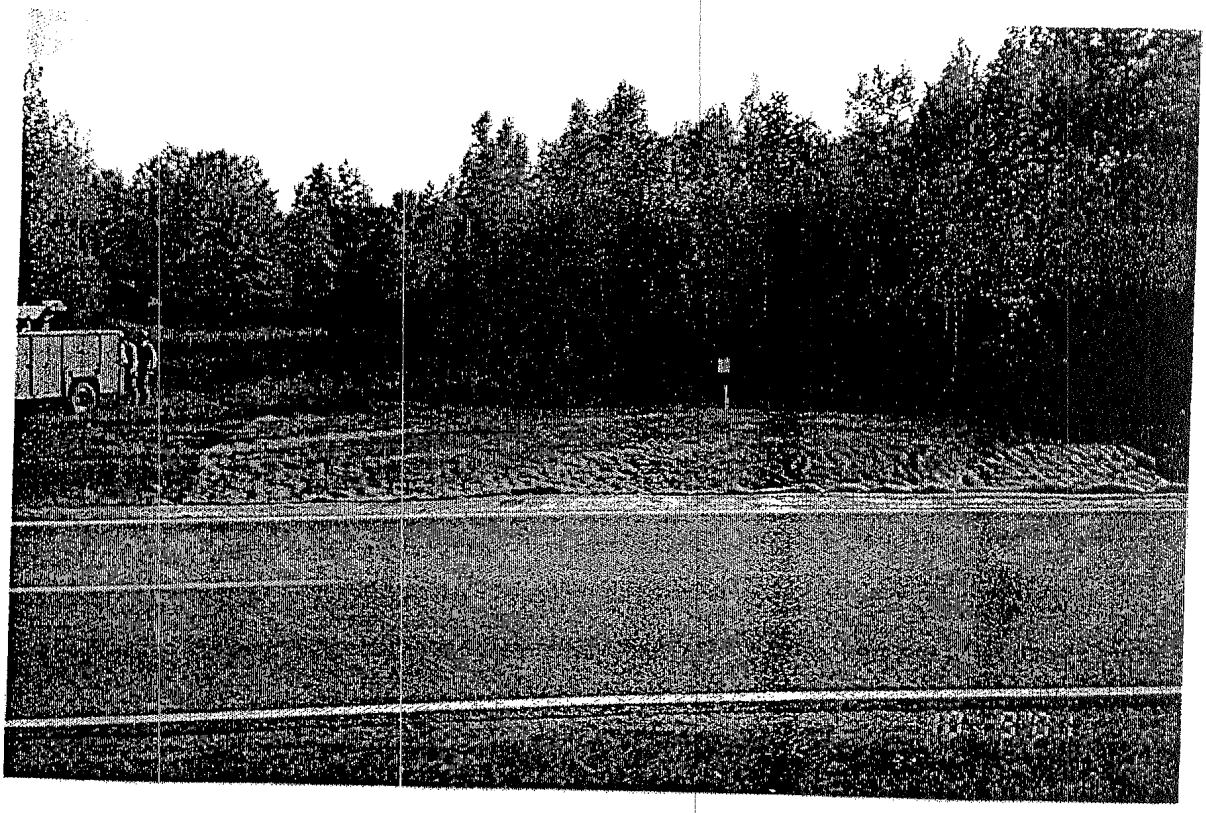
Completing Excavation, Looking South

Salzburg Road Project

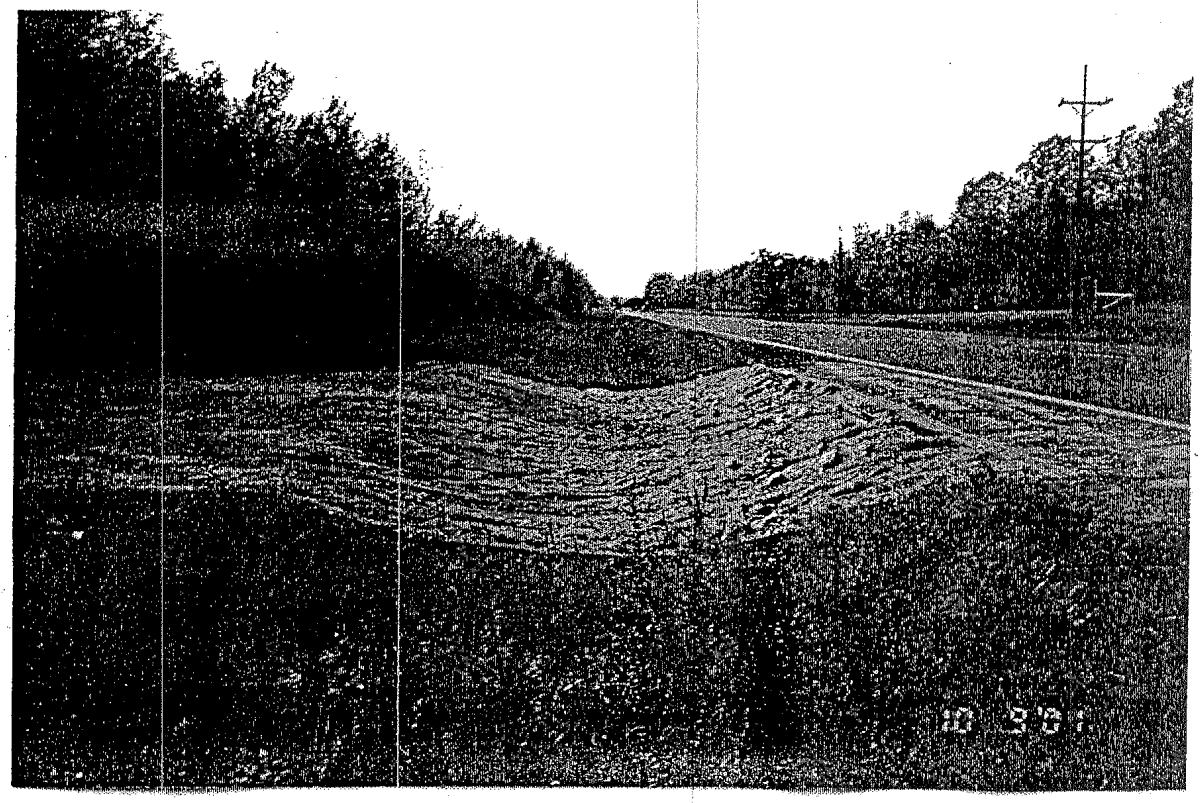
Post Excavation Sampling

Post Excavation Sampling

Salzburg Road Project



Completed Excavation, Looking South



Completed Excavation, Looking West

ATTACHMENT 3

RECORDED

561236

MAY 2 1 50 PM '89

RICHARD O. DIMENT
REGISTER OF DEEDS
MIDLAND COUNTY, MICH

WITNESS:

N 50° E — ℄ OF BELL CABLE M.H. 68.21'

S 10° W — ℄ OF STEM ON VALVE WHEEL, BRINE LINE 49.12'

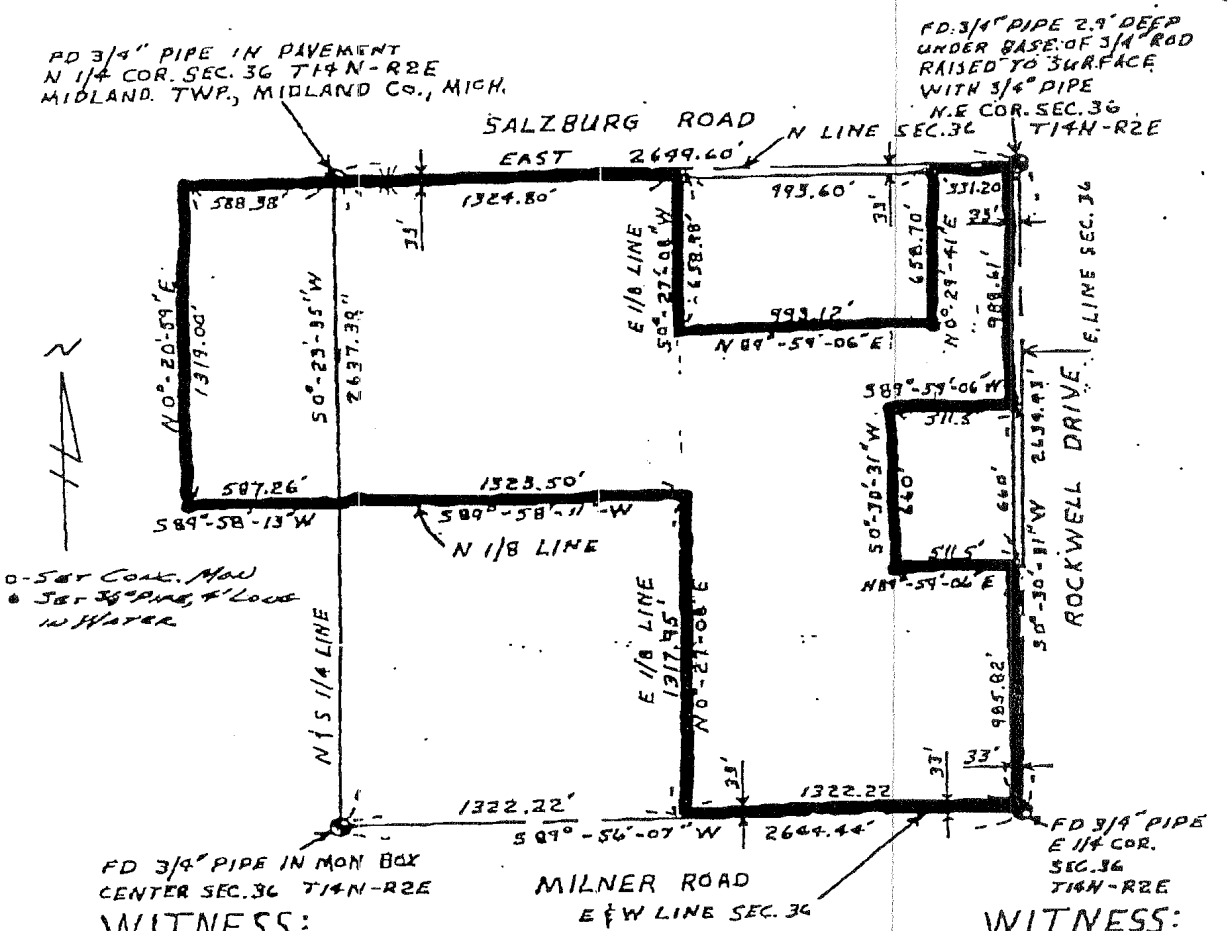
0.85' N OF ℄ PAVEMENT

WITNESS:

N 50° E — P.K. NAIL IN N.W. FACE OF POWER POLE 59.81'

S 35° E — NAIL & TAG IN 8" SPRUCE 91.08'

S 45° W — ℄ N.E. BOLT ON FLANGE ON TOP VALVE, B.L. 70.58'



O - Set Conc. Mon
● Set 3/4" Pipe, 4' Long in Water

WITNESS:

N 60° W — NAIL & TAG IN 8" POPLAR 67.46'

S 45° W — ℄ OF ROAD NAME SIGN 41.12'

N 10° E — NAIL & TAG IN 9" POPLAR 53.41'

1' N. OF ℄ OF PAVEMENT W. AND 0.5' W. OF ℄ PAVEMENT S.

S 40° E. — NAIL & TAG IN 8" BOX ELDER 52.98'

EAST 9.25', 3/4" ROD USED MON. BOX AS COR. SEC. AS HAS BEEN OCCUPIED CORNER

WITNESS:

S 45° E — ℄ OF LOWER HINGE BOLT ON GATE POST 65.27'

S 45° W — NAIL & TAG IN E SIDE OF TWIN 12" MAPLE — 103.61'

N 45° W — ℄ OF 3" PIPE, STANDING 4.5' HIG. 51.07'

SURVEY FOR

Dow Chemical Company
Midland, Michigan 48640

OWEN AYRES & ASSOCIATES INC
ENGINEERS AND SURVEYORS
3773 E. WACKERLY ROAD
MIDLAND, MICHIGAN 48640
(517) 839-9611

Scale: 1" = 600'	Drn. By: TRS	Job No. 3213.00
Date: 4/23/89	Ck'd. By: WCJ	Sheet 1 Of 2

SURVEY FOR: THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

SURVEY OF: PART OF THE NORTHEAST 1/4, NORTHWEST 1/4 AND PART OF THE NORTHEAST 1/4, SECTION 36, T14N-R2E, MIDLAND TOWNSHIP, MIDLAND COUNTY, MICHIGAN DESCIRBED AS BEGINNING AT THE NORTHEAST CORNER OF SAID SECTION 36; THENCE S 00 DEG 30 MIN 31 SEC W, 988.61 FT. ALONG THE EAST SECTION LINE; THENCE S 89 DEG 59 MIN 06 SEC W, 511.50 FT.; THENCE S 00 DEG 30 MIN 31 SEC W, 660 FT.; THENCE N 89 DEG 59 MIN 06 SEC E, 511.50 FT.; THENCE S 00 DEG 30 MIN 31 SEC W, 985.82 FT. ALONG SAID EAST SECTION LINE TO THE EAST 1/4 CORNER; THENCE S 89 DEG 56 MIN 07 SEC W, 1322.22 FT. ALONG THE EAST AND WEST 1/4 LINE; THENCE N 00 DEG 27 MIN 06 SEC E, 1317.95 FT. ALONG THE EAST 1/8th LINE; THENCE S 89 DEG 58 MIN 11 SEC W, 1323.50 FT. ALONG THE NORTH 1/8th LINE TO THE NORTH AND SOUTH 1/4 LINE; THENCE S 89 DEG 58 MIN 13 SEC W, 587.26 FT. ALONG THE NORTH 1/8th LINE; THENCE N 00 DEG 29 MIN 59 SEC E, 1319.00 FT. ALONG A LINE PARALLEL TO THE WEST 1/8th LINE TO A POINT WHICH IS EAST, 2060.26 FT. FROM THE NORTHWEST CORNER OF SAID SECTION 36; THENCE EAST, 588.38 FT. ALONG THE NORTH SECTION TO THE NORTH 1/4 CORNER OF SECTION 36; THENCE EAST, 1324.80 FT. ALONG SAID NORTH SECTION LINE; THENCE S 00 DEG 27 MIN 08 SEC W, 658.98 FT. ALONG THE EAST 1/8th LINE; THENCE N 89 DEG 59 MIN 06 SEC E, 993.12 FT. ALONG THE SOUTH LINE OF THE NORTH 1/2, NORTHEAST 1/4, NORTHEAST 1/4; THENCE N 00 DEG 29 IN 41 SEC E, 658.70 FT.; THENCE EAST 331.20 FT. ALONG THE NORTH SECTION LINE TO THE POINT OF BEGINNING. CONTAINING 115.16 ACRES, AND SUBJECT TO SALZBURG RD., ROCKWELL DR., AND MILNER RD. RIGHT OF WAYS, AND ANY EASEMENTS OF RECORD.

I, JERRY L. JONES, HEREBY CERTIFY THAT I HAVE SURVEYED AND MAPPED THE LAND ABOVE PLATTED AND DESCRIBED ON APRIL 23, 1984, AND THAT THE RATIO OF CLOSURE ON THE UNADJUSTED FIELD OBSERVATIONS OF SUCH SURVEY WAS 1/10,000, OR GREATER, AND THAT ALL OF THE REQUIREMENTS P.A. 132 OF 1970 HAVE BEEN COMPLIED WITH.

Jerry L Jones
JERRY L. JONES, LS 19838

STATE OF MICHIGAN
JERRY L. JONES
LAND SURVEYOR
No. 19838
REGISTERED LAND SURVEYOR

SURVEY FOR

The Dow Chemical Company
Midland, Michigan 48640

OWEN AYRES & ASSOCIATES INC
ENGINEERS AND SURVEYORS
3775 E. WACKERLY ROAD
MIDLAND, MICHIGAN 48640
(517) 839-9611

Scale: 1"=60'	Drn. By: TS	Job No. 3213.00
Date: 4-24-8	Ck'd. By: JLJ	Sheet 2 Of 2

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

"Better Service for a Better Environment"

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

INTERNET: www.deq.state.mi.us

RUSSELL J. HARDING, Director

REPLY TO:

WASTE MANAGEMENT DIVISION
PO BOX 30241
LANSING MI 48909-7741

September 24, 2001

Mr. Todd Konechne, Remediation Leader
Environmental Operations
The Dow Chemical Company
1100 Building
Midland, Michigan 48667

Dear Mr. Konechne:

SUBJECT: Approval of Interim Measure
Excavation and Backfilling of Salzburg Road Sample SSRR-10 Area
Near The Dow Chemical Company (Dow) Michigan Operations, Midland Plant
MID 000 724 724

Staff of the Michigan Department of Environmental Quality (MDEQ), Waste Management Division (WMD), have completed a review of the draft Salzburg Road Excavation Specifications (Specifications) dated August 28, 2001. The work described in the Specifications involves excavation of dioxin/furan contaminated soils to a depth of 0.5-foot in a diameter of about 50 feet around soil sampling location SSRR-10, adjacent to Salzburg Road and about ¾ mile east of Waldo Road, backfilling the area with clean topsoil/gravel and reestablishing vegetation. The removed soil is to be disposed of in the Dow Salzburg Road Landfill. The work is to be conducted within the public right of way of property owned by Dow during the week of September 24, 2001.

This work is considered a corrective action interim measure by the WMD and is hereby approved with the stipulations for approval listed below:

1. A confirmation sample must be taken from the SSRR-10 location after the contaminated soil has been removed to verify that levels of contamination have been reduced to below the Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, generic industrial criteria for dioxins and furans.

2. An Interim Measure Report summarizing the work completed (including, but not limited to, photo documentation, a description of the disposition of the excavated soils, copies of manifests for the soils, and verification sampling results) shall be submitted to the WMD (one copy to Ms. Cheryl Howe, Hazardous Waste Program Section, WMD, and one copy to Ms. Trisha Peters, WMD, Saginaw Bay District) within 30 days of completion. The Interim Measure Report must provide documentation that Dow owns the subject property, the property is zoned for industrial use, and the current and reasonably foreseeable future uses

of the land will be consistent with the exposure assumptions used for the development of the Part 201 generic industrial direct contact criteria.

For your information, the WMD's analytical results from the April 11, 2001 split sampling of this area are provided on the enclosed copy of the sample location/excavation diagram that you submitted on August 28, 2001. The spreadsheet for this data is also enclosed.

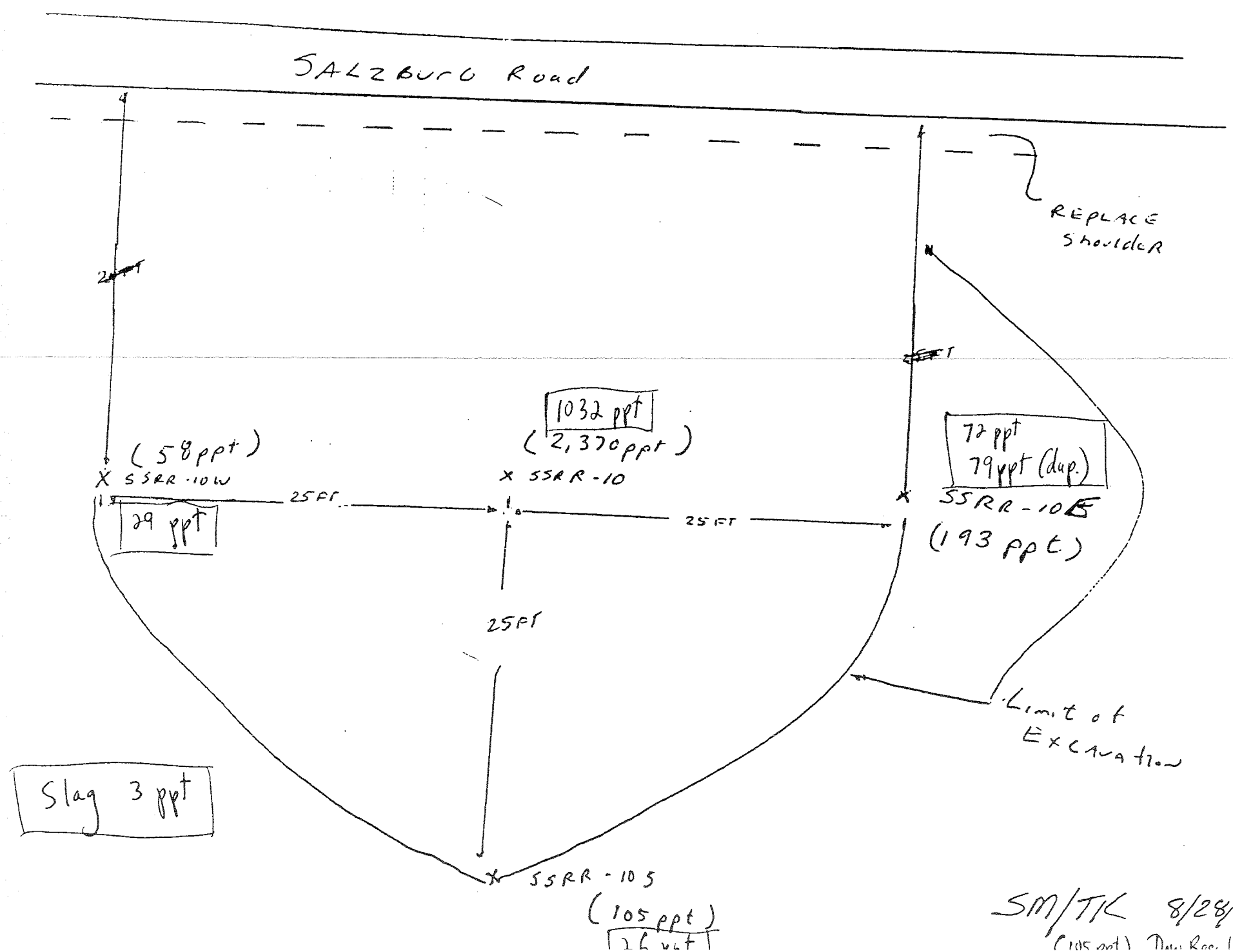
Please contact Ms. Howe, at 517-373-9881, if you have any questions regarding this approval, or you may contact me.

Sincerely,

Jim Sygo, Chief
Waste Management Division
517-373-9523

Enclosures

cc/enc: Dr. Jeffrey Feerer, Dow
Mr. Karl Tomion, City of Midland
Mr. Charles Newell, Midland County Health Department
Mr. Greg Rudloff, U.S. Environmental Protection Agency
Mr. Arthur R. Nash Jr., Deputy Director, MDEQ
Mr. Ken Burda, MDEQ/Corrective Action File
Mr. John Craig/Mr. Gary Tuma, MDEQ
Mr. Steve Buda, MDEQ
Ms. De Montgomery/Mr. Allan Taylor, MDEQ
Mr. Ed Haapala/Ms. Trisha Peters, MDEQ - Saginaw Bay
Ms. Cheryl Howe, MDEQ


SALZBURG Road
REPLACE Shoulder
25FT
(58ppt)
X SSRR-10W
29 ppt
25FT
1032 ppt
(2,370ppt)
X SSRR-10
25FT
25FT
72 ppt
79ppt (dup.)
SSRR-10E
(193 ppt)
Limit of Excavation
Slag 3 ppt
SSRR-10S
(105 ppt)
SM/TK 8/28/01

SSRR-10 REMEDIATION

Analyte	TEF		SS RR-S-10 *Project 53786* sampled (pg/g)	toxic eq. (ug/kg)	nondetect 1/2 d.l.	nondetect zero		SS RR-S-10-E(1) *Project 53786* sampled (pg/g)	toxic eq. (ug/kg)	nondetect 1/2 d.l.	nondetect zero		SS RR-S-10-E(2) *Project 53786* sampled (pg/g)	toxic eq. (ug/kg)	nondetect 1/2 d.l.	nondetect zero
2378-TCDD	1		11.7	0.0117	0.0117	0.0117		2.4	0.0024	0.0024	0.0024		2.8	0.0028	0.0028	0.0028
12378-PeCDD	0.5		173.0	0.0865	0.0865	0.0865		14.0	0.0070	0.0070	0.0070		14.6	0.0073	0.0073	0.0073
123478-HxCDD	0.1		464.0	0.0464	0.0464	0.0464		29.4	0.0029	0.0029	0.0029		29.4	0.0029	0.0029	0.0029
123678-HxCDD	0.1		1600.0	0.1600	0.1600	0.1600		69.6	0.0070	0.0070	0.0070		80.3	0.0080	0.0080	0.0080
123789-HxCDD	0.1		1020.0	0.1020	0.1020	0.1020		65.6	0.0066	0.0066	0.0066		72.5	0.0073	0.0073	0.0073
1234678-HpCDD	0.01	S,E	29070.0	0.2907	0.2907	0.2907	E	2010.0	0.0201	0.0201	0.0201	E	2270.0	0.0227	0.0227	0.0227
12346789-OCDD	0.001	Q,E	79230.0	0.0792	0.0792	0.0792	E	12460.0	0.0125	0.0125	0.0125	E	13890.0	0.0139	0.0139	0.0139
2378TCDF	0.1		4.2	0.0004	0.0004	0.0004		1.6	0.0002	0.0002	0.0002		1.8	0.0002	0.0002	0.0002
12378-PeCDF	0.05	ND	0.2	0.0000	0.0000	0.0000	J	3.3	0.0002	0.0002	0.0002	J	2.7	0.0001	0.0001	0.0001
23478-PeCDF	0.5		31.7	0.0159	0.0159	0.0159	J	3.8	0.0019	0.0019	0.0019	J	3.6	0.0018	0.0018	0.0018
123478-HxCDF	0.1		495.0	0.0495	0.0495	0.0495		25.4	0.0025	0.0025	0.0025		26.9	0.0027	0.0027	0.0027
123678-HxCDF	0.1		269.0	0.0269	0.0269	0.0269		17.9	0.0018	0.0018	0.0018		18.9	0.0019	0.0019	0.0019
234678-HxCDF	0.1		427.0	0.0427	0.0427	0.0427		23.3	0.0023	0.0023	0.0023		24.6	0.0025	0.0025	0.0025
123789-HxCDF	0.1	ND	0.2	0.0000	0.0000	0.0000	ND	0.1	0.0000	0.0000	0.0000	ND	0.2	0.0000	0.0000	0.0000
1234678-HpCDF	0.01	E	8570.0	0.0857	0.0857	0.0857		367.0	0.0037	0.0037	0.0037		415.0	0.0042	0.0042	0.0042
1234789-HpCDF	0.01		595.0	0.0060	0.0060	0.0060		24.0	0.0002	0.0002	0.0002		24.4	0.0002	0.0002	0.0002
12346789-OCDF	0.001	Q,E	28190.0	0.0282	0.0282	0.0282		506.0	0.0005	0.0005	0.0005		573.0	0.0006	0.0006	0.0006
nondetects = detection limit			TEQ =	1.0318				TEQ =	0.0717				TEQ =	0.0791		
nondetects = 1/2 d.l.			*teq =*		1.0318			*teq =*		0.0717			*teq =*		0.0790	
nondetects = zero			teq =			1.0317		teq =			0.0717		teq =			0.0790
			(pg/g)	(ug/kg)				(pg/g)	(ug/kg)				(pg/g)	(ug/kg)		
TOTAL TCDD			94	0.0938				28	0.0280				48	0.0478		
TOTAL PeCDD			818	0.8180				93.5	0.0935				107	0.1070		
TOTAL HxCDD			8450	8.4500				560	0.5600				617	0.6170		
TOTAL HpCDD		S,E	51130	51.1300			E	3510	3.5100			E	3950	3.9500		
TOTAL TCDF		X	610	0.6100			X	177	0.1770			X	234	0.2340		
TOTAL PeCDF		X	2990	2.9900			X	238	0.2380			X	291	0.2910		
TOTAL HxCDF		X,E	18410	18.4100			X	612	0.6120			X	727	0.7270		
TOTAL HpCDF		S,X,E	31610	31.6100				1140	1.1400			X	1360	1.3600		

SSRR-10 REMEDIATION															
			SS RR-S-10-S				SS RR-S-10-W					SSRR-10 SLAG			
			Project 53786				*Project 53786*					*Project 53877Br2*			
Analyte		sampled	toxic eq.	nondetect	nondetect		sampled	toxic eq.	nondetect	nondetect		sampled	toxic eq.	nondetect	nondetect
		(pg/g)	(ug/kg)	1/2 d.l.	zero		(pg/g)	(ug/kg)	1/2 d.l.	zero		(pg/g)	(ug/kg)	1/2 d.l.	zero
2378-TCDD		8.90	0.0089	0.0089	0.0089		3.70	0.0037	0.0037	0.0037	ND	1.00	0.0010	0.0005	0.0000
12378-PeCDD		6.40	0.0032	0.0032	0.0032		6.10	0.0031	0.0031	0.0031	ND	1.20	0.0006	0.0003	0.0000
123478-HxCDD		7.30	0.0007	0.0007	0.0007		6.60	0.0007	0.0007	0.0007	ND	1.30	0.0001	0.0001	0.0000
123678-HxCDD		15.30	0.0015	0.0015	0.0015		15.70	0.0016	0.0016	0.0016	ND	1.20	0.0001	0.0001	0.0000
123789-HxCDD		13.20	0.0013	0.0013	0.0013		14.40	0.0014	0.0014	0.0014	ND	1.20	0.0001	0.0001	0.0000
1234678-HpCDD		230.00	0.0023	0.0023	0.0023		384.00	0.0038	0.0038	0.0038	ND	1.60	0.0000	0.0000	0.0000
12346789-OCDD		2730.00	0.0027	0.0027	0.0027		2710.00	0.0027	0.0027	0.0027	B	14.90	0.0000	0.0000	0.0000
2378TCDF		2.70	0.0003	0.0003	0.0003		1.70	0.0002	0.0002	0.0002	ND	0.70	0.0001	0.0000	0.0000
12378-PeCDF	ND	0.10	0.0000	0.0000	0.0000	ND	0.10	0.0000	0.0000	0.0000	ND	0.80	0.0000	0.0000	0.0000
23478-PeCDF	J	2.70	0.0014	0.0014	0.0014	J	1.90	0.0010	0.0010	0.0010	ND	0.80	0.0004	0.0002	0.0000
123478-HxCDF		8.70	0.0009	0.0009	0.0009		6.30	0.0006	0.0006	0.0006	ND	0.80	0.0001	0.0000	0.0000
123678-HxCDF	J	4.20	0.0004	0.0004	0.0004	J	3.40	0.0003	0.0003	0.0003	ND	0.70	0.0001	0.0000	0.0000
234678-HxCDF		5.40	0.0005	0.0005	0.0005		5.20	0.0005	0.0005	0.0005	ND	0.80	0.0001	0.0000	0.0000
123789-HxCDF	ND	0.20	0.0000	0.0000	0.0000	ND	0.20	0.0000	0.0000	0.0000	ND	1.00	0.0001	0.0001	0.0000
1234678-HpCDF		124.00	0.0012	0.0012	0.0012		109.00	0.0011	0.0011	0.0011	ND	1.20	0.0000	0.0000	0.0000
1234789-HpCDF	ND	5.20	0.0001	0.0000	0.0000		5.40	0.0001	0.0001	0.0001	ND	1.50	0.0000	0.0000	0.0000
12346789-OCDF		216.00	0.0002	0.0002	0.0002		207.00	0.0002	0.0002	0.0002	J,B	2.20	0.0000	0.0000	0.0000
nondetects = detection limit		TEQ =	0.0257				TEQ =	0.0210				TEQ =	0.0029		
nondetects = 1/2 d.l.		*teq =*		0.0257			*teq =*		0.0209			*teq =*		0.0014	
nondetects = zero		teq =			0.0256		teq =			0.0209		teq =			0.0000
		(pg/g)	(ug/kg)				(pg/g)	(ug/kg)				(pg/g)	(ug/kg)		
TOTAL TCDD		57.2	0.0572				39.5	0.0395				1.0	0.0010		
TOTAL PeCDD		37.8	0.0378				41.7	0.0417			ND	1.2	0.0012		
TOTAL HxCDD		132.0	0.1320				131.0	0.1310			ND	1.2	0.0012		
TOTAL HpCDD		618.0	0.6180				714.0	0.7140			ND	1.6	0.0016		
TOTAL TCDF	X	252.0	0.2520			X	157.0	0.1570				8.9	0.0089		
TOTAL PeCDF	X	145.0	0.1450			X	107.0	0.1070			ND	1.9	0.0019		
TOTAL HxCDF	X	152.0	0.1520			X	147.0	0.1470			ND	4.4	0.0044		
TOTAL HpCDF		316.0	0.3160			X	357.0	0.3570			ND	1.3	0.0013		

SSRR-10 REMEDIATION					
			FIELD BLANK		
			Project 53877Br2		
Analyte		sampled	toxic eq.	nondetect	nondetect
		(pg/g)	(ug/kg)	1/2 d.l.	zero
2378-TCDD	ND	0.30	0.0003	0.0002	0.0000
12378-PeCDD	ND	0.30	0.0002	0.0001	0.0000
123478-HxCDD	ND	0.40	0.0000	0.0000	0.0000
123678-HxCDD	ND	0.30	0.0000	0.0000	0.0000
123789-HxCDD	ND	0.30	0.0000	0.0000	0.0000
1234678-HpCDD	J	1.90	0.0000	0.0000	0.0000
12346789-OCDD	B	11.70	0.0000	0.0000	0.0000
2378TCDF	ND	0.20	0.0000	0.0000	0.0000
12378-PeCDF	ND	0.20	0.0000	0.0000	0.0000
23478-PeCDF	ND	0.20	0.0001	0.0001	0.0000
123478-HxCDF	J	0.54	0.0001	0.0001	0.0001
123678-HxCDF	ND	0.20	0.0000	0.0000	0.0000
234678-HxCDF	ND	0.20	0.0000	0.0000	0.0000
123789-HxCDF	ND	0.20	0.0000	0.0000	0.0000
1234678-HpCDF	ND,J	0.80	0.0000	0.0000	0.0000
1234789-HpCDF	ND	0.30	0.0000	0.0000	0.0000
12346789-OCDF	ND,J	2.00	0.0000	0.0000	0.0000
nondetects = detection limit		TEQ =	0.0008		
nondetects = 1/2 d.l.		*teq =*		0.0005	
nondetects = zero		teq =			0.0001
		(pg/g)	(ug/kg)		
TOTAL TCDD	ND	0.3	0.0003		
TOTAL PeCDD	ND	0.3	0.0003		
TOTAL HxCDD	ND	0.8	0.0008		
TOTAL HpCDD		3.2	0.0032		
TOTAL TCDF	ND	0.2	0.0002		
TOTAL PeCDF		0.7	0.0007		
TOTAL HxCDF		0.5	0.0005		
TOTAL HpCDF		1.2	0.0012		

DATA FLAGS

In order to assist with data interpretation, data qualifier flags are used on the final reports. The most commonly used flags are:

ND = analyte not detected. Value is the detection limit.

B = analyte has been detected in the laboratory method blank as well as in an associated field sample.

E = indicates a concentration based on an analyte to internal standard ratio which exceeds the range of the calibration curve. Values which are outside the calibration curve are estimates only.

I = indicates labeled standards have been interfered with on the GC column by coeluting, interferent peaks.

J = indicates a concentration based on an analyte to internal standard ration which is below the calibration curve. Values outside the calibration curve are estimates only.

PR = indicates that a GC peak is poorly resolved. The concentrations or amounts reported for such peaks are most likely overestimated.

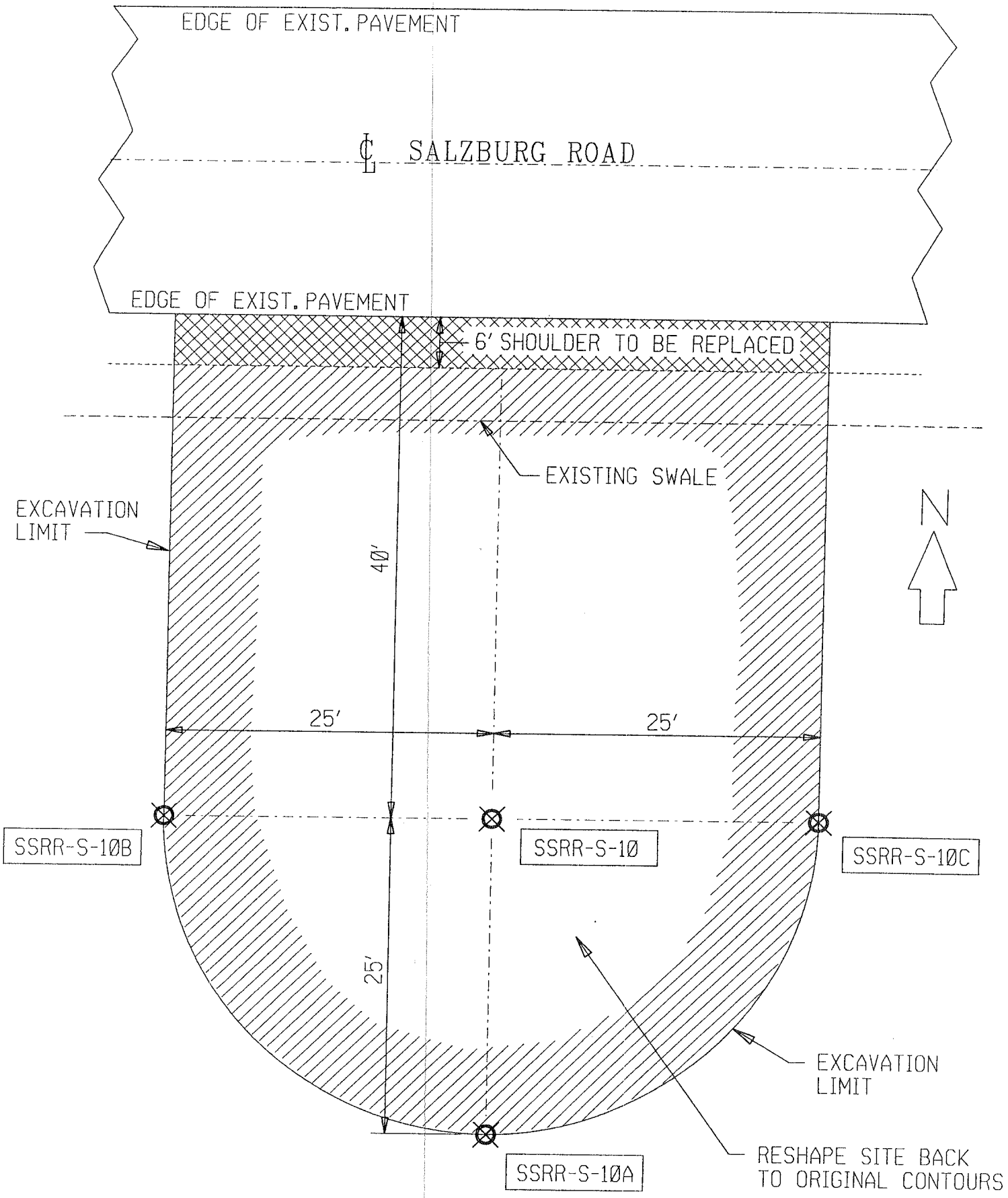
Q = indicates the presence of QC ion instabilities caused by quantitative interferences.

S = indicates that the response of a specific PCDD/PCDF isomer has exceeded the normal dynamic range of the mass spectrometer detection system. The corresponding signal is saturated and the reported analyte concentration is a 'minimum estimate'. Results for saturated analytes are reported as greater than the upper calibration limit.

U = indicates that a specific isomer cannot be resolved from a large, coleluting interferent GC peak. The specific isomer is reported as not detected as a valid concentration cannot be determined. The calculated detection limit, therefore, should be considered an underestimated value.

V = indicates that, although the percent recovery of a labeled standard may be below a specific QC limit, the signal-to-noise ratio of the peak is greater than ten-to-one. The standard is considered reliably quantifiable. All quantitations derived from the standard are considered valid as well.

X = indicates that a polychlorodibenzofuran (PCDF) peak has eluted at the same time as the associated diphenyl ether (DPE) and that the DPE peak intensity is at least ten percent of the total PCDF peak intensity. Total PCDF values are flagged "X" if the total DPE contribution to the total PCDF value is greater than ten percent.



* SSRR-S-10 (OCT. 2001)
COLLECTED FROM EXPOSED SUBGRADE

\DUST\Scott.DGN

LEG/SM 11-28-01

SALZBURG ROAD EXCAVATION SPECIFICATIONS

Project Description

An excavation has been selected to address soils adjacent to Salzburg Road approximately 0.6 miles east of Waldo Road or 1.45 miles east of Saginaw Road. The area is along the south portion of the Salzburg Road right of way and Dow Chemical property and is approximately 50 feet in diameter. Soils will be excavated to a depth of 0.5 feet and placed into tandem dump trucks. The material will then be transported to Dow Michigan Division and appropriately managed. The disturbed area will be backfilled with topsoil and gravel (shoulder) and seeded. The contractor shall adhere to procedures and specifications stipulated in the Midland County Road Commission permit.

Safety

The Contractor shall prepare a Safety Activity Plan addressing how the work will be completed in a safe manor both within Public right-of-way (ROW). As a minimum, the Contractor shall perform all work within Public ROW in accordance with Midland County requirements and the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). Signage and traffic control within Public ROW shall be paid for on a time and material basis and include all labor, materials and equipment required to erect, maintain, relocate (if necessary) and remove all signage and traffic control devices.

Site Preparation

Site Preparation work shall be paid for on a time and material basis. There is a gas line that is within the working area. The Site Preparation activities shall include the following items:

- Miss Dig notification
- Verifying utilities

Soil Excavation

The soil shall be removed with an excavator to approximately six inches below level surface. The excavation should extend to the limit of Salzburg Road. The limit of the excavation will be marked in the field prior to commencement of the activities. As presented on the attached Figure, the approximate limit is 50 feet x 50 feet. The activity should commence near the northwest portion of the removal area and proceed southeast. Manifesting procedures will be completed during the transportation of the soil. Truck traffic on exposed subgrade should be avoided to eliminate track out. The removed topsoil should be direct loaded into a tandem dump truck. Access to the excavation is provided by an access road located approximately 200 feet due east of the planned excavation area.

Dust & Trackout Control Measures

The work shall be carried out in a manner that will minimize dust and trackout. The area shall be prepared by applying water to the excavation area. Dust and trackout control shall be managed by the Contractor at all times. Dust & Trackout Control Measures shall be paid for on a time and material basis.

Backfill

The existing Salzburg Road shoulder shall be reestablished with appropriate aggregate base per MDOT specifications. Topsoil shall be of the heavy, silty/clayey loam variety. Topsoil source(s) shall be approved prior to project commencement. Topsoil shall be tailgate dumped and spread from site boundaries and proceed inward. Topsoil shall be placed to a nominal 6-inch thickness. The topsoil shall be placed so the established site drainage patterns. The flow line of the drainage swale adjacent to Salzburg Road shall be reestablished. Topsoil shall be measured and paid for on a cubic yard (loose measure) basis. The price shall include all labor, material and equipment required to furnish and place a 6-inch layer of topsoil. Estimated quantity – 8 tons aggregate, 50 tons of topsoil.

Seeding

The disturbed areas shall be hydroseeded, fertilized, and mulched at the agreed greenbelt enhancement rate. The straw shall be "crimped" into the topsoil immediately after it has been placed. Estimated quantity – 5625 cubic feet.

Appendix C
Soil Sample Results from Previous Studies

see Inset A

Inset A

Saginaw Rd.
Wheeler Rd.
Eastman Rd.
Jefferson Ave.
Washington St.
Swede Ave.
E Ashman St.
Waldo Ave.
Bay City Rd.
W. Midland St.
Salzburg Rd.
Poseyville Rd.
Gordonville Rd.
Bailey Bridge
HotchkissRd.
Smiths Crossing Rd.
Bitzer Rd.
Stanley Rd.
Ave.
10

Tittabawassee River
Chippewa River
Tittabawassee River
Tittabawassee River
Tittabawassee River
Brine Pond Number 6
Tertiary Pond
Midland Cogeneration Venture Cooling Pond

84DOW-371 17-III (A) 2378 TCDD: 0.6

83EPA2-300 F-1-L 2378 TCDD: 13

02DEQ1-083 EMP-1 2378 TCDD: 1.6 Calculated TEQ: 5

02DEQ1-083 EMP-1 2378 TCDD: 8.9 Calculated TEQ: 21

02DEQ1-083 EMP-1 2378 TCDD: 3.7 Calculated TEQ: 10

02DEQ1-083 EMP-1 2378 TCDD: 3 Calculated TEQ: 7.2

02DEQ1-084 EMP-2 2378 TCDD: 5.7 Calculated TEQ: 27

02DEQ1-084 EMP-2 2378 TCDD: 17 Calculated TEQ: 92

02DEQ1-084 EMP-2 2378 TCDD: 15 Calculated TEQ: 50

02DEQ1-084 EMP-2 2378 TCDD: 6.3 Calculated TEQ: 23

02DEQ1-085 EMP-3 2378 TCDD: 6.2 Calculated TEQ: 20

02DEQ1-085 EMP-3 2378 TCDD: 5.2 Calculated TEQ: 21

02DEQ1-085 EMP-3 2378 TCDD: 1.4 Calculated TEQ: 5.2

02DEQ1-085 EMP-3 2378 TCDD: 3.9 Calculated TEQ: 14

96DEQ-448 SW-22 2378 TCDD: 7.4 Calculated TEQ: 16

83EPA2-349 TO-4-G 2378 TCDD: 11

96DEQ-432 NE-P-23 2378 TCDD: 64 Calculated TEQ: 140

83EPA2-277 A-3-L 2378 TCDD: 9

84DOW-376 20-III (C) 2378 TCDD: 7.2

83EPA2-275 A-1-L 2378 TCDD: 75

83EPA2-302 I-10-L 2378 TCDD: 12

96DEQ-441 NE-S-10 2378 TCDD: 30 Calculated TEQ: 100

96DEQ-435 NE-P-26 2378 TCDD: 10 Calculated TEQ: 24

96DEQ-442 NE-S-11 2378 TCDD: 41 Calculated TEQ: 100

96DEQ-443 NE-S-12 2378 TCDD: 44 Calculated TEQ: 100

96DEQ-434 NE-P-25 2378 TCDD: 9.6 Calculated TEQ: 99

83EPA2-310 P-8-L 2378 TCDD: 76

83EPA2-309 P-8-L 2378 TCDD: 170

83EPA2-279 B-1-L 2378 TCDD: 76

83EPA2-313 PER-2-L 2378 TCDD: 310

83EPA2-314 PER-5-L 2378 TCDD: 210

83EPA2-350 TO-6-G 2378 TCDD: 250

96DEQ-416 NE-47 2378 TCDD: 290 Calculated TEQ: 590

83EPA2-316 PER-8-L 2378 TCDD: 10

98DOW-519 NEPP-S-05 2378 TCDD: 14 Calculated TEQ: 43

98DOW-518 NEPP-S-04 2378 TCDD: 20 Calculated TEQ: 120

98DOW-520 NEPP-S-06 2378 TCDD: 16 Calculated TEQ: 67

98DOW-521 NEPP-S-07 2378 TCDD: 20 Calculated TEQ: 86

98DOW-523 NEPP-S-09 2378 TCDD: 18 Calculated TEQ: 70

98DOW-524 NEPP-S-10 2378 TCDD: 66 Calculated TEQ: 850

83EPA2-351 TO-9-G 2378 TCDD: 14

98DOW-468 AA3-S-01 2378 TCDD: 94 Calculated TEQ: 310

83EPA2-317 PER-9-D 2378 TCDD: 2000

96DEQ-420 NE-D-106 2378 TCDD: 13 Calculated TEQ: 72

96DEQ-463 SW-P-45 2378 TCDD: 12 Calculated TEQ: 45

83EPA2-311 PER-10-L 2378 TCDD: 40

96DEQ-451 SW-38 2378 TCDD: 5.8 Calculated TEQ: 25

96DEQ-461 SW-D-104 2378 TCDD: 120 Calculated TEQ: 450

83EPA2-296 E-1-L 2378 TCDD: 26

83EPA2-303 P-11-L 2378 TCDD: 110

96DEQ-465 SW-S-39 2378 TCDD: 43 Calculated TEQ: 100

83EPA2-297 E-3-L 2378 TCDD: 9

83EPA2-298 E-3-L 2378 TCDD: 9

96DEQ-454 SW-43 2378 TCDD: 3.5 Calculated TEQ: 14

96DEQ-450 SW-36 2378 TCDD: 25 Calculated TEQ: 76

83EPA2-305 P-2-L 2378 TCDD: 28

96DEQ-433 NE-P-24 2378 TCDD: 15 Calculated TEQ: 33

83EPA2-281 B-3-L 2378 TCDD: 20

96DEQ-444 NE-S-13 2378 TCDD: 47 Calculated TEQ: 94

96DEQ-430 NE-P-16 2378 TCDD: 100 Calculated TEQ: 210

83EPA2-285 C-1-L 2378 TCDD: 26

98DOW-522 NEPP-S-08 2378 TCDD: 27 Calculated TEQ: 88

84DOW-372 18-III (I) 2378 TCDD: 58

84DOW-378 23-III (K) 2378 TCDD: 170

84DOW-408 9-II (J) 2378 TCDD: 450

83EPA2-291 D-1-L 2378 TCDD: 1

83EPA2-283 B-4-L 2378 TCDD: 19

96DEQ-437 NE-P-28 2378 TCDD: 15 Calculated TEQ: 44

96DEQ-436 NE-P-27 2378 TCDD: 37 Calculated TEQ: 85

96DEQ-438 NE-P-29 2378 TCDD: 11 Calculated TEQ: 32

84DOW-367 16-III (D) 2378 TCDD: 9.2

96DEQ-439 NE-P-30 2378 TCDD: 3.8 Calculated TEQ: 14

96DEQ-440 NE-P-30A 2378 TCDD: 3.5 Calculated TEQ: 14

83EPA2-289 C-4-L 2378 TCDD: 24

96DEQ-431 NE-P-17 2378 TCDD: 46 Calculated TEQ: 180

83EPA2-287 C-3-L 2378 TCDD: 12

84DOW-356 10-II (E) 2378 TCDD: 73

96DEQ-445 NE-S-14 2378 TCDD: 22 Calculated TEQ: 69

83EPA2-308 P-7-L 2378 TCDD: 78

96DEQ-409 NE-15 2378 TCDD: 11 Calculated TEQ: 30

96DEQ-411 NE-18 2378 TCDD: 50 Calculated TEQ: 120

96DEQ-417 NE-48 2378 TCDD: 22 Calculated TEQ: 77

83EPA2-292 D-2-6 2378 TCDD: 28

98DOW-547 SSRR-S-04 2378 TCDD: 32 Calculated TEQ: 160

98DOW-549 SSRR-S-06 2378 TCDD: 8.5 Calculated TEQ: 35

98DOW-550 SSRR-S-07 2378 TCDD: 8.1 Calculated TEQ: 31

98DOW-551 SSRR-S-08 2378 TCDD: 19 Calculated TEQ: 62

96DEQ-412 NE-19 2378 TCDD: 21 Calculated TEQ: 74

98DOW-555 SSRR-S-12 2378 TCDD: 13 Calculated TEQ: 39

98DOW-556 SSRR-S-13 2378 TCDD: 11 Calculated TEQ: 200

83EPA2-306 P-5-L 2378 TCDD: 3

96DEQ-413 NE-20 2378 TCDD: 86 Calculated TEQ: 580

98DOW-557 SSRR-S-14 2378 TCDD: 15 Calculated TEQ: 54

98DOW-558 SSRR-S-15 2378 TCDD: 5 Calculated TEQ: 30

98DOW-559 SSRR-S-16 2378 TCDD: 1.8 Calculated TEQ: 8.8

96DEQ-414 NE-37 2378 TCDD: 20 Calculated TEQ: 200

98DOW-548 SSRR-S-05 2378 TCDD: 14 Calculated TEQ: 58

83EPA2-294 D-3-L 2378 TCDD: 18

98DOW-552 SSRR-S-09 2378 TCDD: 19 Calculated TEQ: 57

98DOW-554 SSRR-S-11 2378 TCDD: 11 Calculated TEQ: 37

98DOW-553 SSRR-S-10 2378 TCDD: 26 Calculated TEQ: 2000

98DOW-494 CC-S-26 2378 TCDD: 39 Calculated TEQ: 96

98DOW-493 CC-S-25 2378 TCDD: 32 Calculated TEQ: 90

98DOW-491 CC-S-23 2378 TCDD: 33 Calculated TEQ: 99

98DOW-490 CC-S-22 2378 TCDD: 28 Calculated TEQ: 75

98DOW-488 CC-S-20 2378 TCDD: 66 Calculated TEQ: 150

98DOW-496 CC-S-28 2378 TCDD: 230 Calculated TEQ: 490

98DOW-495 CC-S-27 2378 TCDD: 360 Calculated TEQ: 720

98DOW-492 CC-S-24 2378 TCDD: 30 Calculated TEQ: 84

98DOW-489 CC-S-21 2378 TCDD: 38 Calculated TEQ: 96

98DOW-487 CC-S-19 2378 TCDD: 51 Calculated TEQ: 130

98DOW-486 CC-S-18 2378 TCDD: 51 Calculated TEQ: 120

98DOW-484 CC-S-16 2378 TCDD: 39 Calculated TEQ: 100

98DOW-483 CC-S-15 2378 TCDD: 44 Calculated TEQ: 120

98DOW-479 CC-S-11 2378 TCDD: 38 Calculated TEQ: 110

98DOW-476 CC-S-08 2378 TCDD: 32 Calculated TEQ: 89

98DOW-475 CC-S-07 2378 TCDD: 26 Calculated TEQ: 85

98DOW-485 CC-S-17 2378 TCDD: 32 Calculated TEQ: 94

98DOW-482 CC-S-14 2378 TCDD: 34 Calculated TEQ: 95

98DOW-481 CC-S-13 2378 TCDD: 41 Calculated TEQ: 100

98DOW-480 CC-S-12 2378 TCDD: 38 Calculated TEQ: 110

98DOW-478 CC-S-10 2378 TCDD: 34 Calculated TEQ: 95

98DOW-477 CC-S-09 2378 TCDD: 27 Calculated TEQ: 78

98DOW-503 CC-S-35 2378 TCDD: 140 Calculated TEQ: 220

98DOW-501 CC-S-33 2378 TCDD: 51 Calculated TEQ: 120

98DOW-499 CC-S-31 2378 TCDD: 46 Calculated TEQ: 99

98DOW-498 CC-S-30 2378 TCDD: 50 Calculated TEQ: 100

98DOW-497 CC-S-29 2378 TCDD: 29 Calculated TEQ: 78

98DOW-469 CC-S-01 2378 TCDD: 5.8 Calculated TEQ: 14

98DOW-470 CC-S-02 2378 TCDD: 24 Calculated TEQ: 56

98DOW-472 CC-S-04 2378 TCDD: 150 Calculated TEQ: 290

98DOW-502 CC-S-34 2378 TCDD: 90 Calculated TEQ: 180

98DOW-500 CC-S-32 2378 TCDD: 94 Calculated TEQ: 210

98DOW-474 CC-S-06 2378 TCDD: 66 Calculated TEQ: 130

98DOW-513 CC-S-45 2378 TCDD: 39 Calculated TEQ: 140

98DOW-471 CC-S-03 2378 TCDD: 48 Calculated TEQ: 100

98DOW-506 CC-S-41 2378 TCDD: 72 Calculated TEQ: 160

98DOW-511 CC-S-43 2378 TCDD: 56 Calculated TEQ: 160

98DOW-506 CC-S-38 2378 TCDD: 58 Calculated TEQ: 150

98DOW-504 CC-S-36 2378 TCDD: 41 Calculated TEQ: 130

98DOW-512 CC-S-44 2378 TCDD: 62 Calculated TEQ: 170

98DOW-510 CC-S-42 2378 TCDD: 50 Calculated TEQ: 140

98DOW-508 CC-S-40 2378 TCDD: 47 Calculated TEQ: 140

98DOW-507 CC-S-39 2378 TCDD: 100 Calculated TEQ: 210

98DOW-473 CC-S-05 2378 TCDD: 73 Calculated TEQ: 170

98DOW-505 CC-S-37 2378 TCDD: 49 Calculated TEQ: 130

96DEQ-465 - (Project Sample ID)
SW-S-39 - (Original Sample ID)
2378 TCDD: 43 - (2,3,7,8-tetrachlorodibenzo-p-dioxin result)
Calculated TEQ: 100 - (Dioxins in Soil (TEQ ppt) were calculated using the 2005 World Health Organization TEFs)

Legend
- Historic Soil Sample Locations
- City of Midland
- Dow Midland Plant

Definitions:
ppt - Parts per trillion
TEF - Toxic equivalency factor
TEQ - Toxic equivalent

Sources:

Agin et al. 1984. Point Sources and Environmental Levels of 2378-TCDD on the Midland Plant Site of the Dow Chemical Company and in the City of Midland, MI.

USEPA. 1985. Soil Screening at Four Midwestern Sites.

MDEQ. 1997. Summary of 1996 Midland Dioxin Study Results, Working Draft of Document for Public Release.

Dow. 2000. Soil Sampling Summary Report (Revised).

MDEQ. 2003. Final Report, Phase II Tittabawassee River/Saginaw River Dioxin Flood Plain Sampling Study.

Notes:

● * The SSRR-S-10 analytical results are no longer representative because soil was removed during an interim remediation action. See Excavation and Backfill of Salzburg Road Sample SSRR-S-10 Area Near Michigan Operations, MID 000 724 724 Interim Measure Report

0 1,800 3,600
Feet

Exhibit C-1
Midland Area Soil Surface TEQ Results
Midland Area Soils Remedial Investigation Work Plan
The Dow Chemical Company
Midland, MI

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1984	10-II (E)	84DOW-356	84DOW-356-SOI-0822	73	-	-	-
Dow, 1984	16-III (D)	84DOW-367	84DOW-367-SOI-0833	9.2	-	-	-
Dow, 1984	17-III (A)	84DOW-371	84DOW-371-SOI-0837	0.6	-	-	-
Dow, 1984	18-III (I)	84DOW-372	84DOW-372-SOI-0838	58	-	-	-
Dow, 1984	20-III (C)	84DOW-376	84DOW-376-SOI-0842	7.2	-	-	-
Dow, 1984	23-III (K)	84DOW-378	84DOW-378-SOI-0844	170	-	-	-
Dow, 1984	9-II (J)	84DOW-408	84DOW-408-SOI-0875	450	-	-	-
USEPA, 1985	A-1-L	83EPA2-275	83EPA2-275-SOI-0741	75	-	-	-
USEPA, 1985	A-3-L	83EPA2-277	83EPA2-277-SOI-0743	9	-	-	-
USEPA, 1985	B-1-L	83EPA2-279	83EPA2-279-SOI-0745	76	-	-	-
USEPA, 1985	B-3-L	83EPA2-281	83EPA2-281-SOI-0747	20	-	-	-
USEPA, 1985	B-4-L	83EPA2-283	83EPA2-283-SOI-0749	19	-	-	-
USEPA, 1985	C-1-L	83EPA2-285	83EPA2-285-SOI-0751	26	-	-	-
USEPA, 1985	C-3-L	83EPA2-287	83EPA2-287-SOI-0753	12	-	-	-
USEPA, 1985	C-4-L	83EPA2-289	83EPA2-289-SOI-0755	24	-	-	-
USEPA, 1985	D-1-L	83EPA2-291	83EPA2-291-SOI-0757	1	-	-	-
USEPA, 1985	D-2-6	83EPA2-292	83EPA2-292-SOI-0758	28	-	-	-
USEPA, 1985	D-3-L	83EPA2-294	83EPA2-294-SOI-0760	18	-	-	-
USEPA, 1985	E-1-L	83EPA2-296	83EPA2-296-SOI-0762	26	-	-	-
USEPA, 1985	F-1-L	83EPA2-300	83EPA2-300-SOI-0766	13	-	-	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
USEPA, 1985	P-10-L	83EPA2-302	83EPA2-302-SOI-0768	12	-	-	-
USEPA, 1985	P-11-L	83EPA2-303	83EPA2-303-SOI-0769	110	-	-	-
USEPA, 1985	P-2-L	83EPA2-305	83EPA2-305-SOI-0771	28	-	-	-
USEPA, 1985	P-5-L	83EPA2-306	83EPA2-306-SOI-0772	3	-	-	-
USEPA, 1985	P-7-L	83EPA2-308	83EPA2-308-SOI-0774	78	-	-	-
USEPA, 1985	P-8-L	83EPA2-309	83EPA2-309-SOI-0775	170	-	-	-
USEPA, 1985	P-9-L	83EPA2-310	83EPA2-310-SOI-0776	76	-	-	-
USEPA, 1985	PER-10-L	83EPA2-311	83EPA2-311-SOI-0777	40	-	-	-
USEPA, 1985	PER-2-L	83EPA2-313	83EPA2-313-SOI-0779	310	-	-	-
USEPA, 1985	PER-5-L	83EPA2-314	83EPA2-314-SOI-0780	210	-	-	-
USEPA, 1985	PER-8-L	83EPA2-316	83EPA2-316-SOI-0782	10	-	-	-
USEPA, 1985	PER-9-G	83EPA2-317	83EPA2-317-SOI-0783	2000	-	-	-
USEPA, 1985	TO-4-G	83EPA2-349	83EPA2-349-SOI-0815	11	-	-	-
USEPA, 1985	TO-6-G	83EPA2-350	83EPA2-350-SOI-0816	250	-	-	-
USEPA, 1985	TO-9-G	83EPA2-351	83EPA2-351-SOI-0817	14	-	-	-
MDEQ, 1997	NE-15	96DEQ-409	96DEQ-409-SOI-0876	11	30	30	-
MDEQ, 1997	NE-18	96DEQ-411	96DEQ-411-SOI-0878	50	120	120	-
MDEQ, 1997	NE-19	96DEQ-412	96DEQ-412-SOI-0879	21	76	74	-
MDEQ, 1997	NE-20	96DEQ-413	96DEQ-413-SOI-0880	86	630	580	-
MDEQ, 1997	NE-37	96DEQ-414	96DEQ-414-SOI-0881	20	210	200	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
MDEQ, 1997	NE-47	96DEQ-416	96DEQ-416-SOI-0883	290	590	590	-
MDEQ, 1997	NE-48	96DEQ-417	96DEQ-417-SOI-0884	22	77	77	-
MDEQ, 1997	NE-D-106	96DEQ-420	96DEQ-420-SOI-0887	13	72	72	-
MDEQ, 1997	NE-P-16	96DEQ-430	96DEQ-430-SOI-0897	100	210	210	-
MDEQ, 1997	NE-P-17	96DEQ-431	96DEQ-431-SOI-0898	46	170	180	-
MDEQ, 1997	NE-P-23	96DEQ-432	96DEQ-432-SOI-0899	64	140	140	-
MDEQ, 1997	NE-P-24	96DEQ-433	96DEQ-433-SOI-0900	15	33	33	-
MDEQ, 1997	NE-P-25	96DEQ-434	96DEQ-434-SOI-0901	9.6	94	99	-
MDEQ, 1997	NE-P-26	96DEQ-435	96DEQ-435-SOI-0902	10	24	24	-
MDEQ, 1997	NE-P-27	96DEQ-436	96DEQ-436-SOI-0903	37	85	85	-
MDEQ, 1997	NE-P-28	96DEQ-437	96DEQ-437-SOI-0904	15	44	44	-
MDEQ, 1997	NE-P-29	96DEQ-438	96DEQ-438-SOI-0905	11	32	32	-
MDEQ, 1997	NE-P-30	96DEQ-439	96DEQ-439-SOI-0906	3.8	14	14	-
MDEQ, 1997	NE-P-30A	96DEQ-440	96DEQ-440-SOI-0907	3.5	14	14	-
MDEQ, 1997	NE-S-10	96DEQ-441	96DEQ-441-SOI-0908	30	110	100	-
MDEQ, 1997	NE-S-11	96DEQ-442	96DEQ-442-SOI-0909	41	110	100	-
MDEQ, 1997	NE-S-12	96DEQ-443	96DEQ-443-SOI-0910	44	100	100	-
MDEQ, 1997	NE-S-13	96DEQ-444	96DEQ-444-SOI-0911	47	94	94	-
MDEQ, 1997	NE-S-14	96DEQ-445	96DEQ-445-SOI-0912	22	69	69	-
MDEQ, 1997	SW-22	96DEQ-448	96DEQ-448-SOI-0915	7.4	17	16	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
MDEQ, 1997	SW-36	96DEQ-450	96DEQ-450-SOI-0917	25	77	76	-
MDEQ, 1997	SW-38	96DEQ-451	96DEQ-451-SOI-0918	5.8	24	25	-
MDEQ, 1997	SW-43	96DEQ-454	96DEQ-454-SOI-0921	3.5	14	14	-
MDEQ, 1997	SW-D-104	96DEQ-461	96DEQ-461-SOI-0928	120	460	460	-
MDEQ, 1997	SW-P-45	96DEQ-463	96DEQ-463-SOI-0930	12	47	45	-
MDEQ, 1997	SW-S-39	96DEQ-465	96DEQ-465-SOI-0932	43	100	100	-
Dow, 1998	AA3-S-01	98DOW-468	98DOW-468-SOI-0935	94	310	310	270
Dow, 1998	CC-S-01	98DOW-469	98DOW-469-SOI-0936	5.8	15	14	-
Dow, 1998	CC-S-02	98DOW-470	98DOW-470-SOI-0937	24	56	56	-
Dow, 1998	CC-S-03	98DOW-471	98DOW-471-SOI-0938	48	110	100	-
Dow, 1998	CC-S-04	98DOW-472	98DOW-472-SOI-0939	150	290	290	-
Dow, 1998	CC-S-05	98DOW-473	98DOW-473-SOI-0940	73	170	170	-
Dow, 1998	CC-S-06	98DOW-474	98DOW-474-SOI-0941	66	130	130	-
Dow, 1998	CC-S-07	98DOW-475	98DOW-475-SOI-0942	26	85	85	77
Dow, 1998	CC-S-08	98DOW-476	98DOW-476-SOI-0943	32	89	89	81
Dow, 1998	CC-S-09	98DOW-477	98DOW-477-SOI-0944	27	79	78	72
Dow, 1998	CC-S-10	98DOW-478	98DOW-478-SOI-0945	34	95	95	86
Dow, 1998	CC-S-11	98DOW-479	98DOW-479-SOI-0946	38	110	110	99
Dow, 1998	CC-S-12	98DOW-480	98DOW-480-SOI-0947	38	110	110	99
Dow, 1998	CC-S-13	98DOW-481	98DOW-481-SOI-0948	41	110	100	96

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	CC-S-14	98DOW-482	98DOW-482-SOI-0949	34	95	95	85
Dow, 1998	CC-S-15	98DOW-483	98DOW-483-SOI-0950	44	120	120	110
Dow, 1998	CC-S-16	98DOW-484	98DOW-484-SOI-0951	39	100	100	93
Dow, 1998	CC-S-17	98DOW-485	98DOW-485-SOI-0952	32	94	94	83
Dow, 1998	CC-S-19	98DOW-487	98DOW-487-SOI-0954	51	120	120	120
Dow, 1998	CC-S-20	98DOW-488	98DOW-488-SOI-0955	66	130	130	140
Dow, 1998	CC-S-21	98DOW-489	98DOW-489-SOI-0956	38	150	150	86
Dow, 1998	CC-S-22	98DOW-490	98DOW-490-SOI-0957	28	97	96	66
Dow, 1998	CC-S-23	98DOW-491	98DOW-491-SOI-0958	33	75	75	85
Dow, 1998	CC-S-24	98DOW-492	98DOW-492-SOI-0959	30	98	98	74
Dow, 1998	CC-S-25	98DOW-493	98DOW-493-SOI-0960	32	84	84	79
Dow, 1998	CC-S-26	98DOW-494	98DOW-494-SOI-0961	39	90	90	83
Dow, 1998	CC-S-27	98DOW-495	98DOW-495-SOI-0962	360	740	720	-
Dow, 1998	CC-S-28	98DOW-496	98DOW-496-SOI-0963	230	490	490	-
Dow, 1998	CC-S-29	98DOW-497	98DOW-497-SOI-0964	29	78	78	76
Dow, 1998	CC-S-30	98DOW-498	98DOW-498-SOI-0965	50	110	100	100
Dow, 1998	CC-S-31	98DOW-499	98DOW-499-SOI-0966	46	99	99	97
Dow, 1998	CC-S-32	98DOW-500	98DOW-500-SOI-0967	94	210	210	210
Dow, 1998	CC-S-33	98DOW-501	98DOW-501-SOI-0968	51	120	120	120
Dow, 1998	CC-S-34	98DOW-502	98DOW-502-SOI-0969	90	180	180	180

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	CC-S-35	98DOW-503	98DOW-503-SOI-0970	140	220	220	220
Dow, 1998	CC-S-36	98DOW-504	98DOW-504-SOI-0971	41	130	130	130
Dow, 1998	CC-S-37	98DOW-505	98DOW-505-SOI-0972	49	130	130	120
Dow, 1998	CC-S-38	98DOW-506	98DOW-506-SOI-0973	58	150	150	150
Dow, 1998	CC-S-39	98DOW-507	98DOW-507-SOI-0974	100	210	210	210
Dow, 1998	CC-S-40	98DOW-508	98DOW-508-SOI-0975	47	140	140	130
Dow, 1998	CC-S-41	98DOW-509	98DOW-509-SOI-0976	72	160	160	160
Dow, 1998	CC-S-42	98DOW-510	98DOW-510-SOI-0977	60	140	140	140
Dow, 1998	CC-S-43	98DOW-511	98DOW-511-SOI-0978	56	160	160	160
Dow, 1998	CC-S-44	98DOW-512	98DOW-512-SOI-0979	62	180	170	170
Dow, 1998	CC-S-45	98DOW-513	98DOW-513-SOI-0980	39	140	140	140
Dow, 1998	NEPP-S-04	98DOW-518	98DOW-518-SOI-0986	20	120	120	-
Dow, 1998	NEPP-S-05	98DOW-519	98DOW-519-SOI-0987	14	46	43	-
Dow, 1998	NEPP-S-06	98DOW-520	98DOW-520-SOI-0988	16	70	67	-
Dow, 1998	NEPP-S-07	98DOW-521	98DOW-521-SOI-0989	20	89	86	-
Dow, 1998	NEPP-S-08	98DOW-522	98DOW-522-SOI-0990	27	90	88	-
Dow, 1998	NEPP-S-09	98DOW-523	98DOW-523-SOI-0991	18	73	70	-
Dow, 1998	NEPP-S-10	98DOW-524	98DOW-524-SOI-0992	66	920	850	-
Dow, 1998	SSRR-S-04	98DOW-547	98DOW-547-SOI-1018	32	160	160	170
Dow, 1998	SSRR-S-05	98DOW-548	98DOW-548-SOI-1019	14	59	58	58

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	SSRR-S-06	98DOW-549	98DOW-549-SOI-1021	8.5	36	35	36
Dow, 1998	SSRR-S-07	98DOW-550	98DOW-550-SOI-1022	8.1	31	31	31
Dow, 1998	SSRR-S-08	98DOW-551	98DOW-551-SOI-1023	19	62	62	62
Dow, 1998	SSRR-S-09	98DOW-552	98DOW-552-SOI-1024	19	58	57	54
Dow, 1998	SSRR-S-10 (1)	98DOW-553	98DOW-553-SOI-1025	26	1900	2000	2200
Dow, 1998	SSRR-S-11	98DOW-554	98DOW-554-SOI-1026	11	37	37	36
Dow, 1998	SSRR-S-12	98DOW-555	98DOW-555-SOI-1027	13	39	39	38
Dow, 1998	SSRR-S-13	98DOW-556	98DOW-556-SOI-1028	11	240	200	230
Dow, 1998	SSRR-S-14	98DOW-557	98DOW-557-SOI-1029	15	55	54	49
Dow, 1998	SSRR-S-15	98DOW-558	98DOW-558-SOI-1030	5	30	30	31
Dow, 1998	SSRR-S-16	98DOW-559	98DOW-559-SOI-1031	1.8	9.0	8.8	8.2
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0128	3.7	10	10	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0129	3	7.5	7.2	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0130	1.6	5.2	5	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0131	8.9	22	21	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0132	6.3	24	23	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0133	5.7	29	27	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0134	15	54	50	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0135	17	100	92	-
MDEQ, 2003	EMP-3	02DEQ1-085	02DEQ1-085-SOI-0136	3.9	15	14	-

Appendix C
Soil Sample Results from Previous Studies

see Inset A

Inset A

Saginaw Rd.
Wheeler Rd.
Eastman Rd.
Jefferson Ave.
Washington St.
Swede Ave.
E Ashman St.
Waldo Ave.
Bay City Rd.
W. Midland St.
Salzburg Rd.
Poseyville Rd.
Gordonville Rd.
Bailey Bridge
HotchkissRd.
Smiths Crossing Rd.
Bitzer Rd.
Stanley Rd.
Ave.
10

Tittabawassee River
Chippewa River
Tittabawassee River
Tittabawassee River
Tittabawassee River
Brine Pond Number 6
Tertiary Pond
Midland Cogeneration Venture Cooling Pond

84DOW-371 17-III (A) 2378 TCDD: 0.6

83EPA2-300 F-1-L 2378 TCDD: 13

02DEQ1-083 EMP-1 2378 TCDD: 1.6 Calculated TEQ: 5

02DEQ1-083 EMP-1 2378 TCDD: 8.9 Calculated TEQ: 21

02DEQ1-083 EMP-1 2378 TCDD: 3.7 Calculated TEQ: 10

02DEQ1-083 EMP-1 2378 TCDD: 3 Calculated TEQ: 7.2

02DEQ1-084 EMP-2 2378 TCDD: 5.7 Calculated TEQ: 27

02DEQ1-084 EMP-2 2378 TCDD: 17 Calculated TEQ: 92

02DEQ1-084 EMP-2 2378 TCDD: 15 Calculated TEQ: 50

02DEQ1-084 EMP-2 2378 TCDD: 6.3 Calculated TEQ: 23

02DEQ1-085 EMP-3 2378 TCDD: 6.2 Calculated TEQ: 20

02DEQ1-085 EMP-3 2378 TCDD: 5.2 Calculated TEQ: 21

02DEQ1-085 EMP-3 2378 TCDD: 1.4 Calculated TEQ: 5.2

02DEQ1-085 EMP-3 2378 TCDD: 3.9 Calculated TEQ: 14

96DEQ-448 SW-22 2378 TCDD: 7.4 Calculated TEQ: 16

83EPA2-349 TO-4-G 2378 TCDD: 11

96DEQ-432 NE-P-23 2378 TCDD: 64 Calculated TEQ: 140

83EPA2-277 A-3-L 2378 TCDD: 9

84DOW-376 20-III (C) 2378 TCDD: 7.2

83EPA2-275 A-1-L 2378 TCDD: 75

83EPA2-302 I-10-L 2378 TCDD: 12

96DEQ-441 NE-S-10 2378 TCDD: 30 Calculated TEQ: 100

96DEQ-435 NE-P-26 2378 TCDD: 10 Calculated TEQ: 24

96DEQ-442 NE-S-11 2378 TCDD: 41 Calculated TEQ: 100

96DEQ-443 NE-S-12 2378 TCDD: 44 Calculated TEQ: 100

96DEQ-434 NE-P-25 2378 TCDD: 9.6 Calculated TEQ: 99

83EPA2-310 P-8-L 2378 TCDD: 76

83EPA2-309 P-8-L 2378 TCDD: 170

83EPA2-279 B-1-L 2378 TCDD: 76

83EPA2-313 PER-2-L 2378 TCDD: 310

83EPA2-314 PER-5-L 2378 TCDD: 210

83EPA2-350 TO-6-G 2378 TCDD: 250

96DEQ-416 NE-47 2378 TCDD: 290 Calculated TEQ: 590

83EPA2-316 PER-8-L 2378 TCDD: 10

98DOW-519 NEPP-S-05 2378 TCDD: 14 Calculated TEQ: 43

98DOW-518 NEPP-S-04 2378 TCDD: 20 Calculated TEQ: 120

98DOW-520 NEPP-S-06 2378 TCDD: 16 Calculated TEQ: 67

98DOW-521 NEPP-S-07 2378 TCDD: 20 Calculated TEQ: 86

98DOW-523 NEPP-S-09 2378 TCDD: 18 Calculated TEQ: 70

98DOW-524 NEPP-S-10 2378 TCDD: 66 Calculated TEQ: 850

83EPA2-351 TO-9-G 2378 TCDD: 14

98DOW-468 AA3-S-01 2378 TCDD: 94 Calculated TEQ: 310

83EPA2-317 PER-9-D 2378 TCDD: 2000

96DEQ-420 NE-D-106 2378 TCDD: 13 Calculated TEQ: 72

96DEQ-463 SW-P-45 2378 TCDD: 12 Calculated TEQ: 45

83EPA2-311 PER-10-L 2378 TCDD: 40

96DEQ-451 SW-38 2378 TCDD: 5.8 Calculated TEQ: 25

96DEQ-461 SW-D-104 2378 TCDD: 120 Calculated TEQ: 450

83EPA2-296 E-1-L 2378 TCDD: 26

83EPA2-303 P-11-L 2378 TCDD: 110

96DEQ-465 SW-S-39 2378 TCDD: 43 Calculated TEQ: 100

83EPA2-297 E-3-L 2378 TCDD: 9

83EPA2-298 E-3-L 2378 TCDD: 9

96DEQ-454 SW-43 2378 TCDD: 3.5 Calculated TEQ: 14

96DEQ-450 SW-36 2378 TCDD: 25 Calculated TEQ: 76

83EPA2-305 P-2-L 2378 TCDD: 28

96DEQ-433 NE-P-24 2378 TCDD: 15 Calculated TEQ: 33

83EPA2-281 B-3-L 2378 TCDD: 20

96DEQ-444 NE-S-13 2378 TCDD: 47 Calculated TEQ: 94

96DEQ-430 NE-P-16 2378 TCDD: 100 Calculated TEQ: 210

83EPA2-285 C-1-L 2378 TCDD: 26

98DOW-522 NEPP-S-08 2378 TCDD: 27 Calculated TEQ: 88

84DOW-372 18-III (I) 2378 TCDD: 58

84DOW-378 23-III (K) 2378 TCDD: 170

84DOW-408 9-II (J) 2378 TCDD: 450

83EPA2-291 D-1-L 2378 TCDD: 1

83EPA2-283 B-4-L 2378 TCDD: 19

96DEQ-437 NE-P-28 2378 TCDD: 15 Calculated TEQ: 44

96DEQ-436 NE-P-27 2378 TCDD: 37 Calculated TEQ: 85

96DEQ-438 NE-P-29 2378 TCDD: 11 Calculated TEQ: 32

84DOW-367 16-III (D) 2378 TCDD: 9.2

96DEQ-439 NE-P-30 2378 TCDD: 3.8 Calculated TEQ: 14

96DEQ-440 NE-P-30A 2378 TCDD: 3.5 Calculated TEQ: 14

83EPA2-289 C-4-L 2378 TCDD: 24

96DEQ-431 NE-P-17 2378 TCDD: 46 Calculated TEQ: 180

83EPA2-287 C-3-L 2378 TCDD: 12

84DOW-356 10-II (E) 2378 TCDD: 73

96DEQ-445 NE-S-14 2378 TCDD: 22 Calculated TEQ: 69

83EPA2-308 P-7-L 2378 TCDD: 78

96DEQ-409 NE-15 2378 TCDD: 11 Calculated TEQ: 30

96DEQ-411 NE-18 2378 TCDD: 50 Calculated TEQ: 120

96DEQ-417 NE-48 2378 TCDD: 22 Calculated TEQ: 77

83EPA2-292 D-2-6 2378 TCDD: 28

98DOW-547 SSRR-S-04 2378 TCDD: 32 Calculated TEQ: 160

98DOW-549 SSRR-S-06 2378 TCDD: 8.5 Calculated TEQ: 35

98DOW-550 SSRR-S-07 2378 TCDD: 8.1 Calculated TEQ: 31

98DOW-551 SSRR-S-08 2378 TCDD: 19 Calculated TEQ: 62

96DEQ-412 NE-19 2378 TCDD: 21 Calculated TEQ: 74

98DOW-555 SSRR-S-12 2378 TCDD: 13 Calculated TEQ: 39

98DOW-556 SSRR-S-13 2378 TCDD: 11 Calculated TEQ: 200

83EPA2-306 P-5-L 2378 TCDD: 3

96DEQ-413 NE-20 2378 TCDD: 86 Calculated TEQ: 580

98DOW-557 SSRR-S-14 2378 TCDD: 15 Calculated TEQ: 54

98DOW-558 SSRR-S-15 2378 TCDD: 5 Calculated TEQ: 30

98DOW-559 SSRR-S-16 2378 TCDD: 1.8 Calculated TEQ: 8.8

96DEQ-414 NE-37 2378 TCDD: 20 Calculated TEQ: 200

98DOW-548 SSRR-S-05 2378 TCDD: 14 Calculated TEQ: 58

83EPA2-294 D-3-L 2378 TCDD: 18

98DOW-552 SSRR-S-09 2378 TCDD: 19 Calculated TEQ: 57

98DOW-554 SSRR-S-11 2378 TCDD: 11 Calculated TEQ: 37

98DOW-553 SSRR-S-10 2378 TCDD: 26 Calculated TEQ: 2000

98DOW-494 CC-S-26 2378 TCDD: 39 Calculated TEQ: 96

98DOW-493 CC-S-25 2378 TCDD: 32 Calculated TEQ: 90

98DOW-491 CC-S-23 2378 TCDD: 33 Calculated TEQ: 99

98DOW-490 CC-S-22 2378 TCDD: 28 Calculated TEQ: 75

98DOW-488 CC-S-20 2378 TCDD: 66 Calculated TEQ: 150

98DOW-496 CC-S-28 2378 TCDD: 230 Calculated TEQ: 490

98DOW-495 CC-S-27 2378 TCDD: 360 Calculated TEQ: 720

98DOW-492 CC-S-24 2378 TCDD: 30 Calculated TEQ: 84

98DOW-489 CC-S-21 2378 TCDD: 38 Calculated TEQ: 96

98DOW-487 CC-S-19 2378 TCDD: 51 Calculated TEQ: 130

98DOW-486 CC-S-18 2378 TCDD: 51 Calculated TEQ: 120

98DOW-484 CC-S-16 2378 TCDD: 39 Calculated TEQ: 100

98DOW-483 CC-S-15 2378 TCDD: 44 Calculated TEQ: 120

98DOW-479 CC-S-11 2378 TCDD: 38 Calculated TEQ: 110

98DOW-476 CC-S-08 2378 TCDD: 32 Calculated TEQ: 89

98DOW-475 CC-S-07 2378 TCDD: 26 Calculated TEQ: 85

98DOW-485 CC-S-17 2378 TCDD: 32 Calculated TEQ: 94

98DOW-482 CC-S-14 2378 TCDD: 34 Calculated TEQ: 95

98DOW-481 CC-S-13 2378 TCDD: 41 Calculated TEQ: 100

98DOW-480 CC-S-12 2378 TCDD: 38 Calculated TEQ: 110

98DOW-478 CC-S-10 2378 TCDD: 34 Calculated TEQ: 95

98DOW-477 CC-S-09 2378 TCDD: 27 Calculated TEQ: 78

98DOW-503 CC-S-35 2378 TCDD: 140 Calculated TEQ: 220

98DOW-501 CC-S-33 2378 TCDD: 51 Calculated TEQ: 120

98DOW-499 CC-S-31 2378 TCDD: 46 Calculated TEQ: 99

98DOW-498 CC-S-30 2378 TCDD: 50 Calculated TEQ: 100

98DOW-497 CC-S-29 2378 TCDD: 29 Calculated TEQ: 78

98DOW-469 CC-S-01 2378 TCDD: 5.8 Calculated TEQ: 14

98DOW-470 CC-S-02 2378 TCDD: 24 Calculated TEQ: 56

98DOW-472 CC-S-04 2378 TCDD: 150 Calculated TEQ: 290

98DOW-502 CC-S-34 2378 TCDD: 90 Calculated TEQ: 180

98DOW-500 CC-S-32 2378 TCDD: 94 Calculated TEQ: 210

98DOW-474 CC-S-06 2378 TCDD: 66 Calculated TEQ: 130

98DOW-513 CC-S-45 2378 TCDD: 39 Calculated TEQ: 140

98DOW-471 CC-S-03 2378 TCDD: 48 Calculated TEQ: 100

98DOW-506 CC-S-41 2378 TCDD: 72 Calculated TEQ: 160

98DOW-511 CC-S-43 2378 TCDD: 56 Calculated TEQ: 160

98DOW-506 CC-S-38 2378 TCDD: 58 Calculated TEQ: 150

98DOW-504 CC-S-36 2378 TCDD: 41 Calculated TEQ: 130

98DOW-512 CC-S-44 2378 TCDD: 62 Calculated TEQ: 170

98DOW-510 CC-S-42 2378 TCDD: 50 Calculated TEQ: 140

98DOW-508 CC-S-40 2378 TCDD: 47 Calculated TEQ: 140

98DOW-507 CC-S-39 2378 TCDD: 100 Calculated TEQ: 210

98DOW-473 CC-S-05 2378 TCDD: 73 Calculated TEQ: 170

98DOW-505 CC-S-37 2378 TCDD: 49 Calculated TEQ: 130

96DEQ-465 - (Project Sample ID)
SW-S-39 - (Original Sample ID)
2378 TCDD: 43 - (2,3,7,8-tetrachlorodibenzo-p-dioxin result)
Calculated TEQ: 100 - (Dioxins in Soil (TEQ ppt) were calculated using the 2005 World Health Organization TEFs)

Legend
- Historic Soil Sample Locations
- City of Midland
- Dow Midland Plant

Definitions:
ppt - Parts per trillion
TEF - Toxic equivalency factor
TEQ - Toxic equivalent

Sources:

Agin et al. 1984. Point Sources and Environmental Levels of 2378-TCDD on the Midland Plant Site of the Dow Chemical Company and in the City of Midland, MI.

USEPA. 1985. Soil Screening at Four Midwestern Sites.

MDEQ. 1997. Summary of 1996 Midland Dioxin Study Results, Working Draft of Document for Public Release.

Dow. 2000. Soil Sampling Summary Report (Revised).

MDEQ. 2003. Final Report, Phase II Tittabawassee River/Saginaw River Dioxin Flood Plain Sampling Study.

Notes:

● * The SSRR-S-10 analytical results are no longer representative because soil was removed during an interim remediation action. See Excavation and Backfill of Salzburg Road Sample SSRR-S-10 Area Near Michigan Operations, MID 000 724 724 Interim Measure Report

0 1,800 3,600
Feet

Exhibit C-1
Midland Area Soil Surface TEQ Results
Midland Area Soils Remedial Investigation Work Plan
The Dow Chemical Company
Midland, MI

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1984	10-II (E)	84DOW-356	84DOW-356-SOI-0822	73	-	-	-
Dow, 1984	16-III (D)	84DOW-367	84DOW-367-SOI-0833	9.2	-	-	-
Dow, 1984	17-III (A)	84DOW-371	84DOW-371-SOI-0837	0.6	-	-	-
Dow, 1984	18-III (I)	84DOW-372	84DOW-372-SOI-0838	58	-	-	-
Dow, 1984	20-III (C)	84DOW-376	84DOW-376-SOI-0842	7.2	-	-	-
Dow, 1984	23-III (K)	84DOW-378	84DOW-378-SOI-0844	170	-	-	-
Dow, 1984	9-II (J)	84DOW-408	84DOW-408-SOI-0875	450	-	-	-
USEPA, 1985	A-1-L	83EPA2-275	83EPA2-275-SOI-0741	75	-	-	-
USEPA, 1985	A-3-L	83EPA2-277	83EPA2-277-SOI-0743	9	-	-	-
USEPA, 1985	B-1-L	83EPA2-279	83EPA2-279-SOI-0745	76	-	-	-
USEPA, 1985	B-3-L	83EPA2-281	83EPA2-281-SOI-0747	20	-	-	-
USEPA, 1985	B-4-L	83EPA2-283	83EPA2-283-SOI-0749	19	-	-	-
USEPA, 1985	C-1-L	83EPA2-285	83EPA2-285-SOI-0751	26	-	-	-
USEPA, 1985	C-3-L	83EPA2-287	83EPA2-287-SOI-0753	12	-	-	-
USEPA, 1985	C-4-L	83EPA2-289	83EPA2-289-SOI-0755	24	-	-	-
USEPA, 1985	D-1-L	83EPA2-291	83EPA2-291-SOI-0757	1	-	-	-
USEPA, 1985	D-2-6	83EPA2-292	83EPA2-292-SOI-0758	28	-	-	-
USEPA, 1985	D-3-L	83EPA2-294	83EPA2-294-SOI-0760	18	-	-	-
USEPA, 1985	E-1-L	83EPA2-296	83EPA2-296-SOI-0762	26	-	-	-
USEPA, 1985	F-1-L	83EPA2-300	83EPA2-300-SOI-0766	13	-	-	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
USEPA, 1985	P-10-L	83EPA2-302	83EPA2-302-SOI-0768	12	-	-	-
USEPA, 1985	P-11-L	83EPA2-303	83EPA2-303-SOI-0769	110	-	-	-
USEPA, 1985	P-2-L	83EPA2-305	83EPA2-305-SOI-0771	28	-	-	-
USEPA, 1985	P-5-L	83EPA2-306	83EPA2-306-SOI-0772	3	-	-	-
USEPA, 1985	P-7-L	83EPA2-308	83EPA2-308-SOI-0774	78	-	-	-
USEPA, 1985	P-8-L	83EPA2-309	83EPA2-309-SOI-0775	170	-	-	-
USEPA, 1985	P-9-L	83EPA2-310	83EPA2-310-SOI-0776	76	-	-	-
USEPA, 1985	PER-10-L	83EPA2-311	83EPA2-311-SOI-0777	40	-	-	-
USEPA, 1985	PER-2-L	83EPA2-313	83EPA2-313-SOI-0779	310	-	-	-
USEPA, 1985	PER-5-L	83EPA2-314	83EPA2-314-SOI-0780	210	-	-	-
USEPA, 1985	PER-8-L	83EPA2-316	83EPA2-316-SOI-0782	10	-	-	-
USEPA, 1985	PER-9-G	83EPA2-317	83EPA2-317-SOI-0783	2000	-	-	-
USEPA, 1985	TO-4-G	83EPA2-349	83EPA2-349-SOI-0815	11	-	-	-
USEPA, 1985	TO-6-G	83EPA2-350	83EPA2-350-SOI-0816	250	-	-	-
USEPA, 1985	TO-9-G	83EPA2-351	83EPA2-351-SOI-0817	14	-	-	-
MDEQ, 1997	NE-15	96DEQ-409	96DEQ-409-SOI-0876	11	30	30	-
MDEQ, 1997	NE-18	96DEQ-411	96DEQ-411-SOI-0878	50	120	120	-
MDEQ, 1997	NE-19	96DEQ-412	96DEQ-412-SOI-0879	21	76	74	-
MDEQ, 1997	NE-20	96DEQ-413	96DEQ-413-SOI-0880	86	630	580	-
MDEQ, 1997	NE-37	96DEQ-414	96DEQ-414-SOI-0881	20	210	200	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
MDEQ, 1997	NE-47	96DEQ-416	96DEQ-416-SOI-0883	290	590	590	-
MDEQ, 1997	NE-48	96DEQ-417	96DEQ-417-SOI-0884	22	77	77	-
MDEQ, 1997	NE-D-106	96DEQ-420	96DEQ-420-SOI-0887	13	72	72	-
MDEQ, 1997	NE-P-16	96DEQ-430	96DEQ-430-SOI-0897	100	210	210	-
MDEQ, 1997	NE-P-17	96DEQ-431	96DEQ-431-SOI-0898	46	170	180	-
MDEQ, 1997	NE-P-23	96DEQ-432	96DEQ-432-SOI-0899	64	140	140	-
MDEQ, 1997	NE-P-24	96DEQ-433	96DEQ-433-SOI-0900	15	33	33	-
MDEQ, 1997	NE-P-25	96DEQ-434	96DEQ-434-SOI-0901	9.6	94	99	-
MDEQ, 1997	NE-P-26	96DEQ-435	96DEQ-435-SOI-0902	10	24	24	-
MDEQ, 1997	NE-P-27	96DEQ-436	96DEQ-436-SOI-0903	37	85	85	-
MDEQ, 1997	NE-P-28	96DEQ-437	96DEQ-437-SOI-0904	15	44	44	-
MDEQ, 1997	NE-P-29	96DEQ-438	96DEQ-438-SOI-0905	11	32	32	-
MDEQ, 1997	NE-P-30	96DEQ-439	96DEQ-439-SOI-0906	3.8	14	14	-
MDEQ, 1997	NE-P-30A	96DEQ-440	96DEQ-440-SOI-0907	3.5	14	14	-
MDEQ, 1997	NE-S-10	96DEQ-441	96DEQ-441-SOI-0908	30	110	100	-
MDEQ, 1997	NE-S-11	96DEQ-442	96DEQ-442-SOI-0909	41	110	100	-
MDEQ, 1997	NE-S-12	96DEQ-443	96DEQ-443-SOI-0910	44	100	100	-
MDEQ, 1997	NE-S-13	96DEQ-444	96DEQ-444-SOI-0911	47	94	94	-
MDEQ, 1997	NE-S-14	96DEQ-445	96DEQ-445-SOI-0912	22	69	69	-
MDEQ, 1997	SW-22	96DEQ-448	96DEQ-448-SOI-0915	7.4	17	16	-

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
MDEQ, 1997	SW-36	96DEQ-450	96DEQ-450-SOI-0917	25	77	76	-
MDEQ, 1997	SW-38	96DEQ-451	96DEQ-451-SOI-0918	5.8	24	25	-
MDEQ, 1997	SW-43	96DEQ-454	96DEQ-454-SOI-0921	3.5	14	14	-
MDEQ, 1997	SW-D-104	96DEQ-461	96DEQ-461-SOI-0928	120	460	460	-
MDEQ, 1997	SW-P-45	96DEQ-463	96DEQ-463-SOI-0930	12	47	45	-
MDEQ, 1997	SW-S-39	96DEQ-465	96DEQ-465-SOI-0932	43	100	100	-
Dow, 1998	AA3-S-01	98DOW-468	98DOW-468-SOI-0935	94	310	310	270
Dow, 1998	CC-S-01	98DOW-469	98DOW-469-SOI-0936	5.8	15	14	-
Dow, 1998	CC-S-02	98DOW-470	98DOW-470-SOI-0937	24	56	56	-
Dow, 1998	CC-S-03	98DOW-471	98DOW-471-SOI-0938	48	110	100	-
Dow, 1998	CC-S-04	98DOW-472	98DOW-472-SOI-0939	150	290	290	-
Dow, 1998	CC-S-05	98DOW-473	98DOW-473-SOI-0940	73	170	170	-
Dow, 1998	CC-S-06	98DOW-474	98DOW-474-SOI-0941	66	130	130	-
Dow, 1998	CC-S-07	98DOW-475	98DOW-475-SOI-0942	26	85	85	77
Dow, 1998	CC-S-08	98DOW-476	98DOW-476-SOI-0943	32	89	89	81
Dow, 1998	CC-S-09	98DOW-477	98DOW-477-SOI-0944	27	79	78	72
Dow, 1998	CC-S-10	98DOW-478	98DOW-478-SOI-0945	34	95	95	86
Dow, 1998	CC-S-11	98DOW-479	98DOW-479-SOI-0946	38	110	110	99
Dow, 1998	CC-S-12	98DOW-480	98DOW-480-SOI-0947	38	110	110	99
Dow, 1998	CC-S-13	98DOW-481	98DOW-481-SOI-0948	41	110	100	96

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	CC-S-14	98DOW-482	98DOW-482-SOI-0949	34	95	95	85
Dow, 1998	CC-S-15	98DOW-483	98DOW-483-SOI-0950	44	120	120	110
Dow, 1998	CC-S-16	98DOW-484	98DOW-484-SOI-0951	39	100	100	93
Dow, 1998	CC-S-17	98DOW-485	98DOW-485-SOI-0952	32	94	94	83
Dow, 1998	CC-S-19	98DOW-487	98DOW-487-SOI-0954	51	120	120	120
Dow, 1998	CC-S-20	98DOW-488	98DOW-488-SOI-0955	66	130	130	140
Dow, 1998	CC-S-21	98DOW-489	98DOW-489-SOI-0956	38	150	150	86
Dow, 1998	CC-S-22	98DOW-490	98DOW-490-SOI-0957	28	97	96	66
Dow, 1998	CC-S-23	98DOW-491	98DOW-491-SOI-0958	33	75	75	85
Dow, 1998	CC-S-24	98DOW-492	98DOW-492-SOI-0959	30	98	98	74
Dow, 1998	CC-S-25	98DOW-493	98DOW-493-SOI-0960	32	84	84	79
Dow, 1998	CC-S-26	98DOW-494	98DOW-494-SOI-0961	39	90	90	83
Dow, 1998	CC-S-27	98DOW-495	98DOW-495-SOI-0962	360	740	720	-
Dow, 1998	CC-S-28	98DOW-496	98DOW-496-SOI-0963	230	490	490	-
Dow, 1998	CC-S-29	98DOW-497	98DOW-497-SOI-0964	29	78	78	76
Dow, 1998	CC-S-30	98DOW-498	98DOW-498-SOI-0965	50	110	100	100
Dow, 1998	CC-S-31	98DOW-499	98DOW-499-SOI-0966	46	99	99	97
Dow, 1998	CC-S-32	98DOW-500	98DOW-500-SOI-0967	94	210	210	210
Dow, 1998	CC-S-33	98DOW-501	98DOW-501-SOI-0968	51	120	120	120
Dow, 1998	CC-S-34	98DOW-502	98DOW-502-SOI-0969	90	180	180	180

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	CC-S-35	98DOW-503	98DOW-503-SOI-0970	140	220	220	220
Dow, 1998	CC-S-36	98DOW-504	98DOW-504-SOI-0971	41	130	130	130
Dow, 1998	CC-S-37	98DOW-505	98DOW-505-SOI-0972	49	130	130	120
Dow, 1998	CC-S-38	98DOW-506	98DOW-506-SOI-0973	58	150	150	150
Dow, 1998	CC-S-39	98DOW-507	98DOW-507-SOI-0974	100	210	210	210
Dow, 1998	CC-S-40	98DOW-508	98DOW-508-SOI-0975	47	140	140	130
Dow, 1998	CC-S-41	98DOW-509	98DOW-509-SOI-0976	72	160	160	160
Dow, 1998	CC-S-42	98DOW-510	98DOW-510-SOI-0977	60	140	140	140
Dow, 1998	CC-S-43	98DOW-511	98DOW-511-SOI-0978	56	160	160	160
Dow, 1998	CC-S-44	98DOW-512	98DOW-512-SOI-0979	62	180	170	170
Dow, 1998	CC-S-45	98DOW-513	98DOW-513-SOI-0980	39	140	140	140
Dow, 1998	NEPP-S-04	98DOW-518	98DOW-518-SOI-0986	20	120	120	-
Dow, 1998	NEPP-S-05	98DOW-519	98DOW-519-SOI-0987	14	46	43	-
Dow, 1998	NEPP-S-06	98DOW-520	98DOW-520-SOI-0988	16	70	67	-
Dow, 1998	NEPP-S-07	98DOW-521	98DOW-521-SOI-0989	20	89	86	-
Dow, 1998	NEPP-S-08	98DOW-522	98DOW-522-SOI-0990	27	90	88	-
Dow, 1998	NEPP-S-09	98DOW-523	98DOW-523-SOI-0991	18	73	70	-
Dow, 1998	NEPP-S-10	98DOW-524	98DOW-524-SOI-0992	66	920	850	-
Dow, 1998	SSRR-S-04	98DOW-547	98DOW-547-SOI-1018	32	160	160	170
Dow, 1998	SSRR-S-05	98DOW-548	98DOW-548-SOI-1019	14	59	58	58

EXHIBIT C-2
2,3,7,8-TCDD and TEQ Results for Surface Soil Samples Collected from the Midland Study Area in Previous Investigations
Midland Area Soils Remedial Investigation Work Plan

Study	Original Sample ID	Dow Sample Location	Dow Sample ID	2,3,7,8-TCDD (ppt)	TEQ (ppt) 1998 TEFs	TEQ (ppt) 2005 TEFs	Reported TEQ (ppt)
Dow, 1998	SSRR-S-06	98DOW-549	98DOW-549-SOI-1021	8.5	36	35	36
Dow, 1998	SSRR-S-07	98DOW-550	98DOW-550-SOI-1022	8.1	31	31	31
Dow, 1998	SSRR-S-08	98DOW-551	98DOW-551-SOI-1023	19	62	62	62
Dow, 1998	SSRR-S-09	98DOW-552	98DOW-552-SOI-1024	19	58	57	54
Dow, 1998	SSRR-S-10 (1)	98DOW-553	98DOW-553-SOI-1025	26	1900	2000	2200
Dow, 1998	SSRR-S-11	98DOW-554	98DOW-554-SOI-1026	11	37	37	36
Dow, 1998	SSRR-S-12	98DOW-555	98DOW-555-SOI-1027	13	39	39	38
Dow, 1998	SSRR-S-13	98DOW-556	98DOW-556-SOI-1028	11	240	200	230
Dow, 1998	SSRR-S-14	98DOW-557	98DOW-557-SOI-1029	15	55	54	49
Dow, 1998	SSRR-S-15	98DOW-558	98DOW-558-SOI-1030	5	30	30	31
Dow, 1998	SSRR-S-16	98DOW-559	98DOW-559-SOI-1031	1.8	9.0	8.8	8.2
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0128	3.7	10	10	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0129	3	7.5	7.2	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0130	1.6	5.2	5	-
MDEQ, 2003	EMP-1	02DEQ1-083	02DEQ1-083-SOI-0131	8.9	22	21	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0132	6.3	24	23	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0133	5.7	29	27	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0134	15	54	50	-
MDEQ, 2003	EMP-2	02DEQ1-084	02DEQ1-084-SOI-0135	17	100	92	-
MDEQ, 2003	EMP-3	02DEQ1-085	02DEQ1-085-SOI-0136	3.9	15	14	-

Appendix D
Development of Target Analyte List

TECHNICAL MEMORANDUM

To: Mr. Allan Taylor, MDEQ Waste and Hazardous Materials Division

From: Philip B. Simon, ATS
Peter M. Simon, ATS

Date: December 1, 2006

RE: PCOI/COI/TAL Evaluation – Target Analyte List Development
Tittabawassee River & Upper Saginaw River, Michigan
Midland Soils Investigation, Michigan

The Tittabawassee River Sampling and Analysis Plan (SAP, rev. 070706, section 5.1.1) identifies the seventeen federally regulated chlorinated dioxin and furan congeners as the primary Constituents of Interest (COI) for the ***GeoMorph***™ site characterization project. That section of the SAP also discusses the need to identify and develop data for other, secondary COI based on substances used or produced at the Dow Chemical Company Midland Plant (Midland Plant). This memorandum describes the process utilized to identify those secondary COI and develop Target Analyte Lists (TALs) to address them in the Tittabawassee River, Upper Saginaw River and Midland Soils site characterization projects.

Dow Master PCOI List

On June 1, 2006, Mr. Ben Baker of The Dow Chemical Company (Dow) submitted a document concerning this issue entitled *"Target Analyte List Development – Tittabawassee River and Floodplain."* This document contained a discussion draft Target Analyte List (TAL), and presented the methodology used to select the substances for this TAL from a master list of the chemicals used and produced at the Midland Plant over its 100+ years of operation as a chemical manufacturing facility. On June 23, 2006, ATS submitted on behalf of Dow electronic and paper copies of the chemical database assembled by Dow staff to generate the June 1, 2006 submittal. This database contains 802 line items and we are referring to it as the Dow "Master List."

PCOI/COI/TAL Evaluation Process

Subsequent to that submittal, ATS and MDEQ worked collaboratively to develop a process to systematically evaluate each of the 802 references on the Master List, plus additional COI coming from other sources. The objective of this effort was to select substances that should be included on the final TALs for the Tittabawassee River, Upper Saginaw River and Midland Soils site characterizations. The process is detailed in the flow chart given in Attachment 1. Key definitions used in this process, and in RIWP and QAPP documents relating to these site characterizations are given in Attachment 2.

As shown in the process flow chart, this work initially involved crosschecking product compositions, chemical names, CAS numbers, and eliminating overlapping or redundant references. Identified information problems within the database were categorized as follows:

- "Redundant entries"
- "Multi-compound references"
- "CAS number reassigned"
- "Salt references"
- "Composition Uncertain"
- "ID Conflict" (CAS # versus chemical name)

A case narrative was prepared to address each reference falling into each of these categories. The first four case narrative categories ("Redundant entries," "Multi-compound references," "CAS number reassigned," and "Salt references") were resolved by ATS. The resolution for each line item is detailed in the corresponding case narrative, organized by Dow reference number in the Master List (see Attachment 3). The remaining two categories ("Composition Uncertain" and "ID Conflict") were referred back to Dow for resolution by the staff that entered the information (Attachment 4). The information problems for all but approximately 30 of these references have been resolved as of this writing. In some instances, resolution of case narrative items resulted in addition of substances to the database. A case narrative was created to keep track of such database additions (Attachment 5).

Polymers

Some of the materials referenced in the Master List were polymers, or polymer-based products. Because of the limited bioavailability of polymeric materials, and the general lack of environmental analytical methods for such macromolecules, ATS and MDEQ agreed to segregate those referenced, polymeric materials having an average molecular weight greater than 5,000 Daltons into the following case narrative for separate consideration:

- "Polymers (MW >5000)"

This case narrative category was referred to Dow for affirmation that the materials were, indeed, polymers of that size (see Attachment 4). Polymers with average molecular weight of less than 5,000 Daltons were included in the analytical methods evaluation. Larger polymers were excluded from methods evaluation at this time.

Site-Specific Monitoring "Positives"

To assure that contaminants showing up in biomonitoring of the Tittabawassee and Saginaw Rivers were appropriately considered in the site characterizations, ATS and MDEQ agreed to add all such biomonitoring "positives" to the COI database if they were not already present. Fish studies conducted in 1998 and 2002 were the primary source of this information, however other biomonitoring studies available at the time of this writing were also reviewed. The aggregate of these biomonitoring "positives" results in eight compounds being added to the database, as recorded in the following case narrative (Attachment 5):

- "Biomonitoring Positives - Database Additions"

In addition, to assure appropriate consideration of substances that may have been released to the Tittabawassee River through groundwater-related migration pathways prior to the installation of the Revetment Groundwater Intercept System (RGIS), monitoring data from the RGIS system were reviewed and all monitoring "positives" were identified. Any RGIS system monitoring "positive" substance not already in the database was added and recorded in the following case narrative:

- "RGIS System Positives – Database Additions"

Review of RGIS system monitoring data resulted in the addition of nine compounds to the database (Attachment 5).

Midland Soils PCOI/COI

The Midland Soils site characterization has a somewhat different set of COI to consider, focusing primarily on the air-release history of the Midland Plant. To address this, Dow staff assembled a list of PCOI anticipated from historical and current air-discharge sources including tar burners, waste incinerators, and others. This PCOI list included polynuclear aromatic hydrocarbons, chlorobenzenes, chlorophenols, chlorinated dioxins and furans, polychlorinated biphenyls, and all the substances reported by the facility under the United States Environmental Protection Agency (USEPA) SARA III

TRI reporting program. In addition, Dow staff included a list of approximately 200 compounds and TICs reported by USEPA as "Products of Incomplete Combustion (PICs)" from research regarding incineration disposal of halogenated chemical wastes. In total, this Midland Soils PCOI list contains references to 407 substances (Attachment 6).

The Midland Soils PCOI list was error-checked and reviewed to determine which substances were common with the Tittabawassee River/Saginaw River COI database. Those substances not already in the database were added, and recorded in the following case narrative:

- "Midland Soils COI – Database Additions"

This resulted in approximately 200 additional references in the COI database, approximately half of which are TICs from the USEPA PICs list (Attachment 5). Integrating the Midland Soils COIs into a common database with the Tittabawassee River/Saginaw River COIs allows the Dow Master List and derived COI database to be used for all three site characterizations, facilitating analytical method selection, development of TALs, and standardization of data quality objectives in project QAPPs.

COI Database

As shown on the process flow chart, the error-checked and edited Master List serves as the core database for COI evaluation and TAL development. The source lineage for all references in this database has been retained for audit purposes. It is anticipated that the COI database will be periodically updated to reflect new information developed during the site characterizations, and that it will be useful in future phases of work, including ecologic and human health risk analysis, and evaluation of corrective action alternatives. The current version of the database, in spreadsheet form as of this writing, is available on-line in the ***eProject***™ workspaces for the Tittabawassee River, Saginaw River and Midland Soils projects.

Analytical Methods Evaluation

One of the purposes of the COI database is to serve as the basis for evaluating which substances have available analytical methods and can be included in monitoring for site impact. To facilitate the analytical methods evaluation task, all the substances in the COI database were classified according to their elemental composition and chemical functionality, using the following groupings:

- Organochlorine compounds
- Organobromine compounds

- Other organohalogen compounds
- Organophophorus compounds
- Phenols, aromatic alcohols and aldehydes
- Organic acids, and corresponding salts
- Amines and other organic bases, and corresponding salts
- Polynuclear Aromatic Hydrocarbons, and derivatives
- Aliphatic and aromatic hydrocarbons, alcohols, ethers, carbonyl compounds, and other heteromolecules
- Organometallic compounds
- Metals and other inorganic compounds

Each substance was coded in the COI database so that the queries could be made to review classes of chemicals with analytical chemistry commonality—that is, they could be addressed with the same analytical method. In many cases, substances fell into multiple chemical classes (e.g. pentachlorophenol is both an organochlorine compound, and a phenolic compound; chloroacetic acid is both an organochlorine compound and an organic acid; tryptophan is both an organic acid and an organic base).

To determine the availability of analytical methods, current versions of all U.S. Environmental Protection Agency SW-846 RCRA methods were considered in the analytical methods evaluation process. Each substance was evaluated separately to determine whether it was a standard target analyte in each RCRA analytical method suitable for that COI group, or whether it could be included either as an extended target analyte or as a site-specific tentatively identified compound (TIC) within the conditions of the method. At the same time, each substance was also coded to indicate whether USEPA has designated it for RCRA Appendix IX profiling.

Substances that are standard target analytes in USEPA RCRA methods were coded in the database with the letter “T”. In those cases where USEPA has indicated that method conditions can be extended to include a particular substance, or if, based on structure/activity considerations, there is a possibility the substance could be included as a target analyte the substance was coded with the designation “?”. In a number of circumstances USEPA has designated a substance as a target analyte in one method (e.g. tetrachlorophenol [25167-83-3] in USEPA 8041), but not in another similar method applicable to that chemical class (e.g. USEPA 8270). If USEPA has designated the substance for RCRA Appendix IX profiling, the substance was coded with an “X” under the Appendix IX heading. For certain substances, no suitable USEPA analytical methods exist. These COIs were coded with an “X” under the “No EPA Method” heading.

<u>Evaluation of Site Positives/Designation of Extended Target Analytes</u>

Once standard target compounds were identified in the COI database, the lists of “Biomonitoring Positives” and “RGIS System Monitoring Positives” were reviewed to

assure that all such compounds were included as fully calibrated, target analytes in one or more analytical methods. In those cases where these site positive substances were not standard USEPA target analytes, they were coded in the database with the designation "E" under the appropriate analytical method headings so that they would be included as extended target analytes in the TALs.

Tentatively Identified Compounds

All analytical methods referenced in the TALs specify mass spectrometric detection, primarily because of the selectivity this technique brings and its potential for post-acquisition data analysis. Ion current chromatograms of multi-compound analytical methods utilizing mass spectrometric detection (e.g. USEPA 8260 and 8270) often contain useful qualitative and quantitative information for substances beyond the fully-calibrated target analytes. Qualitative and quantitative information about the substances responsible for "non-target peaks" in such chromatograms can be included in the laboratory data reports if the peaks are handled using the procedure for Tentatively Identified Compounds (TICs), as specified in USEPA Methods 8260B and 8270C (section 7.6.2 in both methods). Post-acquisition data analysis for TICs can be optimized for site-specific COIs by identifying those compounds to the analyst as site-specific TICs in the TALs.

ATS and MDEQ have agreed upon a specification for treatment of TIC information, and incorporating TIC data into project data reports (Attachment 7). This specification will be employed for all Appendix IX and other secondary COI sample analyses, allowing post-acquisition data analysis for TICs in all samples analyzed with secondary COI methods. TICs that show up analytically in analysis for secondary COI will be considered further for reclassification as extended target analytes in subsequent phases of site work. Such consideration will take into account additional factors including environmental persistence, toxicity, and availability of reference materials for analytical calibration, among others.

Environmental Filters/ Designation of Site-Specific TICs

To determine which non-target COI substances warrant classification as site-specific TICs, ATS and MDEQ agreed to use certain environmentally relevant physical and chemical properties to assess the likelihood of these substances occurring as sediment or soil contaminants. These properties included:

- Hydrolytic instability/reactivity (unstable in contact with water, or having a very short hydrolytic half-life)
- Volatility (currently defined empirically by USEPA 8260 retention time; threshold for concern: retention time greater than bromoform)

- Aqueous solubility (threshold for concern: 1.0 g/L or less, at 20 degrees C)
- Octanol-water partition coefficient (threshold for concern: KOW approximately 3.0, or greater)

Except in continuing-source circumstances (e.g. near-plant sampling locations), substances with substantial hydrolytic reactivity and/or volatility were considered unlikely prospects as sediment and soil contaminants, given atmospheric or water-borne release pathways. Conversely, substances with hydrolytic stability, low volatility, low aqueous solubility and/or elevated octanol-water partition coefficient, were considered likely to occur in sediment or soil contaminant deposition zones.

ATS and MDEQ staff researched these physical and chemical properties for all COI coded "No USEPA Methods" in the COI database. The data were reviewed collaboratively, and non-target COI substances considered potentially useful as indicators of sediment or soil contamination, based on the properties and thresholds given above, were classified as site-specific TICs. Site-specific TICs are listed in a special section of each method TAL.

Method-Specific Target Analyte Lists

TALs were prepared for each analytical method by extracting the database based on the coding system described above. Versions of these TALs current as of this writing are given in Attachment 8. These TALs have been incorporated into the current revision of the Quality Assurance Project Plans (QAPPs). As with the COI database and QAPP documents, it is anticipated that the TALs will change as the investigations proceed. Substances may be added, deleted and/or reclassified, based on study findings. Revisions of the TALs will be reflected in formal updates to the applicable QAPP.

ATTACHMENT 1

PCOI/COI/TAL Process Flow Chart

PCOI/COI/TAL Process Flowchart

Tittabawassee River and Saginaw River Project
Midland Soils Project

Dow Master List (PCOI)

Error Check & Correct

Resolve By ATS or Dow

Case Narratives
- Redundant Entries
- Multi-Compound References
- CAS Number Reassigned
- Salts
- Biomonitoring Positives – Database Additions
- RGIS System Positives – Database Additions
- Midland Soils COI – Database Additions
- Other Database Additions

Resolve By Dow

Case Narratives
- Composition Uncertain
- Identification Conflict
- Polymers

Resolved

Add To COI Database

COI Database

Resolved

Add To COI Database

Resolved?

- Polymers (MW>5000)
- Composition Uncertain (unresolved)

Excluded References

Sort By Chemical Class

Analytical Methods Evaluation

Possible USEPA Methods

Extended Target Analytes & TICs

No USEPA Methods

- No Available Methods

Excluded References

Standard Methods & Target Analytes

- USEPA Appendix IX
- USEPA 8260 (Volatile Organics)
- USEPA 8270 (Semi-Volatile Organics)
- USEPA 1613B (Dioxins & Furans)
- METHOD 1613-TRP/RT (Dioxins & Furans)
- USEPA 1668A (Polychlorinated Biphenyls)
- USEPA 8041 (Phenols)
- USEPA 8081 (Chlorinated Pesticides)
- USEPA 8082 (Polychlorinated Biphenyls)
- USEPA 8121 (Chlorinated Hydrocarbons)
- USEPA 8141 (Organophosphorus Compounds)
- USEPA 8151 (Chlorinated Herbicides)
- USEPA 6010/6020 (Metals)
- USEPA 7471 (Mercury)
- Other USEPA Methods

Evaluate For Reported Site Positives
- Biomonitoring Studies
- RGIS System Monitoring

All Site Positives Included as Target Analytes

(Add As Extended Target Analyte if Necessary)

Evaluate Environmental Filters
- Volatility (8260 RRT > $CHBr_3$)
- Aqueous Solubility (<1 g/L)
- KOW (>3.0)

Trigger One or More Filters?

Handle As Site-Specific TIC

Pass All Filters

QAPP Target Analyte Tables
- Standard Target Analytes
- Extended Target Analytes
- Site-Specific TIC's
- Other TIC's

Excluded COI

Excluded References

PCOI/COI/TAL Technical Memo

ANN ARBOR TECHNICAL SERVICES, INC.

Rev. 11/29/2006

ATTACHMENT 2

Definitions

Definitions:

PCOI: Potential Constituents of Interest

The PCOI for this project consist of those substances on the master list of chemicals submitted by The Dow Chemical Company to MDEQ on June 1, 2006, plus those substances found in biomonitoring of the Tittabawassee and Saginaw Rivers, and routine monitoring of the RGIS system. It is recognized that not all substances on the Dow master list will have significance as environmental contaminants, nor that the substances found in biomonitoring of the two rivers are necessarily related to Dow operations in Midland.

COI: Constituents of Interest

The lists of COI for this project are derived from the PCOI, and reflect those substances that are likely to have been released to the environment during the approximately 110 year period of interest for the study. Because of the large number of PCOI, the COI lists have been organized by chemical class to facilitate evaluation of physical/chemical properties and selection of analytical methods, and therefore may or may not be included on the TALs.

TAL: Target Analyte List

The Target Analyte Lists are compilations of those substances (elements or chemicals) that will be analyzed in samples from the study. TALs are method specific, and are integral components of the project QAPP and method SOPs. Together, SOPs and TALs constitute the work instructions for laboratories generating analytical data for site characterization. Because of the large number of COI and project samples, not all samples will be analyzed for all TALs.

The TAL for a specific method may contain compounds in three categories: (1) Standard Target Analytes, which are those substances for which the method was originally developed and validated; (2) Extended Target Analytes, which are specific substances of interest for which the method has been performance tested, validated, and calibrated using the same criteria as for Standard Target Analytes; and, (3) Site-Specific TICs, which are specific substances of interest for which the method is likely to useful for detection and semi-quantitation.

TIC: Tentatively Identified Compounds & Site-Specific TICs

The ion current chromatograms of multi-compound analytical methods based upon GC/MS or LC/MS (e.g. USEPA 8260 and 8270) can contain information beyond the fully-calibrated target analytes. Qualitative and quantitative information about the substances responsible for non-target peaks in such chromatograms can be included in the laboratory data reports if the peaks are handled using the procedure for Tentatively Identified Compounds (TIC) as described in USEPA Methods 8260B and 8270C (section 7.6.2 in both methods). Post-run data analysis for TICs can be optimized for site-specific COIs by identifying those compounds to the analyst as Site-Specific TICs in the TALs.

ATTACHMENT 3

Case Narratives – Resolved By ATS
Revision Date: November 27, 2006

- "Redundant entries"
- "Multi-compound references"
- "CAS number reassigned"
- "Salt references"

CASE NARRATIVE - Redundant Entries

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
433	67-72-1	Hexachloroethane	redundant entry. See Dow # 428 [67-72-1]
293	71-55-6	Chlorothene	redundant entry. See Dow # 16 [71-55-6], formerly [74552-83-3]
512	71-55-6	Methyl Chloroform	redundant entry. See Dow # 16 [71-55-6], formerly [74552-83-3]
499	74-83-9	Bromomethane	redundant entry. See Dow # 498 [74-83-9]
545	74-83-9	N/A	redundant entry. See Dow # 498 [74-83-9]
500	74-87-3	Methyl Chloride	redundant entry. See Dow # 287 [74-87-3]
284	74-97-5	Chlorobromomethane	redundant entry. See Dow # 233 [74-97-5]; formerly [83847-49-8]
515	74-97-5	Methylene Chlorobromide	redundant entry. See Dow # 233 [74-97-5]; formerly [83847-49-8]
388	75-00-3	Ethyl Chloride	redundant entry. See Dow # 285 [75-00-3]
514	75-09-2	Methylene Chloride	redundant entry. See Dow #325 [75-09-2]
161	79-06-1	Acrylamide	redundant entry. See Dow # 160 [79-06-1]
606	79-06-1	Acrlamide (Paper Filler)	DOW RESOLVED. Redundant entry See Dow #160.
157	79-34-5	Acetylene tetrachloride	redundant entry. See Dow # 17 [79-34-5]
756	79-34-5	1,1,2,2-Tetrachloroethane	redundant entry. See Dow # 17 [79-34-5]
226	80-05-7	Bisphenol-A	redundant entry. See Dow # 128 [80-05-7]
353	88-85-7	Dinitro-o-sec-butylphenol	redundant entry. See Dow # 351 [88-85-7]
357	92-52-4	Diphenyl	redundant entry. See Dow # 221 [92-52-4]
608	92-69-3	[1,1'-Biphenyl]-4-ol	redundant entry. See Dow # 682 [92-69-3]
81	93-76-5	2,4,5-Trichlorophenoxyacetic acid	redundant entry. See Dow # 65 [93-76-5]
346	93-76-5	Dimethylamine salts of 2,4-D abd 2,4,5-TP	redundant entry. See Dow # 65 [93-76-5]
68	94-75-7	2-(2,4-Dichlorophenoxy)acetic acid	redundant entry. See Dow # 67 [94-75-7]
84	94-75-7	2-(2,4-Dichlorophenoxy)acetic acid	redundant entry. See Dow # 67 [94-75-7]
86	94-75-7	2-(2,4-Dichlorophenoxy)acetic acid	redundant entry. See Dow # 67 [94-75-7]
589	95-50-1	ortho-Chlorobenzene	redundant entry. See Dow # 47 [95-50-1]
602	95-50-1	ortho-dichlorobenzene	redundant entry. See Dow # 47 [95-50-1]
590	95-57-8	ortho-chlorophenol	redundant entry. See Dow # 102 [95-57-8]
520	96-34-4	Monochloromethyl acetate	redundant entry. See Dow # 501 [96-34-4]
454	98-82-8	Isopropylbenzene	redundant entry. See Dow # 453 [98-82-8]
393	100-41-4	Ethylbenzene	redundant entry. See Dow # 386 [100-41-4]
59	100-42-5	100-42-5	DOW RESOLVED; redundant entry see Dow # 730 [100-42-5]
524	100-42-5	Monomeric Styrene	redundant entry. See Dow # 730 [100-42-5]
729	100-42-5	Styrene	DOW AFFIRMED. polymer (MW>5000) and redundant see Dow #730.
362	101-84-8	Diphenylaniline (Diphenyl oxide)	multi-compound listing for Diphenylaniline and Diphenyl oxide; AND redundant entry. See Dow # 358 [101-84-8]
370	101-84-8	DPO (5,5-diphenyloxazolidine-2,4-dione)	DOW RESOLVED.redundant entry see Dow #358 [101-84-8].

CASE NARRATIVE - Redundant Entries

736	101-84-8	Substituted phenyl ether	redundant entry. See Dow # 358 [101-84-8]
629	104-38-1	Phenolic polyglycols	DOW RESOLVED and redundant. See Dow #628.
607	106-48-9	4-chlorophenol (Para Chlo Phenol)	DOW RESOLVED and redundant. See Dow #614
401	106-93-4	1,2-Dibromoethane	redundant entry.See Dow # 46 [106-93-4]; formerly [8003-07-4]
402	106-93-4	1,2-Dibromoethane	redundant entry.See Dow # 46 [106-93-4]; formerly [8003-07-4]
403	106-93-4	Ethylene Dibromide	redundant entry.See Dow # 46 [106-93-4]; formerly [8003-07-4]
398	107-06-2	Ethylene chloride	redundant entry. See Dow # 48 [107-06-2, formerly [52399-93-6]
324	111-44-4	Dichloroethyl ether	redundant entry. See Dow # 224 [111-44-4]
407	122-99-6	Ethylene Glycol Phenyl Ether	former [56257-90-0] has been replaced with [122-99-6] for Ethylene Glycol Phenyl Ether; See Dow # 114
624	127-18-4	Perc (Perchloroethylene)	redundant entry. See Dow # 18 [127-18-4]
757	127-18-4	Tetrachloroethylene	redundant entry. See Dow # 18 [127-18-4]
568	317-83-9	2-Cyclohexyl-4,6-dinitrophenol dicyclohexylamine salt	redundant entry. See Dow # 11 [317-83-9]
130	534-52-1	2-Methyl-4,6-dinitrophenol	redundant entry. See Dow # 111 [534-52-1]
374	1321-74-0	DVB (Divinylbenzene)	redundant entry. See Dow # 367 [1321-74-0]
101	1918-16-7		redundant entry. See Dow # 684 [1918-16-7]
77	1970-40-7	2,3,5-trichloro-1H-pyridin-4-one	redundant entry see Dow # 76 [1970-40-7]
329	2921-88-2	O,O-Diethyl O-(3,5,6-trichloro-2-pyridinyl) ester phosphorothioic acid	redundant entry. See Dow # 294 [2921-88-2], formerly [39475-55-3]
406	3775-85-7	Ethylene glycol	redundant; see Dow #405
271	5017-45-8	chlorbenzol	redundant entry; See Dow #282 [108-90-7]
698	6027-02-7	Quinoline	redundant entry see Dow #436 [6027-02-7]
470	7439-95-4	Magnesium	redundant entry; see Dow #469 [7439-95-4]
472	7439-95-4	Magnesium alloy metal	redundant entry; see Dow #469 [7439-95-4]
479	7439-95-4	Magnesium metal	redundant entry. See Dow #469 [7439-95-4]
480	7439-95-4	Magnesium metal sticks	redundant entry; see Dow #469 [7439-95-4]
646	7439-95-4	Pistons and castings(Magnesium)	redundant entry; see Dow #469 [7439-95-4]
526	7647-01-0	Muriatic acid	redundant entry. See Dow # 424 [7647-01-0]
187	7664-41-7	Anhydrous Ammonia	redundant entry. See Dow #181 [7664-41-7]
53	8022-76-2	1,3-dichloroprop-1-ene	reduntant entry See Dow # 52 [8022-76-2]
54	8022-76-2	1,3-dichloropropene	reduntant entry See Dow # 52 [8022-76-2]
368	8071-51-0	2-methyl-4,6-dinitrophenol	DOW RESOLVED [8071-51-0] and [534-52-1]for chemical name 2-methyl-4,6-dinitrophenol; REDUNDANT see Dow #111 [534-52-1]
289	25167-80-0	2-Chlorophenol	DOW RESOLVED conflicting [25167-80-0] and [95-57-8] for chlorophenol; REDUNDANT; see Dow #590.
365	34590-94-8	Dipropylene glycol methyl ether	redundant entry. See Dow # 364 [34590-94-8]
519	50717-45-8	Monochlorobenzene	DOW RESOLVED [5017-45-8] and [108-90-7]for monochlorobenzene; REDUNDANT see Dow # 282 [108-90-7]
63	58769-19-0	1-methoxypropan-2-ol	redundant entry. See Dow # 62 [58769-19-0]
666	63625-56-9	Propylene glycol	DOW RESOLVED and redundant. See Dow #685

CASE NARRATIVE - Redundant Entries

689	63625-56-9	Propylene glycol	DOW RESOLVED and redundant entry. See Dow # 685 [57-55-6]; formerly [63625-56-9]
690	63625-56-9	Propylene Glycol	redundant entry. See Dow # 685 [57-55-6]; formerly [63625-56-9]
733	79637-11-9	Styrene P-100	redundant entry. See Dow # 729 [79637-11-9]
255	N/A	Carbon disulfide	redundant entry. See Dow # 254 [75-15-0]
471	N/A	Magnesium alloy	redundant entry; see Dow #469 [7439-95-4]
482	N/A	Magnesium ribbon anode	redundant entry; see Dow #469 [7439-95-4]
517	N/A	Mixture of Ethylene oxide and propylene oxide	DOW RESOLVED and redundant entry. See Dow #516
738	N/A	Sulphur	redundant entry. See Dow # 739 [81032-32-8]
382			redundant entry. See Dow # 381 [9004-57-3]
383			redundant entry. See Dow # 381 [9004-57-3]
659		Polychlorinated diphenyl ethers	DOW RESOLVED and redundant entry. See Dow# 274
660		Polychlorinated diphenyl sulfides	DOW RESOLVED and redundant entry. See Dow# 275
662		Polycyclic Aromatic Compounds	DOW RESOLVED and redundant entry. See Dow# 278
776			redundant entry. See Dow # 16 [71-55-6]
781			redundant entry. See Dow # 771 [1918-02-1]
793			redundant entry. See Dow # 22 [75-35-4]
795			redundant entry. See Dow # 467 [1330-20-7]

CASE NARRATIVE - Multi-Compound Listings

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
362	101-84-8	Diphenylaniline (Diphenyl oxide)	multi-compound listing for Diphenylaniline and Diphenyl oxide; AND redundant entry. See Dow # 358 [101-84-8]
168	102-71-6	Alkanolamines	DOW RESOLVED. Multi compound listing. Individual components are Dow #208 triethanolamine [102-71-6] and monoethanolamine [9007-33-4] Added to Master List
637	8004-13-5	Phenylbenzene	multi-compound listing. Indivudual components Dow #357 Biphenyl [92-52-4] and Dow #358 Diphenyl ether [101-84-8] are included.
85	50884-30-5	2,4-Dichlorophenol/2,4-Dichlorophenol potassium salt	multi-compound listing [120-83-2] for 2,4-Dichlorophenol added to master list
20	62587-63-7	1,1'-Biphenyl,phenoxy-, mixt. with 1,1'-oxybis[benzene]	multi-compound listing. Individual components are Dow #358 Diphenyl ether [101-84-8] and 1,1-Biphenyl, phenoxy [28984-89-6] added to Master List, are included.
252	97794-26-8	Caprylic/Capric Triglyceride - DDS 223	DOW RESOLVED.multi compound listing. Individual components are decanoic acid [334-48-5], octanoic acid [124-07-2], propane-1,2,3-triol [no CAS] all Added to Master List.
55	N/A		multi-compound listing. Individual compounds Dow #54 [8022-76-2] 1,3-dichloropropene, Dow #49 [78-87-5] 1,2-dichloropropane, 2,3-dichloropropene and 3,3-dichloropropene are added to Master List.
142	N/A	4-tert-butyl catechol + n-butyl bromide	DOW RESOLVED multi compound listing. Individual components are Dow #752 [98-29-3] 4-t-butyl catechol and [109-65-9] n-butyl bromide Added to Master List.
155	N/A	Acetylene Bromide	DOW RESOLVED. Dow #156 [79-27-6] for 1,1,2,2-Tetrabromoethane or [540-49-8] for 1,2-dibromoethene Added to Master List.
167	N/A	Acrylonitrile + Vinylidene Chloride	DOW RESOLVED. Multi-compound listing individual components are Dow # 165 [63908-52-1] acrylonitrile and Dow # 22 [75-35-4] 1,1-dichloroethene.
310	N/A	D.N. Sulphur Dust No. 10	RESOLVED. Multi compound listing. Individual components are Dow #350 [131-89-5] and Dow #739 [7704-34-9].

CASE NARRATIVE - Multi-Compound Listings

369	N/A	Dowanol EB, Triethanolamine, Dowfax 2A1, Neutronyx-600 (Dowfax 9N9), Deodorized kerosene and Versene	DOW RESOLVED. Multi compound listing. Individual components are [12626-49-2] and [26571-11-9] Added to Master List, Dow # 97 [52663-57-7] and Dow # 208 [102-71-6], and [60-00-4] Added to Master List.
427	N/A	Heptane + Ethyl Ether + Carbon dioxide	DOW RESOLVED, multi-compound listing individual components are [142-82-5] heptane, [7578-39-4] ethyl ether, [124-38-9] carbon dioxide all Added to Master List.
456	N/A	Jojoba Ester - High Internal Phase (Myristic Acid, Palmetic Acid, Oleic Acid, Eicosenic Acid, Erucic Acid, Nervonic Acid, Eicosenol, Docosenol, Tetracosenol)	DOW RESOLVED. Multi-compound listing individual components are [544-63-8] myristic acid, [66321-94-6] palmitic acid, [112-80-1] oleic acid, [506-30-9] eicosenic acid, [112-86-7] eruc+AG808ic acid, [506-37-6] nervonic acid, [629-96-9] eiconsenol, [506-51-4] tetracosenol, [30303-65-2]docosenal, all Added to Master List.
516	N/A	Mixture of Ethylene oxide and propylene oxide	DOW RESOLVED. Multi-compound listing individual components are [99932-75-9] Added to Master List ethylene oxide and Dow # 693 [75-56-9] propylene oxide.
534	N/A	Aromatic Eutectic Blend	DOW RESOLVED. Multi-compound listing individual components are Dow # 358 [101-84-8] diphenyl ether and Dow # 221 [92-52-4] diphenyl.
535	N/A	Aromatics	DOW RESOLVED. Multi compound listing individual components are Dow # 209 [71-43-2] benzene, Dow # 770 [108-88-3] toluene, Dow # 386 [100-41-4] ethylbenzene, Dow # 467 [1330-20-7] xylenes.
560	N/A	Sylvenol	DOW RESOLVED. multi-compound listing individual components are [28231-03-0] Cedrenol Added to Master List, Dow #18 [127-18-4] Tetrachloroethene, [8041-89-2] Retrol Added to Master List
627	N/A	Phenol Sulphonates	DOW RESOLVED. Multi-compound listing individual components are salts [825-90-1] parahydroxybenzene sulfonic acid and [127-82-2] zinc phenyl sulphonate. See Dow #705 (sodium) and Dow #797 (zinc).
229			Multi-compound listing. Individual compounds Dow #245 Calcium Chloride [7440-70-2], Dow #672 Potassium Chloride [7440-09-7], Dow #469 Magnesium Chloride [7439-95-4], Dow #705 Sodium Chloride [12258-98-9], Dow #230 Bromine [7726-95-6], Dow #443 Iodine [7553-56-2] are included.
258			multi-compound listing. Individual components Dow #258 Carbon tetrachloride [56-23-5], Dow #48 1,2 Dichloroethane [107-06-2]. No [CAS#] for 1,2-Dibromomethane added to Conflict ID Category

CASE NARRATIVE - Multi-Compound Listings

259			multi-compound listing. Individual components Dow #258 Carbon tetrachloride [56-23-5], Dow #404 Ethylene dichloride [52399-93-6], Dow #401 Ethylene Dibromide [106-93-4] are included.
260			multi-compound listing. Individual components Dow #258 carbon tetrachloride [56-23-5], Dow #255 Carbon Disulfide [75-15-0], Dow #498 Methyl bromide [74-83-9] are included.
302			multi-compound listing. Individual compounds Dow #301 copper [7440-50-8], Dow #204 arsenic [7440-38-2] are included.
543		Dow Mill and Bin Spray	DOW RESOLVED. multi-compound listing individual components are Dow # 417[58-89-9] gamma-BHC, [57157-84-3] Atlox 1045A Added to Mater List, Dow # 451 [78-59-1]Isophoreone, Dow # 467 [1330-20-7] xylene.
544		Dow Oven Cleaner	DOW RESOLVED. Multi-compound listing individual componests are Dow #325 [75-09-2] methylene chloride, [no CAS#] paraffin, Dow # 770[108-88-3] toluene, Dow # [9968-59-2] methocel, Dow # 491 [67-56-1] methanol, [35365-94-7] triethyl ammonium phosphate and [9007-33-4] monethanolamine Added to Master List.
566		Naptha solvent + Toluene + Dowanol EB - ethylene glycol + mono-n-butyl ether	DOW RESOLVED. multi-compound lisiting individual components are [no CAS #] Naptha solvent, Dow #770 [108-88-3]Toluene, [111-76-2] Dowanol EB added to Master List.
572			multi-element listing. Individual components Dow #571 nickel [8049-31-8], Dow #245 calcium [7440-70-2], Dow # 295 chromium [7440-47-3] are included.
594		Octyl Methoxycinnamate + Octyl Salicylate + Oxybenzone ("Sunscreens")	DOW RESOLVED. Multi-compound listing individual components are Dow #593 [5466-77-3} octyl methoxycinnamate , [118-60-5] octyl salicylalte Added to Master List, [131-57-7] oxybenzone Added to Master List.
631		Phenoxy herbicides	DOW RESOLVED. General reference to Dow #67 [94-75-7] 2,4-D, Dow # 66[93-72-1] 2,4,5-TP, Dow # 65 [93-76-5] 2,4-T.
648		Plasticizers (Phthalates)	DOW RESOLVED. General reference to Dow #225 [117-81-7 bis(2-ethylhexyl) phthalate, Dow # 355[117-84-0]di-n-octyl phthalate, Dow # 342 [131-11-3] dimethyl phthalalte.
662		Polycyclic Aromatic Compounds	DOW RESOLVED and redundant entry. See Dow# 278
783		Phosphoric acid, isodecyl diphenylester, mixt. with triphenyl phosphate	RESOLVED. Multi-compound listing individual components are[115-86-6] triphenylphospahte and [29761-21-5] isodecyldiphenylphosphate ester both Added to Master List.

CASE NARRATIVE - CAS # CHANGES

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
415	50-00-0	Formaldehyde	former [8013-13-6] has been replaced with [50-00-0] for Formaldehyde
206	50-78-2	2-(Acetyloxy) benzoic acid	former [98201-60-6] has been replaced with [50-78-2] for Aspirin (2-Acetyloxy benzoic acid)
104	51-05-8	Benzoic acid, 4-amino-, 2-(diethylamino)ethyl ester, monohydrochloride	former [8023-03-8] has been replaced with [51-05-8] for 2-diethylaminoethyl 4-aminobenzoate
758	56-23-5	Tetrachloromethane	[8068-85-7] not in registry; [56-23-5]may be correct for Tetrachloromethane
420	56-40-6	Glycine	former [87867-94-5] has been replaced with [56-40-6] for Glycine
419	56-81-5	Glycerine	former [8013-25-0] has been replaced with [56-81-5] for glycerine
685	57-55-6	Propane-1,2-diol	former [63625-56-9] has been replaced with [57-55-6] for propane-1,2-diol
636	63-91-2	L-Phenylalanine	former [3617-44-5] has been replaced with [63-91-2] for L-phenylalanine
763	64-02-8	Glycine, N,N'-1,2-ethanediylbis[N-(carboxymethyl)-, tetrasodium salt	former [8013-51-2] hasa been replaced with [64-02-8] for Glycine, N,N'-1,2-ethanediylbis(N-carboxymethyl)-tetrasodium salt
150	64-19-7	Acetic acid	former [77671-22-8] has been replaced with [64-19-7] for acetic acid
217	65-85-0	Benzoic acid	former [8013-63-6] has been replaced with [65-85-0] for benzoic acid
286	67-66-3	Chloroform	former [8013-54-5] has been replaced with [67-66-3] for chloroform
439	69-72-7	Hydroxybenzoic acid	DOW RESOLVED. [69-72-7] for hydroxybenzoic acid
434	70-30-4	2,2'-Methylenebis[3,4,6-trichloro]phenol	former [8054-98-6] has been replaced with [70-30-4] for hexachlorophene
293	71-55-6	Chlorothene	redundant entry. See Dow # 16 [71-55-6], formerly [74552-83-3]
512	71-55-6	Methyl Chloroform	redundant entry. See Dow # 16 [71-55-6], formerly [74552-83-3]
96	72-18-4	(S)-2-Amino-3-methyl-butanoic acid	former [7004-03-7] has been replaced with [72-18-4] for 2-amino-3-methyl-butanoic acidglycerine
785	73-22-3	L-Tryptophan	former [80206-30-0] has been replaced with [73-22-3] for L-Tryptophan
203	74-79-3	Arginine	former[7004-12-8] has been replaced with [50-78-2] for arginine
395	74-85-1	Ethylene	former [87701-65-3] has been replaced with [74-85-1] for ethene
408	75-21-8	Ethylene Oxide	former [99932-75-9] has been replaced with [75-21-8] for ethylene oxide

CASE NARRATIVE - CAS # CHANGES

686	79-09-4	Propionic acid	conflict [69806-86-6]not in registry; [79-09-4] for Propionic acid may be correct
391	79-11-8	Chloracetic acid, ethyl ester	DOW RESOLVED. Former [763-69-9] replaced with [79-11-8] and name changed.
555	79-11-8	chloroacetic acid, ethyl ester (Lonex)	DOW RESOLVED and redundant entry. See Dow #521
766	80-68-2	Threonine	conflict [632-20-2]not in registry; [80-68-2] for Threonine may be correct
559	87-84-3	Pentabromochlorocyclohexane (SE-651)	DOW RESOLVED. [79-11-8] for pentabromochlorocyclohexane
603	89-72-5	2-(1-Methylpropyl)phenol	former [96346-15-5] has been replaced with [89-72-5] for o-sec-butylphenol
630	92-84-2	10H-Phenothiazine	conflict [117-89-5]not in registry; [92-84-2] for Phenothiazine may be correct
524	100-42-5	Monomeric Styrene	former [79637-11-9] replaced with [100-42-5]. Redundant entry See Dow # 730 [100-42-5]
730	100-42-5	Styrene	former [79637-11-9] replaced with [100-42-5] for Styrene
729	100-42-5	Styrene	DOW AFFIRMED. polymer (MW>5000) and redundant see Dow #730. Former [79637-11-9] replaced with [100-42-5] for styrene.
584	100-75-4	N-Nitrosopiperidine	former [68374-62-9] has ben replaced with [100-75-4] for N-nitrosopiperdine
363	102-06-7	Diphenylguanidine	former [55556-10-0] has been replaced with [102-06-7] for diphenylguanidine
709	106-25-2	(z)-3,7-dimethyl-2,6-octadiene-1 ol (Secondary sesquiterpene alcohol or Nearasol)	DOW AFFIRMED. [106-25-2] for Secondary sesquiterpene alcohol
614	106-48-9	4-Chlorophenol	conflict; [1193-00-6]not in registry; [106-48-9] may be correct for 4-Chlorophenol
377	106-89-8	Chloromethyloxirane	former [13403-37-7] has been replaced with [106-89-8] for epichlorohydrin
396	106-93-4	Ethylene bromide	former [8003-07-4] replaced with [106-93-4] for Ethylene bromide
50	106-99-0	1,3-Butadiene	former [130983-70-9] replaced with [106-99-0] for 1,3-Butadiene
238	106-99-0	1,3-Butadiene	DOW RESOLVED [106-99-0] for 1,3-Butadiene
404	107-06-2	Ethylene dichloride	former [52399-93-6] replaced with [107-06-2] for Ethylene dichloride
397	107-07-3	2-Chloroethanol	former [1867-09-0] has been replaces with [107-07-3] for 2-chloroethanol
165	107-13-1	Acrylonitrile	former [63908-52-1] has been replaced with [107-13-1] for Acrylonitrile
691	107-98-2	Propylene Glycol Methyl Ether	DOW RESOLVED. former [89024-56-6] for Propylene glycol methyl ether has been replaced with [107-98-2]
626	108-95-2	Phenol	former [8002-07-1] has been replaced with [108-95-2] for phenol
116	109-06-8	2-Methylpyridine	former [82005-07-0] has been replaced with [109-06-8] for 2-methylpyridine
570	110-54-3	N-Hexane	former [8031-34-3] has been replaced with [110-54-3] for N-Hexane
644	110-85-0	Piperazine	former [81546-15-8] replaced with [110-85-0] for Piperazine

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336	110-97-4	1,1'-Iminobis-2-propanol	former [1335-54-2] has been replaced with [110-97-4] for 1,1'-Iminobis-2-propanol
328	111-42-2	2,2'-Iminobisethanol	former [8033-73-6] has been replaced with [111-42-2] for Diethanolamine
333	111-46-6	Diethylene Glycol	former [4669-26-5] has been replaced with [111-46-6] for Diethylene Glycol
779	112-27-6	Triethylene glycol	former [676-18-6] has been replaced with [112-27-6] for Triethylene glycol
334	112-34-5	Diethylene glycol butyl ether	former [210818-08-9] has been replaced with [112-34-5] for Diethylene glycol butyl ether
687	115-07-1	Propylene	former [676-63-1] has been replaced with [115-07-1] for Propylene
198	118-92-3	2-Aminobenzoic acid	former [80206-34-4] has been replaced with [118-92-3] for 2-Aminobenzoic acid
509	119-36-8	Methyl salicylate (Oil of wintergreen)	former [8024-54-2] has been replaced with [119-36-8] for Methyl salicylate
356	120-07-0	Diethoxy Aniline (Dioxy Diethyl Aniline)	DOW RESOLVED. [120-07-0] for diethoxy aniline.
455	120-58-1	Isosafrole	former [191281-03-5] has been replaced with [120-58-1] for Isosafrole
263	120-80-9	1,2-Benzenediol	former [37349-32-9] has been replaced with [120-80-9] for Catechol
787	121-33-5	Vanillin	former [8014-42-4] has been replaced with [121-33-5] for Vanillin
114	122-99-6	2-phenoxyethanol	former [56257-90-0] has been replaced with [122-99-6] for 2-phenoxyphenol
407	122-99-6	Ethylene Glycol Phenyl Ether	former [56257-90-0] has been replaced with [122-99-6] for Ethylene Glycol Phenyl Ether; See Dow # 114
438	123-31-9	Hydroquinone	former [8027-02-9] has been replaced with [23-31-9] for Hydroquinone
696	129-00-0	Pyrene	former [76165-23-6] has been replaced with [129-00-0] for pyrene
64	134-32-7	1-Naphthalenamine	former [25168-10-9] not in registry; [134-32[7] may be correct
678	140-92-1	Potassium Isopropyl Xanthate	former [41256-16-0] replaced with [140-92-1] for Potassium Isopropyl Xanthate
239	141-32-2	Butyl acrylate	former [220713-31-5] has been replaced with [141-32-2] for Butyl acrylate
380	141-43-5	2-Aminoethanol	former [9007-33-4] has been replaced with [141-43-5] for Ethanolamine
645	142-64-3	Dihydrochloride piperazine	former [8049-00-1] has been replaced with [142-64-3] for Piperazine dihydrochloride
268	107-04-0	1-bromo-2-chloroethane (Chlor Ethylene Bromide)	DOW RESOLVED. [107-04-0] for 1-bromo-2-chloroethane (chlor ethylene bromide).
802	299-85-4	o-(2,4-dichlorophenyl + o-methylisopropyl phosphoramidothioate) (Zytron)	DOW RESOLVED. [299-85-4] for Zytron+o-(2,4-dichlorophenyl + o-methyl isopropylphosphoromidothioate)
532	309-00-2	Aldrin - 1,2,3,4,10,10-Xexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-1,4:5,8-dimethanonaphthalene	former [6851-31-6] for Aldrin has been replaced with [309-00-2]

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449	465-73-6	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-(1R,4S,4aS,5R,8S,8aR)-rel-1,4:5,8-dimethanonaphthalene	conflicting [370-14-9] not in registry;[463-73-6] may be correct for Isodrin.
527	505-60-2	1,1'-Thiobis[2-chloro]ethane	former [69020-37-7] has been replaced with [505-60-2] for Mustard gas
103	598-78-7	2-Chloropropionic acid	former [62138-52-7] has been replaced with [598-78-7] for 2-Chloropropionic acid
753	630-25-1	Tetrachlordibromoethane	DOW RESOLVED. [630-25-1] for Tetrachlordibromoethane
549	1031-07-8	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide-6,9-methano-2,4,3-benzodioxathiepin	former [87695-43-0] replaced with [1031-07-8] for endosulfan sulfate
796	1300-73-8	Xylidene with mixed isomers	DOW RESOLVED. [1300-73-8] for Xylidene with mixed isomers.
367	1321-74-0	Divinylbenzene	former[61804-50-0] hes been replaced with [1321-74-0] for divinylbenzene
292	1331-28-8	2-Chloroethenylbenzene	former [8063-96-5] has been replaced with [1331-28-8] for Chlorostyrene (2-Chloroethylbenzene)
747	1406-05-9	Synthetic Penicillin Medium	DOW RESOLVED. [1406-05-9] for Synthetic Penicillin Medium
69	2008-39-1	Acetic acid, (2,4-dichlorophenoxy)-, compd. with N-methylmethanamine	former [64296-19-1] has been replaced with [2008-39-1] for 2-(2,4-dichlorophenoxy)acetic acid; N-methylmethanamine
556	2385-85-5	1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta[cd]pentalene	former [56449-78-6] replaced with [2385-85-5] for Mirex
673	2720-73-2	Potassium Amyl Xanthate	DOW RESOLVED. [2720-73-2] for Potassium Amyl Xanthate
329	2921-88-2	O,O-Diethyl O-(3,5,6-trichloro-2-pyridinyl) ester phosphorothioic acid	redundant entry. See Dow # 294 [2921-88-2], formerly [39475-55-3]
754	3228-99-7	1,3-dichloro-2,2-bis(chloromethyl)propane (Tetrachloride)	DOW RESOLVED. [3228-99-7] for tetrachloride
745	3775-85-7	Super Coolant Anti-freeze (Ethylene glycol)	DOW RESOLVED. [3775-85-7] for Super Coolant anti-freeze (Ethylene glycol)
643	3819-00-9	Piperacetazine	DOW RESOLVED. [3819-00-9] for piperacetazine
523	6168-72-5	2-Amino-1-propanol	former [78-91-1] has been replaced with [6168-72-5] for Monoisopropanolamine
571	7440-02-0	Nickel	former [8049-31-8] has been replaced with [7440-02-0] for nickel
715	7440-23-5	Sodium	former [12258-98-9] not in registry; [7440-23-5] may be correct for sodium
764	7440-28-0	Thallium	former [82870-81-3] hasa been replaced with [7440-28-0] for thallium
742	7446-09-5	Sulfur dioxide	former [89125-89-3] replaced with [7446-09-5] Sulphur Dioxide
623	7607-99-0	Pentasol Xanthate	DOW RESOLVED. [7607-99-0] for Pentasol Xanathate
181	7664-41-7	Ammonia	former [8007-57-6] has been replaced with [7664-41-7] for ammonia
574	7697-37-2	Nitric acid	former [78989-43-2] has been replacec with [7697-37-2] for nitric acid
739	7704-34-9	Sulfur	former [81032-32-8] replaced with [7704-34-9] for Sulfur

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422	7782-42-5	Graphite electrodes	former [87934-03-0] has been replaced with [7782-42-5] for graphite electrodes
710	7782-49-2	Selenium	former [95788-45-7] has bben replaced with [7782-49-2] for selenium
772	8001-35-2	Toxaphene	former [8022-04-6] has been replaced with [8001-35-2] for toxaphene
163	9003-04-7	2-Propenoic acid, homopolymer, sodium salt	DOW AFFIRMED. polymer (MW>5000) AND former [95077-68-2] has been replaced with [9003-04-7] for Acrylic acid + Sodium Acylate (2-Propenoic acid, homopolymer, sodium salt)
595	9082-06-8	Polyacrylamide (Oil Emulsion)	DOW RESOLVED. [9082-06-8] for polyacylamide
641	10025-87-3	Phosphoric trichloride	former [39380-77-3] has been replaced with [10025-87-3] for Phosphorus oxychloride (Phosphoric trichloride)
437	10035-10-6	Hydrobromic acid	former [62140-56-1] has been replaced with [10035-10-6] for hydrobromic acid
741	10545-99-0	Sulphur Dichloride	former [39461-36-4] replaced with [10545-99-0] Sulphur Dichloride
318	13552-09-5	DHC (2-aminooctadecane-1,3-diol)	DOW RESOLVED. Former [764-22-7] replaced with [13552-09-5].
313	13654-09-6	Decabromobiphenyl	former [39282-95-6] has been replaced with [13654-09-6] for Decabromobiphenyl
347	14484-64-1	Tris(dimethylcarbamodithioato-.kappa.S,.kappa.S')-, (OC-6-11) iron	former [64070-92-4] has been replaced with [14484-64-1] for Dimethylaminomethannedithioate;iron(+3) cation
546	24556-65-8	3,4,5-tribromosalicylanide	DOW RESOLVED. [24556-65-8] for 3,4,5-tribromosalicylanide
722	25155-30-0	Sodium dodecylbenzene sulfonate	DOW RESOLVED. [25155-30-0] for sodium dodecylbenzene sulfonate
664	25322-68-3	Polyethylene glycol	DOW RESOLVED. [25322-68-3] for polyethylene glycol
784	25498-49-1	Tripropylene Glycol Methyl Ether	former [30373-82-1] has been replaced with [25498-49-1] for Tripropylene Glycol Methyl Ether
548	33213-65-9	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3.alpha.,5a.alpha.,6.beta.,9.beta.,9a.alpha.)-6,9-methano-2,4,3-benzodioxathiepin	former [891-86-1] for Endosulfan II replaced with [33213-65-9]
562	35884-77-6	Xylyl bromide (Y-11)	DOW RESOLVED. [35884-77-6] for Xylyl bromide
773	49690-94-0	Tribromophenyl ether	DOW RESOLVED. [49690-94-0] for tribromodiphenylether
412	55860-53-2	Flotation agent (Isobutyl ethyl thionocarbamate)	DOW RESOLVED. [55860-53-2] for isobutyl ethyl thionocarbamate.
692	57018-52-7	Propylene Glycol n-Butyl Ether (Dowanol)	DOW RESOLVED. [57018-52-7] for Propylene glycol n-Butyl ether
231	62140-56-1	Hydrobromic acid (Bromine Acid)	DOW RESOLVED. [62140-56-1] for hydrobromic acid.
765	63148-67-4	Polysulfide rubber compounds (Thiokol)	DOW RESOLVED. [63148-67-4] for Thiokol
375	63908-52-1	Emulsion - Finishing (primary component - acrylonitrile)	DOW RESOLVED. [63908-52-1] for acrylonitrile, primary compnent
423	69806-40-2	Haloxyfop-methyl	former [86510-80-7] for Haloxyfop-methyl replaced with [69806-40-2]
335	89698-92-0	Toluene diisocyanate	DOW RESOLVED. [89698-92-0] for toluene diisocyanate

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665	96956-24-0	Polyethleneimine	DOW RESOLVED. [96956-24-0] for polyethleneimine
596	104053-06-7	Oligonucleotide (Nucleotide - RNA or DNA)	DOW RESOLVED. [104053-06-7] for Nucleotide
317	166524-65-8	DFEP (2-ethoxy-4,6-difluropyrimidine)	DOW RESOLVED. [166524-65-8] for 2-ethoxy-4,6-difluropyrimidine (DFEP)
627	N/A	Phenol Sulphonates	DOW RESOLVED. Multi-compound listing individual components are salts [825-90-1] parahydroxybenzene sulfonic acid and [127-82-2] zinc phenyl sulphonate. See Dow #705 (sodium) and Dow #797 (zinc).
594		Octyl Methoxycinnamate + Octyl Salicylate + Oxybenzone ("Sunscreens")	DOW RESOLVED. Multi-compound listing individual components are Dow #593 [5466-77-3} octyl methoxycinnamate , [118-60-5] octyl salicylalte Added to Master List, [131-57-7] oxybenzone Added to Master List.
648		Plasticizers (Phthalates)	DOW RESOLVED. General reference to Dow #225 [117-81-7 bis(2-ethylhexyl) phthalate, Dow # 355[117-84-0]di-n-octyl phthalate, Dow # 342 [131-11-3] dimethyl phthalalte.
783		Phosphoric acid, isodecyl diphenylester, mixt. with triphenyl phosphate	DOW RESOLVED. Multi-compound listing individual components are[115-86-6] triphenylphospahte and [29761-21-5] isodecyldiphenylphosphate ester both Added to Master List.

CASE NARRATIVE - Salts

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
726	650-51-1	Trichlorosodium salt acetic acid	salt; see Dow #705 (sodium) [12258-98-9]
786	1314-62-1	Vanadium oxide	salt; [7440-62-2] Vanadium Added
743	7487-88-9	Sulphuric acid, magnesium salt	DOW RESOLVED; salt see Dow# 469 (magnesium) [7439-95-4]
744	7681-38-1	Sulphuric Acid, sodium salt	DOW RESOLVED; salt see Dow# 705 (sodium) [12258-98-9]
719	7789-38-0	Bromic acid, sodium salt	salt; see Dow #705 (sodium) [12258-98-9]
675	7790-93-4	Chloric acid	salt; see Dow #672 (potassium) [7440-09-7]
798	16485-55-5	Zincate(3-), pentachlorotriammonium	salt; see Dow #797 (zinc) [7440-66-6]
483	18917-89-0	Bis[2-(hydroxy.kappa.O)benzoato-.kapp.O]-,(T-4)r	salt; see Dow #469 (magnesium) [7439-95-4]
627	N/A	Phenol Sulphonates	DOW RESOLVED. Multi-compound listing individual components are salts [825-90-1] parahydroxybenzene sulfonic acid and [127-82-2] zinc phenyl sulphonate. See Dow #705 (sodium) and Dow #797 (zinc).
178			salt; see Dow #176 (aluminum) [7429-90-5]
179			salt; see Dow #176 (aluminum) [7429-90-5]
182			salt; see Dow #181 (ammonia) [8007-57-6]
183			salt; see Dow #181 (ammonia) [8007-57-6]
184			salt; see Dow #181 (aluminum) [80007-57-6]
185			salt; see (benzoic acid) [69-72-7] Added to Master List.
186			salt; see Dow #181 (ammonia) [8007-57-6]
188			salt; see Dow #469 (magnesium) [7439-95-4]
189			salt; see Dow #705, #150 (sodium, acetic acid) [12258-98-9],[64-19-7 former 77671-22-8]
205			salt; see Dow #204, #301 (arsenic, copper) [7440-38-2], [7440-50-8]
246			salt; see Dow #245 (calcium) [7440-70-2]
247			salt; see Dow #245,(calcium) [7440-70-2] and benzoic acid [65-85-0] Added to Master List.
248			salt; see Dow #245 (calcium) [7440-70-2]
249			salt; see Dow #245 (calcium) [7440-70-2]
250			salt; see Dow #245 (calcium) [7440-70-2]
251			salt; see Dow #245 (calcium) [7440-70-2]
264			salt; see Dow #705 (sodium) [12258-98-9]
267			salt; see Dow #245 (calcium) [7440-70-2]
371			salt; see Dow 204, #457 (arsenic, lead) [7440-38-2, 7439-92-1]
372			salt; see Dow #245 (calcium) [7440-70-2]
411			salt; see Dow #445 (iron) [7439-89-6]
416			salt; see Dow #764 (thallium) [82870-81-3]
458			salt; see Dow #204, #457 (arsenic, lead) [7440-38-2, 7439-92-1]
459			salt; see Dow #457 (lead) [7439-92-1]
460			salt; see Dow #457 (lead) [7439-92-1]
461			salt; see Dow #457 (lead) [7439-92-1]
462			salt; see Dow #245 (calcium) [7440-70-2]
463			salt; see Dow #245 (calcium) [7440-70-2]
464			salt; see Dow #245 (calcium) [7440-70-2]
468			salt; see Dow #469 (magnesium) [7439-95-4]

CASE NARRATIVE - Salts

473			salt; see Dow #469 (magnesium) [7439-95-4]
474			salt; see Dow #469 (magnesium) [7439-95-4]
475			salt; see Dow #469 (magnesium) [7439-95-4]
476			salt; see Dow #469 (magnesium) [7439-95-4]
477			salt; see Dow #469 (magnesium) [7439-95-4]
478			salt; see Dow #469 (magnesium) [7439-95-4]
481			salt; see Dow #469 (magnesium) [7439-95-4]
484			salt; see Dow #469 (magnesium) [7439-95-4]
487			salt; see Dow #486 (manganese) [7439-96-5]
538		Zinc salt of 2,4,5 -trichlorophenol (Dow 9-B)	DOW RESOLVED. salt; see Dow #8[95-95-4] 2,4,5-trichlorophenol
573		Nitrate Compounds	DOW RESOLVED. Salt see Dow #
671			salt; see Dow #672 (potassium) [7440-09-7]
674			salt; see Dow #672 (potassium) [7440-09-7]
702			salt; see Dow #181 (ammonia) [8007-57-6]
704			salt; see Dow #705 (sodium) [12258-98-9], benzoic acid [69-72-7] Added to Master List.
705			salt; see Dow #705 (sodium) [12258-98-9]
714			salt; see Dow #245 (calcium) [7440-70-2]
716			salt; see Dow #705, #150 (sodium, acetic acid) [12258-98-9], [64-19-7 former 77671-22-8]
717			salt; see Dow #204, #705 (arsenic, sodium) [7440-38-2, 12258-98-9]
718			salt; see Dow #705 (sodium) [12258-98-9], benzoic acid 69-72-7] Added to Master List.
720			salt; see Dow #705 (sodium) [12258-98-9]
721			salt; see Dow #705 (sodium) [12258-98-9]
724			salt; see Dow #705 (sodium) [12258-98-9]
725			salt; see Dow #705 (sodium) [12258-98-9]
768			salt; see (titanium) [7440-32-6] Added to Master List.
769			salt; see (titanium) [7440-32-6] Added to Master List.
799			salt; see Dow #797 (zinc) [7440-66-6]
800			salt; see Dow #797 (zinc) [7440-66-6]
801			salt; see Dow #797, #295 (zinc, chromium) [7440-66-6, 7440-47-3]

ATTACHMENT 4

Case Narratives – Resolved or Affirmed by Dow
Revision Date: November 27, 2006

- "Composition Uncertain"
- "ID Conflicts" (between CAS and chemical name)
- "Polymers" (MW > 5000 Daltons)

CASE NARRATIVE - Composition Uncertain

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
237	N/A	Bromozones	DOW AFFIRMED. composition uncertain for chemical name Bromozones (very old product)
242	N/A	By-products of brominated biphenyl ethers	DOW AFFIRMED. composition uncertain for chemical name By-products of brominated diphenyl ethers
253	N/A	Carbamoyl Sarcosine (CMS) or 2-(carbomyl-methyl-ami	DOW AFFIRMED. no [CAS] for chemical name Carbamoyl Sarcosine or 2-(carbonyl-methyl-amino)acetic acid
265	N/A	Cedambrette	DOW AFFIRMED. composition uncertain for chemical name Cedambrette (very old product)
297	N/A	Ciba blue (brominated indigo)	DOW AFFIRMED. composition uncertain for chemical name Ciba blue
312	N/A	DBR (N-[4-(5-dimethylaminonaphthalen-1-yl)sulfonylaminobutyl]adamantane-1-carboxamide)	DOW AFFIRMED. composition uncertain for chemical name DBR (N-[4-(5-dimethylaminoaphthalenyl)sulfonylaminobutyl]adamante-1-c
373	N/A	DTRP - 1,2,3,4-tetrahydro-(1-phenylethyl)napthalene)	DOW AFFIRMED. composition uncertain (no CAS #) for chemical name DTRP - 1,2,3,4-tetrahydro-(1-phenylethyl)napthalene)
410	N/A	F Reagant, Potassium Furfuryl Xanthate	DOW AFFIRMED. composition uncertain for chemical name F Reagent, Potassium Furfuryl Xanthate
418	N/A	Ginger root, Boric Acid, Soluble Oil	DOW AFFIRMED. composition uncertain for chemical name Ginger root, boric acid, soluble oil
243			DOW AFFIRMED. composition uncertain for chemical name By-products of phenol process
274			DOW AFFIRMED. composition uncertain for chemical name Chlorinated Diphenyloxide
275			DOW AFFIRMED. composition uncertain for chemical name Chlorinated Diphenylsulfide
276			DOW AFFIRMED. composition uncertain for chemical name Chlorinated Heterocycles like chlorinated carbazoles, acridin, polychlorinated dibenzophenes
277			DOW AFFIRMED. composition uncertain for chemical name Chlorinated Indene
278			DOW AFFIRMED. composition uncertain for chemical name Chlorinated PAH's (3-5 rings)
279			DOW AFFIRMED. composition uncertain for chemical name Chlorinated Phenols, cresols
553		N/A	DOW AFFIRMED. composition uncertain for chemical name Gardanthrol
561		N/A	DOW AFFIRMED. composition uncertain for chemical name Sylviola
609		Paraffins + Bentonite + Pale Linsee Fatty Acid + Ammonia + Water	DOW AFFIRMED. composition uncertain for chemical name Paraffins +Bentonite + Pale Linsee fatty acid + ammonia + water
658			DOW RESOLVED. General reference to Dow # 655, Dow #533, Dow #657, Dow #651, Dow #652, Dow #654, Dow# 656, Dow #653.

CASE NARRATIVE - Composition Uncertain

661			DOW AFFIRMED. composition uncertain for chemical name Polychlorinated naphthalenes
737		Sulphonated base oil	DOW AFFIRMED. composition uncertain for chemical name Sulphonated base oil
749		t-butylsalol	DOW AFFIRMED. composition uncertain for chemical name t-butylsalol
755		Tetrachlorodinuthane	DOW AFFIRMED. Composition uncertain for Tetrachlorodiuthane.
788		Velvetine	DOW AFFIRMED.composition uncertain for chemical name Velvetine

CASE NARRATIVE - ID Conflict

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
758	56-23-5	Tetrachloromethane	[8068-85-7] not in registry; [56-23-5]may be correct for Tetrachloromethane
686	79-09-4	Propionic acid	conflict [69806-86-6]not in registry; [79-09-4] for Propionic acid may be correct
766	80-68-2	Threonine	conflict [632-20-2]not in registry; [80-68-2] for Threonine may be correct
630	92-84-2	10H-Phenothiazine	conflict [117-89-5]not in registry; [92-84-2] for Phenothiazine may be correct
614	106-48-9	4-Chlorophenol	conflict; [1193-00-6]not in registry; [106-48-9] may be correct for 4-Chlorophenol
292	1331-28-8	2-Chloroethenylbenzene	former [8063-96-5] has been replaced with [1331-28-8] for Chlorostyrene (2-Chloroethylbenzene)
715	7440-23-5	Sodium	former [12258-98-9] not in registry; [7440-23-5] may be correct for sodium
135	N/A	4-chloro-2-nitrophenylphenylether; "Nitrophene"	conflict; no [CAS #] for chemical name 4-chloro-2-nitrophenylphenylether
208	N/A	B-chloro-B'-(2,4,6-trichlorophenoxy)-diethyl ether	DOW RESOLVED no [CAS #] for chemical name B-chloro-B'-(2,4,6-trichlorophenoxy)-diethyl ether. Experiemental chemical, not produced.
316	N/A	DFBA (2-[1-[3,5-diflurorphenyl)methoxy]-6-imino-purin-9-yl]-5-hydroxymethyl)oxolane-3,4-diol)	conflict; no [CAS #] for chemical name DFBA (2-[1-[3,5-diflurorphenyl)methoxy]-6-imino-purin-9-yl]-5-hydroxymethyl)oxolane-3,4-diol)
679	N/A	PPH((1-amino-2-phenyl-ethyl)phosphinic acid)	conflict; no [CAS #] for chemical name PPH((1-amino-2-phenyl-ethyl)phosphinic acid)
258			multi-compound listing. Individual components Dow #258 Carbon tetrachloride [56-23-5], Dow #48 1,2 Dichloroethane [107-06-2]. No [CAS#] for 1,2-Dibromomethane added to Conflict ID Category

CASE NARRATIVE - Polymers

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
446	100-42-5	IRPS (Ignition-resistant polystyrene)	DOW AFFIRMED. polymer (MW>5000)
729	100-42-5	Styrene	DOW AFFIRMED. polymer (MW>5000) and redundant see Dow #730.
163	9003-04-7	2-Propenoic acid, homopolymer, sodium salt	DOW AFFIRMED. polymer (MW>5000) AND former [95077-68-2] has been replaced with [9003-04-7] for Acrylic acid + Sodium Acylate (2-Propenoic acid, homopolymer, sodium salt)
378	28064-14-4	Epoxy resin (epichlorohydrin + phenol-formaldehyde novolac)	DOW AFFIRMED. polymer (MW>5000)
23	N/A	1,1'-isopropylidene bis (p-phenyleneoxy) di-2-pr+C32opanol or 2,2-bis(p-(2-hydroxypropxy))-phenyl propane	DOW AFFIRMED. polymer (MW>5000)
376	N/A	Emulsion - HGABS	DOW AFFIRMED. polymer (MW>5000)
409	N/A	Ethylene/propylene/diene monomer (EPDM)	DOW AFFIRMED. polymer (MW>5000)
444	N/A	Ion exchange resins	DOW AFFIRMED. polymer (MW>5000)
780	N/A	Triethylene Glycol -main ingredient + Methyl Ether + 4,4'-(1-Methylethylidene)bisphenol + 2,2',2''-Nitrilotrisethanol + 1-Amino-2-propanol + Voranol CP-3322	DOW RESOLVED. Multi-compound listing individual componenets are [112-35-6] Triethylene glycol Methyl Ether, [25068-38-6] 4,4' (1-Methyltheylidene)bisphenol, [24794-58-9] 2,2,2'-Nitrilotrisethanol, [78-96-6] Amino-2-propanol, [no CAS] Voranol CP-3322, all Added to Master List.
124			DOW AFFIRMED. polymer (MW>5000)
164			DOW AFFIRMED. polymer (MW>5000)
166			DOW AFFIRMED. polymer (MW>5000)
177			DOW AFFIRMED. polymer (MW>5000)
180			DOW AFFIRMED. polymer (MW>5000)
192			DOW AFFIRMED. polymer (MW>5000)
193			DOW AFFIRMED. polymer (MW>5000)
194			DOW AFFIRMED. polymer (MW>5000)
195			DOW AFFIRMED. polymer (MW>5000)
196			DOW AFFIRMED. polymer (MW>5000)
201			DOW AFFIRMED. polymer (MW>5000)
262			DOW AFFIRMED. polymer (MW>5000)
266			DOW AFFIRMED. polymer (MW uncertain; very old product)
343			DOW AFFIRMED. polymer (MW>5000)
381			DOW AFFIRMED. polymer (MW>5000)
384			DOW AFFIRMED. polymer (MW>5000)
394			DOW AFFIRMED. polymer (MW>5000)
466			DOW AFFIRMED. polymer (MW>5000)
494			DOW AFFIRMED. polymer (MW>5000)
511			DOW AFFIRMED. polymer (MW>5000)
539		N/A	DOW AFFIRMED. polymer (MW>5000)

CASE NARRATIVE - Polymers

540		N/A	DOW AFFIRMED. polymer (MW>5000)
541		N/A	DOW AFFIRMED. polymer (MW>5000)
542		N/A	DOW AFFIRMED. polymer (MW>5000)
552			DOW AFFIRMED. polymer (MW>5000)
569			DOW AFFIRMED. polymer (MW>5000)
647		Plastic	DOW AFFIRMED. polymer (MW>5000)
663			DOW AFFIRMED. polymer (MW>5000)
667			DOW AFFIRMED. polymer (MW>5000)
668			DOW AFFIRMED. polymer (MW>5000)
669			DOW AFFIRMED. polymer (MW>5000)
670			DOW AFFIRMED. polymer (MW>5000)
683			DOW AFFIRMED. polymer (MW>5000)
695			DOW AFFIRMED. polymer (MW>5000)
706			DOW AFFIRMED. polymer (MW>5000)
707			DOW AFFIRMED. polymer (MW>5000)
711		Silicon compounds	DOW AFFIRMED. polymer (MW>5000)
712		Silicon compounds	DOW AFFIRMED. polymer (MW>5000)
727			DOW AFFIRMED. polymer (MW>5000)
731		Styrene + Acrylonitrile	DOW AFFIRMED. polymer (MW>5000)
732			DOW AFFIRMED. polymer (MW>5000)
734			DOW AFFIRMED. polymer (MW>5000)
735			DOW AFFIRMED. polymer (MW>5000)
782			DOW AFFIRMED. polymer (MW>5000)

ATTACHMENT 5

Case Narrative – Database Additions
Revision Date: November 27, 2006

- "Case Narrative Additions"
- "Biomonitoring Positives"
- "RGIS System Positives"
- "Midland Soils COI"

CASE NARRATIVE - Database Additions

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
Added	60-00-4	Versene (sodium EDTA)	See Dow #369; [60-00-4] for Versene
Added	69-72-7	Benzoic acid, 2-hydroxy	salt, See Dow #185 and #704 Added to Master List.
Added	75-69-4	trichlorofluoromethane	Appendix IX.
Added	78-88-6	2,3-Dichloropropene	[78-88-6] 2,3-Dichloropropene
Added	78-96-6	Amino-2-propanol	See Dow #780; [78-96-6] for amino-2-propanol
Added	107-12-0	propionitrile	Appendix IX. RGIS.
Added	108-05-4	vinyl acetate	Appendix IX.
Added	109-65-9	n-butyl bromide	See Dow #142; [109-65-9] n-butyl bromide
Added	110-57-6	trans-1,4-dichloro-2-butene	Appendix IX. RGIS.
Added	111-76-2	2-butoxy ethanol	See Dow #566; [111-76-2] for 2-butoxy ethanol
Added	112-35-6	Triethylene glycol methyl ether	See Dow #780; [112-35-6] for triethylenen glycol methyl ether
Added	112-80-1	Oleic acid	See Dow #456; [112-80-1] for Oleic acid
Added	112-86-7	Erusic acid	See Dow #456; [112-86-7] for Erusic acid
Added	115-86-6	Triphenylphospahte	See Dow #783; [115-86-6] for triphenylphospahte
Added	118-60-5	Octyl Salicylate	See Dow # 594; [118-60-5] for octyl salicylate
Added	119-93-7	3,3[min]dimethylbenzidine	Appendix IX.
Added	120-83-2	2,4-Dichlorophenol	RGIS. [120-83-2] 2,4-Dichlorophenol
Added	124-07-2	Octanoic acid	See Dow #252; [124-07-2] for octanoic acid.
Added	124-38-9	Carbon dioxide	See Dow #427; [124-38-9] for carbon dioxide
Added	131-57-7	Oxybenzone	See Dow # 594; [131-57-7] for oxybenzone
Added	142-82-5	Heptane	See Dow #427; [142-82-5] for heptane
Added	156-59-2	cis-1,2-Dichloroethene	RGIS. [156-59-2] cis-1,2-Dichloroethene
Added	156-60-5	trans-1,2-dichloroethene	Appendix IX. RGIS.
Added	334-48-5	Decanoic acid	See Dow #252; [334-48-5] for decanoic acid.
Added	506-30-9	Eicosinic acid	See Dow #456; [506-30-9] for Eicosinic acid
Added	506-37-6	Nervonic acid	See Dow #456; [506-37-6] for Nervonic acid
Added	506-51-4	Tetraconsenol	See Dow #456; [506-51-4] for Tetraconsinol
Added	540-49-8	1,2-Dibromoethene	See Dow #155; [540-49-8] for 1,2-Dibromoethene
Added	544-63-8	Myristic acid	See Dow #456; [544-63-8] for Myristic acid
Added	563-57-5	3,3-Dichloropropene	[563-57-5] 3,3-Dichloropropene
Added	629-96-9	Eicosenol	See Dow #456; [629-96-9] for Eiconsenol
Added	2432-11-3	2,6-Diphenyl Phenol	RGIS.
Added	5103-73-1	Cis Nonachlor - 1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-(1.alpha.,2.alpha.,3.alpha.,3a.alpha., 4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene	[5103-73-1] Cis Nonachlor
Added	7440-32-6	Titanium	[7440-32-6] Titanium
Added	7440-62-2	Vanadium	RGIS. [7440-62-2] Vanadium

CASE NARRATIVE - Database Additions

Added	7578-39-4	Ethyl ether	See Dow #427; [7578-39-4] for ethyl ether
Added	7783-06-4	Sulfide	RGIS.
Added	8041-89-2	Retrol	See Dow #560; [8041-89-2] for Retrol
Added	8063-96-5	Chlorostyrene	[8063-96-5] Chlorostyrene
Added	9007-33-4	Monoethanolamine	See Dow #208; [9007-33-4] monethanolamine
Added	10061-02-6	trans-1,3-Dichloropropene	[10061-02-6] trans-1,3-Dichloropropene
Added	12626-49-2	Dowfax 2A1	See Dow #369; [12626-49-2] for Dowfax 2A1
Added	18496-25-8	sulfide	Appendix IX.
Added	23950-58-5	pronnamide	Appendix IX.
Added	24794-58-9	2,2',2''-nitrilotrisethanol	See Dow #780; [112-35-6] for triethylenen glycol methyl ether
Added	25068-38-6	4,4'-(1-Methylethylidene)bisphenol	See Dow #780; [25068-38-6] for 4,4'-(1-Methyiethylidene bisphenol
Added	26571-11-9	Dowfax 9N9	See Dow #369; [26571-11-9] for Dowfax 9N9
Added	27178-34-3	Tertbutyl Phenol	RGIS.
Added	27304-13-8	2,3,4,5,6,6a,7,7-Octachloro-1a,1b,5,5a,6,6a-hexahydro-, (1a.alpha.,1b.beta.,2.alpha.,5.alpha.,5a.beta.,6.beta.,6a.alpha.)- 2,5-methano-2H-indeno[1,2-b]oxirene	[27304-13-8] Oxychlordane
Added	28231-03-0	Cedrenol	See Dow #560; [28231-03-0] for Cedrenol
Added	28984-89-6	1,1'-Biphenyl, phenoxy-	multi-compound listing. See Dow #20 [62587-63-7] Added to Master List.
Added	29082-74-4	Octachlorostyyrene - Pentachloro(trichloroethenyl)benzene	[29082-74-4] Octachlorostyrene
Added	29761-21-5	Isodecyldiphenylphospahte ester	See Dow #783; [29761-21-5] for isodecyldiphenylphosphate ester
Added	30303-65-2	Docosenal	See Dow #456; [30303-65-2] for Docosenol+AG574
Added	35365-94-7	triethylammonium phosphate	See Dow #544; [35365-94-7] for triethylammonium phosphate
Added	39765-80-5	1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-, (1.alpha.,2.beta.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene	[39765-80-5] trans Nonachlor
Added	57157-84-3	Isophorone	See Dow #543; [57157-84-3] for Atlox 1045A
Added	61255-81-0	Heptachlorostyrene	[61255-81-0] Heptachlorostyrene
Added	66321-94-6	Palmitic acid	See Dow #456; [66321-94-6] for Palmitic acid
Added	67774-32-7	PBB	[67774-32-7] PBB
Added	83484-75-7	Pentachlorostyrene	[83484-75-7] Pentachlorostyrene
Added	90301-92-1	Hexachlorostyrene	[90301-92-1] Hexachlorostyrene
Added	99932-75-9	Ethylene oxide	See Dow #516; [99932-75-9] for ethylene oxide
185			salt; see (benzoic acid) [69-72-7] Added to Master List.

CASE NARRATIVE - Database Additions

544		Dow Oven Cleaner	DOW RESOLVED. Multi-compound listing individual componests are Dow #325 [75-09-2] methylene chloride, [no CAS#] paraffin, Dow # 770[108-88-3] toluene, Dow # [9968-59-2] methocel, Dow # 491 [67-56-1] methanol, [35365-94-7] triethyl ammonium phosphate and [9007-33-4] monethanolamine Added to Master List.
566		Naptha solvent + Toluene + Dowanol EB - ethylene glycol + mono-n-butyl ether	DOW RESOLVED. multi-compound lisiting individual components are [no CAS #] Naptha solvent, Dow #770 [108-88-3]Toluene, [111-76-2] Dowanol EB added to Master List.
704			salt; see Dow #705 (sodium) [12258-98-9], benzoic acid [69-72-7] Added to Master List.
Added		Propane-1,2,3-triol	See Dow #252; [no CAS] for propane-1,2,3-triol.

CASE NARRATIVE - Biomonitoring Positives/Database Additions

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
Added	5103-73-1	Cis Nonachlor - 1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-(1.alpha.,2.alpha.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene	[5103-73-1] Cis Nonachlor
Added	27304-13-8	2,3,4,5,6,6a,7,7-Octachloro-1a,1b,5,5a,6,6a-hexahydro-,(1a.alpha.,1b.beta.,2.alpha.,5.alpha.,5a.beta.,6.beta.,6a.alpha.)- 2,5-methano-2H-indeno[1,2-b]oxirene	[27304-13-8] Oxychlordane
Added	29082-74-4	Octachlorostyyrene - Pentachloro(trichloroethenyl)benzene	[29082-74-4] Octachlorostyrene
Added	39765-80-5	1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-,(1.alpha.,2.beta.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene	[39765-80-5] trans Nonachlor
Added	61255-81-0	Heptachlorostyrene	[61255-81-0] Heptachlorostyrene
Added	67774-32-7	PBB	[67774-32-7] PBB
Added	83484-75-7	Pentachlorostyrene	[83484-75-7] Pentachlorostyrene
Added	90301-92-1	Hexachlorostyrene	[90301-92-1] Hexachlorostyrene

CASE NARRATIVE - RGIS System Positives/Database Additions

Dow ID	CAS Number	Chemical Name	Case Narrative Comments
Added	107-12-0	propionitrile	Appendix IX. RGIS.
Added	110-57-6	trans-1,4-dichloro-2-butene	Appendix IX. RGIS.
Added	120-83-2	2,4-Dichlorophenol	RGIS. [120-83-2] 2,4-Dichlorophenol
Added	156-59-2	cis-1,2-Dichloroethene	RGIS. [156-59-2] cis-1,2-Dichloroethene
Added	156-60-5	trans-1,2-dichloroethene	Appendix IX. RGIS.
Added	2432-11-3	2,6-Diphenyl Phenol	RGIS.
Added	7440-62-2	Vanadium	RGIS. [7440-62-2] Vanadium
Added	7783-06-4	Sulfide	RGIS.
Added	27178-34-3	Tertbutyl Phenol	RGIS.

CASE NARRATIVE - Midland Soils COI/Database Additions

Dow ID	CAS Number	Chemical Name	Case Narrative Comments

ATTACHMENT 6

Midland Soils PCOI List
November 22, 2006

Midland Soils PCOI List From DOW (11/22/06)

CAS # (sortable)	Chemical Name	In COI/TAL Database? (Y/N)
50000	Formaldehyde	Y
50328	Benzo(a)pyrene	Y
51285	2,4-Dinitrophenol	N
51796	Ethyl carbamate (Urethane)	N
53703	Dibenzo(a,h)anthracene	Y
53963	2-Acetylaminofluorene	Y
56235	Carbon tetrachloride	Y
56382	Parathion	Y
56495	3-Methylcholanthrene	Y
56553	Benzo(a)anthracene	Y
57147	1,1-Dimethyl hydrazine	N
57578	beta-Propiolactone	N
57749	Chlordane	Y
57976	7,12-Dimethylbenz(a)anthracene	Y
58899	Lindane (all isomers)	Y
59892	N-Nitrosomorpholine	Y
60117	Dimethyl aminoazobenzene	Y
60344	Methyl hydrazine	N
60355	Acetamide	Y
62533	Aniline	Y
62737	Dichlorvos	N
62759	N-Nitrosodimethylamine	Y
63252	Carbaryl	N
64675	Diethyl sulfate	N
67561	Methanol	N
67641	Acetone	Y
67663	Chloroform	Y
67721	Hexachloroethane	Y
68122	Dimethyl formamide	Y
71363	Butyl alcohol	Y
71432	Benzene (including benzene from gasoline)	Y
71556	Methyl chloroform (1,1,1-Trichloroethane)	Y
71556	1,1,1-Trichloroethane	Y-REDUNDANT
72435	Methoxychlor	Y
74839	Bromomethane	Y
74839	Methyl bromide (Bromomethane)	Y-REDUNDANT
74873	Chloromethane	Y
74873	Methyl chloride (Chloromethane)	Y-REDUNDANT
74884	Methyl iodide (Iodomethane)	Y
74953	Dibromomethane	Y
74964	bromoethane	Y
74975	Bromodichloromethane	Y
75003	Chloroethane	Y
75003	Ethyl chloride (Chloroethane)	Y-REDUNDANT
75014	Vinyl chloride	Y
75058	Acetonitrile	Y
75070	Acetaldehyde	Y
75092	Methylene chloride (Dichloromethane)	Y
75150	Carbon disulfide	Y
75218	Ethylene oxide	Y
75252	Bromoform	Y
75343	1,1-Dichloroethane	Y
75343	Ethylidene dichloride (1,1-Dichloroethane)	Y-REDUNDANT
75354	1,1-Dichloroethene	Y
75354	Vinylidene chloride (1,1-Dichloroethylene)	Y-REDUNDANT
75445	Phosgene	Y
75558	1,2-Propylenimine (2-Methyl aziridine)	N
75569	Propylene oxide	Y
75627	Bromotrichloromethane	N
75718	Dichlorodifluoromethane	N
76448	Heptachlor	Y
77474	Hexachlorocyclopentadiene	Y
77781	Dimethyl sulfate	N
78591	Isophorone	Y
78875	1,2-Dichloropropane	Y
78875	Propylene dichloride (1,2-Dichloropropane)	Y-REDUNDANT
78933	2-Butanone	Y
78933	Methyl ethyl ketone (2-Butanone)(See Modification)	Y-REDUNDANT
79005	1,1,2-Trichloroethane	Y
79016	Trichloroethylene	Y
79061	Acrylamide	Y
79107	Acrylic acid	Y
79118	Chloroacetic acid	Y
79287	Tetrabromoethene	N
79345	1,1,2,2-Tetrachloroethane	Y
79447	Dimethyl carbamoyl chloride	N
79469	2-Nitropropane	N
80057	4,4'-Isopropylidenediphenol	Y

Midland Soils PCOI List From DOW (continued)

80626	Methyl methacrylate	Y
82688	Pentachloronitrobenzene (Quintobenzene)	Y
83329	Acenaphthene	Y
84641	Anthracenedione	N
84662	Diethyl phthalate	Y
84742	Dibutylphthalate	Y
85018	Phenanthrene	Y
85449	Phthalic anhydride	N
85687	Benzyl butyl phthalate	Y
86737	Fluorene	Y
87616	1,2,3-Trichlorobenzene	Y
87650	3,4-dichlorophenol	Y
87683	Hexachlorobutadiene	Y
87865	Pentachlorophenol	Y
88062	3,4,5-trichlorophenol	Y
88755	2-Nitrophenol	Y
90040	o-Anisidine	N
90437	2-phenylphenol	Y
90471	Xanthenone	N
91203	Naphthalene	Y
91225	Quinoline	N
91576	2-Methylnaphthalene	Y
91587	2-Chloronaphthalene	Y
91941	3,3-Dichlorobenzidene	Y
92524	Biphenyl	Y
92671	4-Aminobiphenyl	Y
92875	Benzidine	N
92933	4-Nitrobiphenyl	N
93583	Benzoic acid, methyl ester	N
94757	2,4-D, salts and esters	Y
95363	1,2,4-Trimethylbenzene	Y
95476	o-Xylenes	N
95487	o-Cresol	Y
95501	1,2-Dichlorobenzene	Y
95534	o-Toluidine	Y
95578	2-chlorophenol	Y
95578	3-chlorophenol	Y-REDUNDANT
95772	3,5-dichlorophenol	N
95807	2,4-Toluene diamine	N
95943	1,2,4,5-tetrachlorobenzene	Y
95954	2,4,6-trichlorophenol	Y
96093	Styrene oxide	N
96128	1,2-Dibromo-3-chloropropane	Y
96333	Methyl acrylate	Y
96457	Ethylene thiourea	N
98077	Benzotrichloride	N
98828	Cumene	Y
98862	Acetophenone	Y
98953	Nitrobenzene	Y
100027	4-Nitrophenol	Y
100414	Ethyl benzene	Y
100425	Styrene	Y
100447	Benzyl chloride	N
100470	Benzonitrile	N
101144	4,4-Methylene bis(2-chloroaniline)	N
101688	Methylene diphenyl diisocyanate (MDI)	N
101779	4,4¬-Methylenedianiline	N
105602	Caprolactam(See Modification)	N
106423	p-Xylenes	N
106445	p-Cresol	Y
106467	1,4-Dichlorobenzene(p)	Y
106489	2,3-dichlorophenol	Y
106503	p-Phenylenediamine	Y
106514	Quinone	N
106650	Butanedioic acid, dimethyl ester	N
106887	1,2-Epoxybutane	N
106898	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Y
106934	Ethylene dibromide (Dibromoethane)	Y
106990	1,3-Butadiene	Y
107028	Acrolein	Y
107051	Allyl chloride	Y
107062	1,2-Dichlorothane	Y
107062	Ethylene dichloride (1,2-Dichloroethane)	Y-REDUNDANT
107119	Allylamine	Y
107131	Acrylonitrile	N
107186	Allyl Alcohol	Y
107211	Ethylene glycol	N
107302	Chloromethyl methyl ether	Y
107506	Tetradecamethylcycloheptasiloxane	N

Midland Soils PCOI List From DOW (continued)

108054 Vinyl acetate	Y
108101 Methyl isobutyl ketone (Hexone)	Y
108101 4-Methyl-2-pentanone	Y-REDUNDANT
108316 Maleic anhydride	N
108383 m-Xylenes	N
108394 m-Cresol	Y
108430 4-chlorophenol	N
108703 1,3,5-Trichlorobenzene	N
108850 Bromocyclohexane	N
108861 Bromobenzene	Y
108872 Methylcyclohexane	N
108883 Toluene	Y
108907 Chlorobenzene	Y
108952 Phenol	Y
110527 Benzaldehyde	N
110543 Hexane	Y
110576 trans-1,4-Dichloro-2-butene	Y
111422 Diethanolamine	Y
111444 Dichloroethyl ether (Bis(2-chloroethyl)ether)	Y
111659 Octane	N
111842 Nonane	N
114261 Propoxur (Baygon)	N
115117 Methyl propene	N
117817 Bis(2-ethylhexyl)phthalate (DEHP)	Y
117840 Di-N-Octyl phthalate	Y
118741 Hexachlorobenzene	Y
119904 3,3-Dimethoxybenzidine	N
119937 3,3'-Dimethyl benzidine	Y
120127 Anthracene	Y
120809 Catechol	Y
120821 1,2,4-Trichlorobenzene	Y
120832 2,5-dichlorophenol	Y
121142 2,4-Dinitrotoluene	Y
121448 Triethylamine	N
121697 N,N-Diethyl aniline (N,N-Dimethylaniline)	N
122667 1,2-Diphenylhydrazine	N
123319 Hydroquinone	Y
123386 Propionaldehyde	N
123911 1,4-Dioxane (1,4-Diethyleneoxide)	Y
124185 Decane	N
124481 Dibromochloromethane	Y
126998 Chloroprene	Y
127184 tetrachloroethene	Y
127184 Tetrachloroethylene (Perchloroethylene)	Y-REDUNDANT
129000 Pyrene	Y
131113 Dimethyl phthalate	Y
132649 Dibenzofuran	Y
132649 Dibenzofurans	Y-REDUNDANT
133062 Captan	N
133904 Chloramben	N
140885 Ethyl acrylate	Y
151564 Ethylene imine (Aziridine)	N
156627 Calcium cyanamide	N
189559 Benzo(r,s,t)pentaphene	N
189640 Dibenzo(a,h)pyrene	N
191242 Benzo (g,h,i) perylene	Y
191300 Dibenzo(a,l)pyrene	N
192654 Dibenzo(a,e)pyrene	N
192972 Benzo(e)pyrene	N
193395 Indeno(1,2,3-cd)pyrene	Y
194592 7H-Dibenzo(c,g)carbazole	N
205823 Benzo(j)fluoranthene	N
205992 Benzo(b)fluoranthene	Y
206440 Benzo(j,k)fluorene(fluoranthene)	Y
206440 Fluoranthene	Y-REDUNDANT
207089 Benzo(k)fluoranthene	Y
218019 Benzo(a)phenanthrene (chrysene)	Y
218019 Chrysene	Y-REDUNDANT
224420 Dibenz(a,j)acridine	N
226368 Dibenz(a,h)acridine	N
302012 Hydrazine	N
334883 Diazomethane	N
460128 Butadiyne	N
463581 Carbonyl sulfide	N
506592 Dimethylamine	Y
510156 Chlorobenzilate	Y
532274 2-Chloroacetophenone	N
534521 4,6-Dinitro-o-cresol, and salts	Y
540841 2,2,4-Trimethylpentane	N

Midland Soils PCOI List From DOW (continued)

	540976	Dodecamethylcyclohexasiloxane	N
	541026	Decamethylcyclopentasiloxane	N
	541731	1,3-Dichlorobenzene	Y
	542881	Bis(chloromethyl)ether	N
	558134	tetrabromomethane	Y
	576249	2,4-dichlorophenol	N
	584849	2,4-Toluene diisocyanate	N
	591355	2,3,4-trichlorophenol	N
	593602	Bromoethene	Y
	593602	Vinyl bromide	Y-REDUNDANT
	593635	Chloroethyne	N
	593788	2,6-dichlorophenol	N
	594150	tribromochloromethane	N
	594183	dibromodichloromethane	N
	598163	Tribromoethene	N
	608935	Pentachlorobenzene	Y
	609198	2,3,4,5-tetrachlorophenol	N
	624839	Methyl isocyanate	N
	627930	Hexanedioic acid, dimethyl ester	N
	630206	1,1,1,2-Tetrachloroethane	Y
	634662	1,2,3,4-tetrachlorobenzene	Y
	634902	1,2,3,5-tetrachlorobenzene	Y
	676631	Propene	N
	676631	Propylene	N-REDUNDANT
	680319	Hexamethylphosphoramide	N
	684935	N-Nitroso-N-methylurea	N
	822060	Hexamethylene-1,6-diisocyanate	N
	872504	N-methyl-2-pyrrolidone	Y
	933754	2,4,5-trichlorophenol	N
	933788	2,3,6-trichlorophenol	N
	935955	2,3,5,6-tetrachlorophenol	N
	992983	Formic acid	N
	1120214	Undecane	N
	1120714	1,3-Propane sultone	N
	1319773	Cresols/Cresylic acid (isomers and mixture)	N
	1330207	Xylenes (isomers and mixture)	Y
	1332214	Asbestos	N
	1336363	Polychlorinated biphenyls (Aroclors)	N
	1582098	Trifluralin	N
	1634044	Methyl tert butyl ether	N
	1735177	Cyclohexane	N
	1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	Y
	3547044	DDE	N
	3697243	5-Methylchrysene	N
	4901513	2,3,4,6-tetrachlorophenol	N
	5385751	Dibenzo(a,e)fluoranthene	N
	5522430	1-Nitropyrene	N
	6012971	Tetrachlorothiophene	N
	7550450	Titanium tetrachloride	N
	7572294	Dichloroethyne	N
	7647010	Hydrochloric acid	Y
	7664393	Hydrogen fluoride (Hydrofluoric acid)	N
	7664417	Ammonia	Y
	7723140	Phosphorus	N
	7726956	Bromine	Y
	7782505	Chlorine	Y
	7783064	Hydrogen sulfide(See Modification)	N
	7803512	Phosphine	N
	8001352	Toxaphene (chlorinated camphene)	Y
	8003074	1,2-Dibromoethane	N
	8031332	Heptane	N
	8031354	Pentane	N
	10061015	cis-1,3-Dichloropropene	Y
	10061026	trans-1,3-Dichloropropene	Y
	15950660	2,3,5-trichlorophenol	N
	30498669	Dimethylheptane	N
	52663577	Butoxyethanol	Y
	77392713	Perylene	N
	83847498	bromochloromethane	N
	87701653	Ethylene	N
	145538745	Decabromodiphenyl oxide	N
	220713315	Butyl acrylate	N
isomer uncertain		Bromochlorobenzene	
isomer uncertain		bromodichloroethane	
isomer uncertain		Bromodichlorophenol	
isomer uncertain		Chlorobutane	
isomer uncertain		Chlorooctane	
isomer uncertain		Chloropyridine	
26249-12-7		Dibromobenzene	

Midland Soils PCOI List From DOW (continued)

isomer uncertain	dibromochloroethane
isomer uncertain	Dimethylphenanthrene
isomer uncertain	Ethylhexanoic acid
isomer uncertain	Ethylhexanol
isomer uncertain	Hexene
isomer uncertain	Methylheptane
isomer uncertain	Methyphenanthrene
isomer uncertain	Methylphenol
isomer uncertain	Pentachlorobutadiene
isomer uncertain	Pentene
isomer uncertain	tribromochloroethane
271-89-6	Benzofuran
isomer uncertain	Benzopyranone
isomer uncertain	Bromoanthracene
isomer uncertain	Bromobenzonitrile
isomer uncertain	Bromochlorocyclohexanol
107-04-0	Bromochloroethane
isomer uncertain	Bromochloroethene
isomer uncertain	Bromochloroethyne
isomer uncertain	Bromochloropropyne
16536-57-5	Bromocyclohexanol
isomer uncertain	Bromodichlorobenzene
isomer uncertain	Bromodichloroethene
isomer uncertain	Bromodichloropropyne
isomer uncertain	Bromodimethylbenzene
isomer uncertain	Bromoethyne
	Bromoheptane
629-04-9	1-bromoheptane
1974-04-5	2-bromoheptane
1974-05-6	3-bromoheptane
998-93-6	4-bromoheptane
isomer uncertain	Bromomethoxycyclohexane
	Bromomethylbenzene
95-46-5	o-bromomethylbenzene
106-38-7	p-bromomethylbenzene
591-17-3	m-bromomethylbenzene
100-39-0	benzylbromide
isomer uncertain	Bromomethylpropane
27497-51-4	Bromonaphthalene
106-95-6	Bromopropene (3-bromo-1-propene)
106-96-7	Bromopropyne (3-bromo-1-propyne)
107103-78-6	Bromotrichlorobenzene (1-bromo-2,3,4-trichlorobenzene)
127099-33-6	bromotrichloroethane (2-bromo-1,1,1-trichloroethane)
isomer uncertain	Bromotrichloroethene
74-84-0	C2 Alkanes (Ethane)
87701-65-3	C2 Alkenes (Ethene)
74-86-2	C2 Alkynes (Acetylene)
75-01-4	chloroethene (vinyl chloride)
isomer uncertain	Chlorothiophene
631-64-1 (acid)	Dibromoacetic acid, methyl ester
isomer uncertain	Dibromochloroethene
60956-24-3	Dibromochlorobenzene (1,2-dibromo-4-chlorobenzene)
4526-56-1	Dibromochlorophenol (2,4-dibromo-6-chlorophenol)
isomer uncertain	Dibromocyclohexane
683-68-1	dibromodichloroethane (1,2-dibromo-1,2-dichloroethane)
isomer uncertain	Dibromodichloroethene
25429-23-6	Dibromoethene
624-61-3	dibromoethyne
	Dibromopropane
78-75-1	1,2-dibromopropane
109-64-8	1,3-dibromopropane
594-16-1	2,2-dibromopropane
isomer uncertain	Dibromothiophene
540-59-0	1,2-Dichloroethene (either isomer)
isomer uncertain	Dichloronaphthyridine
isomer uncertain	Diisocyanates
Redundant (Dow ID 351 or 352)	2,4-Dinitro-o-sec-butylphenol (DINOSEB)
142-62-1	Hexanoic acid
85-44-9	Isobenzofuran-1,3-dione
26914-18-1	Methylanthracene
78-78-4	Methyl butane (2-methyl)
isomer uncertain	Methyldecane
6975-98-0	2-methyldecane
2847-72-5	4-methyldecane
27137-41-3	Methylfuran
isomer uncertain	Methylpentenal
12679-43-5	Naphthalenedione
1600-37-9	Pentachloropropene
isomer uncertain	Phenalenone

Midland Soils PCOI List From DOW (continued)

isomer uncertain	Phenoxybiphenyl
	tetrabromoethane
25167-20-8	1,1,1,2-tetrabromoethane
79-27-6	1,1,2,2-tetrabromoethane
	Tribromobutane
632-05-3	1,2,3-tribromobutane
3675-68-1	1,1,2-tribromobutane
3675-69-2	1,2,2-tribromobutane
62127-47-3	2,2,3-tribromobutane
78-74-0	tribromoethane (1,1,2-tribromoethane)
NO CAS Number	Tribromochloroethene
118-79-6	Tribromophenol
55335-06-3 (acid)	Triclopyr triethylammonium salt
25323-89-1	trichloroethane
71-55-6	1,1,1-trichloroethane
79-00-5	1,1,2-trichloroethane
79-01-6	Trichloroethene
isomer uncertain	Trimethylhexane
87-62-7	2,6-xylidene

ATTACHMENT 7

Tentatively Identified Compounds – Specification

Specification:

Treatment of Site-Specific Constituents of Interest, Standard Target Analytes, Extended Target Analytes, and Tentatively Identified Compounds
Tittabawassee River and Upper Saginaw River Project
Midland Soils Project

Purpose: The ion current chromatograms of multi-compound analytical methods based upon GC/MS or LC/MS (e.g. USEPA 8260 and 8270) can contain information beyond the fully calibrated target analytes. Qualitative and quantitative information about the substances responsible for non-target peaks in such chromatograms can be included in the laboratory data reports if the peaks are handled using the procedure for Tentatively Identified Compounds as described in USEPA Methods 8260B and 8270C (section 7.6.2 in both methods).

Specifications for Handling Unknown Peaks as TICs: The specifications for handling TICs in Method 8260 are given in sections 8.10 and 9.5 of the ATS SOP for this method, and in method 8270 are given in sections 8.11 and 9.7 of that SOP (ATS QAPP, July 2006). To summarize, compounds detected will be identified and quantified as TICs if they have peak areas equal to or greater than 10 percent of the nearest (retention time) internal standard. All such peaks will be reported in a special section of the laboratory data report for each sample.

For non-target peaks meeting the 10 percent threshold, the mass spectrum will be compared to referenced spectra in the current NIST library, using a computer search routine. If the spectral match has a fit of 80 percent or better, the substance name representing the best fit will be reported as the tentative identity of the compound. If the spectral fit is less 80 percent, the peak will be reported as "Unknown RRT x.xxx", where x.xxx is the relative retention time in minutes. In either case, an estimated concentration will be calculated by comparing the peak area to that of the internal standard, using a response factor of 1.00. The estimated concentration will be shown on the laboratory data report.

ATTACHMENT 8

Target Analytes Lists
Revision Date: November 10, 2006

- USEPA Appendix IX
- USEPA 8260 (Volatile Organics)
- USEPA 8270 (Semi-Volatile Organics)
- USEPA 1613-B (Chlorinated Dioxins & Furans)
- Method 1613-TRP/RT (Chlorinated Dioxins & Furans)
- USEPA 1668-A (Polychlorinated Biphenyls)
- USEPA 8041 (Phenols)
- USEPA 8081 (Chlorinated Pesticides)
- USEPA 8082 (Polychlorinated Biphenyls)
- USEPA 8121 (Chlorinated Hydrocarbons)
- USEPA 8141 (Organophosphorus Compounds)
- USEPA 8151 (Chlorinated Herbicides)
- USEPA 6010/6020 (Metals)
- USEPA 7471 (Mercury)
- Other USEPA Methods

Target Analyte List: USEPA 8260
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8260B (SW-846, rev. Dec. 1996)
Test Procedure: Methanol extraction; Purge & Trap, GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
Tetrachloromethane	56-23-5	257	0.05
Diethyl ether	60-2-97	NA	0.2
Acetone	67-64-1	152	1
Chloroform	67-66-3	286	0.05
Benzene	71-43-2	209	0.05
1,1,1-Trichloroethane	71-55-6	16	0.05
Methyl Bromide	74-83-9	498	0.2
Chloromethane	74-87-3	287	0.25
Iodomethane	74-88-4	504	0.1
Dibromomethane	74-95-3	513	0.25
Bromochloromethane	74-97-5	233	0.1
Chloroethane	75-00-3	285	0.25
Chloroethene	75-01-4	790	0.04
Dichloromethane	75-09-2	325	0.1
Carbon Disulfide	75-15-0	254	0.25
Tribromomethane	75-25-2	236	0.1
Bromodichloromethane	75-27-4	234	0.1
1,1-Dichloroethane	75-34-3	21	0.05
1,1-Dichloroethene	75-35-4	22	0.05
t-Butanol	75-65-0	NA	2.5
Trichlorofluoromethane	75-69-4	NA	0.1
Dichlorodifluoromethane	75-71-8	323	0.25
1,2-Dichloropropane	78-87-5	49	0.05
Methyl ethyl ketone	78-93-3	503	0.75
1,1,2-Trichloroethane	79-00-5	19	0.05
Trichlorethene	79-01-6	774	0.05
1,1,2,2-Tetrachloroethane	79-34-5	17	0.05
2-Chlorotoluene	95-49-8	NA	0.05
1,2,4-Trimethylbenzene	95-63-6	44	0.1
1,2-Dibromo-3-chloropropane	96-12-8	45	0.25
1,2,3-Trichloropropane	96-18-4	41	0.1
tert-Butylbenzene	98-06-6	NA	0.05
Isopropylbenzene	98-82-8	453	0.25
4-Isopropyltoluene	99-87-6	NA	0.1
Ethylbenzene	100-41-4	386	0.05
Styrene	100-42-5	730	0.05
Propylbenzene	103-65-1	NA	0.1
n-Butylbenzene	104-51-8	NA	0.05
4-Chlorotoluene	106-43-4	NA	0.05
1,2-Dibromoethane	106-93-4	46	0.05
1,2-Dichloroethane	107-06-2	48	0.05
Acrylonitrile	107-13-1	165	0.1
Vinyl Acetate	108-05-4	NA	5
4-Methyl-2-pentanone	108-10-1	140	2.5
Diisopropyl ether	108-20-3	NA	0.25
1,3,5-Trimethylbenzene	108-67-8	NA	0.1
Bromobenzene	108-86-1	232	0.1
Toluene	108-88-3	770	0.1
Chlorobenzene	108-90-7	282	0.05

Target Analyte List: USEPA 8260
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8260B (SW-846, rev. Dec. 1996)
Test Procedure: Methanol extraction; Purge & Trap, GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes (continued)			
Tetrahydrofuran	109-99-9	NA	1
t-1,4-Dichloro-2-butene	110-57-6	NA	0.05
Cyclohexane	110-82-7	308	0.25
Dibromochloromethane	124-48-1	321	0.1
Tetrachloroethene	127-18-4	18	0.05
sec-Butylbenzene	135-98-8	NA	0.05
1,3-Dichloropropane	142-28-9	NA	0.05
cis-1,2-Dichloroethene	156-59-2	Added	0.05
trans-1,2-Dichloroethene	156-60-5	NA	0.05
1,2,3-Trimethylbenzene	526-73-8	NA	0.1
1,1-Dichloropropene	563-58-6	NA	0.05
2-Hexanone	591-78-6	108	2.5
2,2-Dichloropropane	594-20-7	NA	0.05
1,1,1,2-Tetrachloroethane	630-20-6	15	0.1
Ethyl tert-butyl ether	637-92-3	NA	0.25
t-Amyl methyl ether	994-05-8	NA	0.25
Xylenes	1330-20-7	467	0.15
Methyl tert-butyl ether	1634-04-4	NA	0.25
cis-1,3-Dichloro-1-propene	10061-01-5	299	0.05
trans-1,3-Dichloropropene	10061-02-6	Added	0.05
Extended Target Analytes			
None			

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8260
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8260B (SW-846, rev. Dec. 1996)
Test Procedure: Methanol extraction; Purge & Trap, GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (handled as TICs if found)			
N-butyl alcohol	71-36-3	567	
Bromoethane	74-96-4	387	
Acetonitrile	75-05-8	153	
Ethylene Oxide	75-21-8	408	
Carbonic dichloride	75-44-5	640	
Propylene oxide	75-56-9	693	
Pentachloroethane	76-01-7	619	
2,2-Dichloro-1,1-difluoro-1-methoxyethane	76-38-0	496	
Isobutylalcohol	78-83-1	447	
2,3-Dichloropropene	78-88-6	Added	
2-Chloroacetylchloride	79-04-9	269	
Methyl methacrylate	80-62-6	505	
Diethylaniline	91-66-7	331	
2-Methylbenzenamine	95-53-4	604	
Acetic acid, chloro-, methyl ester	96-34-4	501	
Ethyl methacrylate	97-63-2	389	
4-(1,1-Dimethylethyl)cyclohexanone	98-53-3	10	
Benzene, (1-methylethenyl)-	98-83-9	175	
Nitrobenzene	98-95-3	575	
(2-Bromoethyl)benzene	103-63-9	235	
Chloromethyloxirane	106-89-8	377	
1,3-Butadiene	106-99-0	50	
Acrolein	107-02-8	159	
1-Bromo-2-chloroethane	107-04-0	399	
3-Chloro-1-propene	107-05-1	170	
2-Chloroethanol	107-07-3	397	
1,4-Dioxane	123-91-1	57	
Methylacrylonitrile	126-98-7	510	
2-Chlorobuta-1,3-diene	126-99-8	291	
Butyl acrylate	141-32-2	239	
2,2,2-Trichloroethane-1,1-diol	302-17-0	270	
1,1'-Thiobis[2-chloro]ethane	505-60-2	527	
Tetrabromomethane	558-13-4	256	
1,2-Dichloro-1-propene	563-54-2	688	
3,3-Dichloropropene	563-57-5	Added	
Bromoethene	593-60-2	789	
Divinylbenzene	1321-74-0	367	
Isocyclocitral-S	1335-66-6	448	
1-(Chloromethyl)-4-ethenylbezene	1592-20-7	792	
Chloromethanone	2602-42-8	261	
1,3-dichloroprop-1-ene	8022-76-2	52	
Chlorostyrene	8063-96-5	Added	
Vinyl toluene	25013-15-4	791	
Diethylbenzene	25340-17-4	332	
Cyclotene	79299-96-0	309	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
Benzo[a]pyrene	50-32-8	213	0.33
2,4-Dinitrophenol	51-28-5	88	0.8
Dibenz[a,h]anthracene	53-70-3	319	0.33
Benz[a]anthracene	56-55-3	212	0.33
4-Chloro-3-methyl-phenol	59-50-7	613	0.33
Benzenamine	62-53-3	191	0.8
N-Methyl-N-nitrosomethanamine	62-75-9	578	0.33
Hexachloroethane	67-72-1	428	0.3
1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene	77-47-4	432	0.33
Isophorone	78-59-1	451	0.33
1,2-Dihydroacenaphthylene	83-32-9	146	0.33
Diethyl phthalate	84-66-2	330	0.33
Di-n-butyl phthalate	84-74-2	349	0.33
Phenanthrene	85-01-8	625	0.33
Butyl benzyl phthlate	85-68-7	240	0.33
N-Nitroso-N-phenybenzenamine	86-30-6	580	0.33
9H-Carbazole	86-73-7	414	0.33
Carbazole	86-74-8	NA	0.33
1,1,2,3,4,4-Hexachloro-1,3-butadiene	87-68-3	430	0.33
Pentachlorophenol	87-86-5	621	0.8
2,4,6-Trichlorophenol	88-06-2	82	0.33
2-Nitrobenzenamine	88-74-4	597	0.8
2-Nitrophenol	88-75-5	598	0.33
Naphthalene	91-20-3	565	0.33
2-Methylnaphthalene	91-57-6	112	0.33
2-Chloronaphthalene	91-58-7	100	0.33
3,3'-Dichlorobenzidine	91-94-1	117	2
Benzidine	92-87-5	NA	1
2-Methylphenol	95-48-7	591	0.33
1,2-Dichlorobenzene	95-50-1	47	0.33
2-Chlorophenol	95-57-8	102	0.33
2,4,5-Trichlorophenol	95-95-4	80	0.33
Nitrobenzene	98-95-3	NA	0.33
3-Nitroaniline	99-09-2	518	0.8
4-Nitrobenzenamine	100-01-6	649	0.8
4-Nitrophenol	100-02-7	650	0.8
Benzyl alcohol	100-51-6	218	3.3
1-Bromo-4-phenoxybenzene	101-55-3	133	0.33
Azobenzene	103-33-3	NA	0.2
2,4-Dimethylphenol	105-67-9	87	0.33
4-Methylphenol	106-44-5	615	0.33
1,4-Dichlorobenzene	106-46-7	56	0.33
3-Methylphenol	108-39-4	488	0.33
Bis(2-chloro-1-methylethyl)ether	108-60-1	222	0.33
Phenol	108-95-2	626	0.33

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes (continued)			
Pyridine	110-86-1	697	0.33
Bis(2-chloroethyl) ether	111-44-4	224	0.1
Bis(2-chloroethoxy)methane	111-91-1	223	0.33
Bis(2-ethylhexyl) phthlate	117-81-7	225	0.33
Di-n-octyl phthalate	117-84-0	355	0.33
Hexachlorobenzene	118-74-1	429	0.33
Anthracene	120-12-7	197	0.33
1,2,4-Trichlorobenzene	120-82-1	43	0.33
2,4-Dichlorophenol	120-83-2	Add	0.33
2,4-Dinitrotoluene	121-14-2	89	0.33
Pyrene	129-00-0	696	0.33
Dimethyl phthalate	131-11-3	342	0.33
Dibenzofuran	132-64-9	320	0.33
Benzo[ghi]perylene	191-24-2	215	0.33
Indeno[1,2,3-cd]pyrene	193-39-5	440	0.33
Benz[e]acephenanthrylene	205-99-2	214	0.33
Fluoranthene	206-44-0	413	0.33
Benzo[k]fluoranthene	207-08-9	216	0.33
Acenaphthylene	208-96-8	145	0.33
Chrysene	218-01-9	296	0.33
2-Methyl-4,6-dinitrophenol	534-52-1	111	0.8
1,3-Dichlorobenzene	541-73-1	51	0.33
2,6-Dinitrotoluene	606-20-2	93	0.33
N-Nitroso-N-propyl-1-propanamine	621-64-7	581	0.33
4-Chlorophenyl phenyl ether	7005-72-3	137	0.33
Extended Target Analytes			
1-Chloro-2-[2,2-dichloro-1-(4-chlorophenyl)ethenyl]benzene (o,p'-DDD)	53-19-0	60	TBD
1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-(1.alpha.,2.alpha.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene (cis Nonachlor)	5103-73-1	Added	TBD
2,3,4,5,6,6a,7,7-Octachloro-1a,1b,5,5a,6,6a-hexahydro-, (1a.alpha.,1b.beta.,2.alpha.,5.alpha.,5a.beta.,6.beta.,6a.alpha.)- 2,5-methano-2H-indeno[1,2-b]oxirene (Oxychlordane)	27304-13-8	Added	TBD
Pentachloro(trichloroethenyl)benzene (Octachlorostyrene)	29082-74-4	Added	TBD
Heptachlorostyrene	61255-81-0	Added	TBD
Polybrominated biphenyls (PBB)	67774-32-7	Added	TBD
Pentachlorostyrene	83484-75-7	Added	TBD
Hexachlorostyrene	90301-92-1	Added	TBD

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (handled as TICs if found)			
2-(Acetyloxy) benzoic acid	50-78-2	206	
O-[4-[(Dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester phosphorothioic acid	52-85-7	139	
N-9H-Fluoren-2-yl-acetamide	53-96-3	95	
N-Ethyl-N-nitrosoethanamine	55-18-5	577	
O,O-Diethyl O-(4-nitrophenyl) ester phosphorothioic acid	56-38-2	611	
1,2-Dihydro-3-methylbenz[j]aceanthrylene	56-49-5	123	
1,1',1''-Phosphinylidynetris[2-methyl]aziridine	57-39-6	762	
1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene	57-74-9	272	
7,12-Dimethylbenz[a]anthracene	57-97-6	144	
1,2,3,4,5,6-Hexachloro-,(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta)-cyclohexane	58-89-9	417	
2,3,4,6-Tetrachlorophenol	58-90-2	74	
N-Nitrosomorpholine	59-89-2	583	
N,N-Dimethyl-4-(phenylazo)- benzenamine	60-11-7	605	
Benzeneethanol	60-12-8	632	
O,O-Dimethyl S-[2-(methylamino)-2-oxoethyl] ester phosphorodithioic acid	60-51-5	338	
3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1aR,2R,2aS,3S,6R,6aR,7S,7aS)-rel-2,7:3,6-Dimethanonaphth[2,3-b]oxirene	60-57-1	327	
N-(4-ethoxyphenyl)ethanamide	62-44-2	529	
Ethyl methanesulfonate	62-50-0	390	
Benzoic acid	65-85-0	217	
Benzoic acid, 2-hydroxy	69-72-7	Added	
2,2'-Methylenebis[3,4,6-trichloro]phenol	70-30-4	434	
3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1aR,2R,2aR,3R,6S,6aS,7S,7aS)-rel-2,7:3,6-dimethanonaphth[2,3-b]oxirene	72-20-8	550	
1,1'-(2,2,2-Trichloroethylidene)bis[4-methoxy-benzene]	72-43-5	495	
1,1'-(2,2-Dichloroethylidene)bis[4-chlorobenzene]	72-54-8	125	
1,1'-(Dichloroethenylidene)bis[4-chlorobenzene]	72-55-9	126	
1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-Methano-1H-indene	76-44-8	425	
Dicyclopentadiene	77-73-6	326	
Tetraethyllead	78-00-2	761	
Acrylamide	79-06-1	160	
1,1,2,2-Tetrabromoethane	79-27-6	156	
4,4'-(1-Methylethylidene)bisphenol	80-05-7	128	
1-Chloro-4-(4-chlorophenyl)sulfonyloxy-benzene	80-33-1	211	
Pentachloronitrobenzene	82-68-8	620	
3-Methylsalicylic acid	83-40-9	601	
1-Naphthaleneacetic acid	86-87-3	172	
3,5-Dibromo-N-(4-bromophenyl)-2-hydroxybenzamide	87-10-5	748	

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (continued) (handled as TICs if found)			
1,2,3-Trichlorobenzene	87-61-6	40	
2,6-Dimethylbenzenamine	87-62-7	94	
2,6-Dichlorophenol	87-65-0	92	
1,2,3,4,5-Pentabromo-6-chloro-cyclohexane	87-84-3	24	
2-(1-Methylpropyl)-4,6-dinitrophenol	88-85-7	351	
3H-Pyrazol-3-one, 2,4-dihydro-5-methyl-2-phenyl-	89-25-8	634	
2-(1-Methylpropyl)phenol	89-72-5	603	
Salicylaldehyde	90-02-8	703	
[1,1'-Biphenyl]-2-ol	90-43-7	599	
2-Naphthalenamine	91-59-8	113	
N,N-Dimethyl-N'-2-pyridinyl-N'-(2-ethienylmethyl)-1,2-ethanediamine	91-80-5	492	
2-Chloro-4-phenyl-phenol/3-Chloro[1,1'-biphenyl]-4-ol	92-04-6	99	
Biphenyl	92-52-4	221	
[1,1'-Biphenyl]-4-amine	92-67-1	131	
[1,1'-Bicyclohexyl]-4-one	92-68-2	138	
P-Phenylphenol	92-69-3	682	
Benzenemethanol, .alpha.-methyl-, acetate	93-92-5	508	
Safrole	94-59-7	701	
2-Methylbenzenamine	95-53-4	604	
1,2,4,5-Tetrachlorobenzene	95-94-3	42	
1-Chloro-2,4-dinitrobenzene	97-00-7	352	
Tertiary butyl catechol	98-29-3	752	
4-(1,1-Dimethylethyl)phenol	98-55-4	694	
Acetophenone	98-86-2	154	
Sym-Trinitrobenzene	99-35-4	746	
2-Methyl-5-nitroaniline	99-55-8	143	
m-Dinitrobenzene	99-65-0	489	
1-(4-Chlorophenyl)-ethanone	99-91-2	557	
Phenylhydrazine	100-63-0	633	
N-Nitrosopiperidine	100-75-4	584	
Diphenyl methane	101-81-5	359	
Diphenyl ether	101-84-8	358	
Acetic acid, 2-phenylethyl ester/2-Phenyl ester acetic acid	103-45-7	638	
(2-Bromoethyl)benzene	103-63-9	235	
1,4-Dibromobenzene	106-37-6	616	
4-Chloro-benzenamine	106-47-8	612	
1,4-Benzenediamine	106-50-3	681	
2-Methylpyridine	109-06-8	116	
1,1'-Iminobis-2-propanol	110-97-4	336	
Benzoic acid, 2-hydroxy-, phenyl ester	118-55-8	635	
3-hydroxy-2-methyl-pyran-4-one	118-71-8	122	
2-Aminobenzoic acid	118-92-3	198	
Methyl salicylate (Oil of wintergreen)	119-36-8	509	
4-Chloro-2-(phenylmethyl)-phenol	120-32-1	588	

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (continued) (handled as TICs if found)			
Isosafrole	120-58-1	455	
Indole	120-72-9	442	
1,2-Benzenediol	120-80-9	263	
Vanillin	121-33-5	787	
2-Chloro-4-nitro-benzenamine	121-87-9	600	
.alpha.alpha.-Dimethylbenzeneethanamine	122-09-8	173	
N-Phenylbenzenamine	122-39-4	360	
2-phenoxyethanol	122-99-6	114	
p-Hydroxybenzaldehyde	123-08-0	642	
Hydroquinone	123-31-9	438	
O,O,O-Triethyl ester phosphorothioic acid	126-68-1	587	
1,4-Naphthalenedione	130-15-4	58	
[1,1'-Biphenyl]-2-ol sodium salt	132-27-4	115	
1-Naphthalenamine	134-32-7	64	
Aramite	140-57-8	202	
Dihydrochloride piperazine	142-64-3	645	
1,1a,3,3a,4,5,5,5a,5b,6-Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta[cd]pentalen-2-one	143-50-0	273	
2-methyl-3,5-dinitro-benzamide	148-01-6	110	
4-Ethoxybenzenamine	156-43-4	610	
O,O-Diethyl O-pyrazinyl ester phosphorothioic acid	297-97-2	586	
O,O-Dimethyl O-(4-nitrophenyl) ester phosphorothioic acid	298-00-0	507	
O,O-Diethyl S-[(ethylthio)methyl] ester phosphorodithioic acid	298-02-2	639	
O,O-Diethyl S-[2-(ethylthio)ethyl]ester phosphorodithioic acid	298-04-4	366	
O-(2,4-Dichlorophenyl) O-methylisopropylphosphoramidothioate	299-85-4	563	
methyl-2-chloro-4-(1,1-dimethylethyl)phenyl methyl ester phosphoramidic acid	299-86-5	564	
Aldrin - 1,2,3,4,10,10-Xexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-1,4:5,8-dimethanonaphthalene	309-00-2	532	
4-(Dimethylamino)-3,5-dimethyl-, methylcarbamate phenol	315-18-4	9	
1,2,3,4,5,6-hexachloro-, (1.alpha.,2.alpha.,3.beta.,4.alpha.,5.beta.,6.beta.)Cyclohexane	319-84-6	174	
1,2,3,4,5,6-Hexachloro-, (1.alpha.,2.alpha.,3.beta.,4.alpha.,5.beta.,6.beta.)-cyclohexane	319-85-7	220	
1,2,3,4,5,6-Hexachlorocyclohexane	319-86-8	315	
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-(1R,4S,4aS,5R,8S,8aR)-rel-1,4:5,8-dimethanonaphthalene	465-73-6	449	
Ethyl 2,2-bis(4-chlorophenyl)-2-hydroxy-acetate	510-15-6	283	
Tetrabromomethane	558-13-4	256	
10-Chloro-5,10-dihydrophenarsazine	578-94-9	361	
4-Chloro-2-phenyl-phenol	607-12-5	136	
Pentachlorobenzene	608-93-5	618	
1,2,3,4-Tetrachlorobenzene	634-66-2	32	
1,2,3,5-Tetrachlorobenzene	634-90-2	33	

Target Analyte List: USEPA 8270
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
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Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (continued) (handled as TICs if found)			
N-Methyl-2-pyrrolidone	872-50-4	576	
N-Butyl-N-nitroso-1-butanamine	924-16-3	579	
N-Nitrosopyrrolidine	930-55-2	585	
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3.alpha.,5a.beta.,6.alpha.,9.alpha.,9a.beta.)-6,9-methano-2,4,3-benzodioxathiepin	959-98-8	547	
2,3,4,5,6,7,7-Heptachloro-1a,1b,5,5a,6,6a-hexahydro-,(1aR,1bS,2R,5S,5aR,6S,6aR)-rel-2,5-Methano-2H-indeno[1,2-b]oxirene	1024-57-3	426	
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide-6,9-methano-2,4,3-benzodioxathiepin	1031-07-8	549	
4-Bromobenzocyclobutene (BrBCB)	1073-39-8	132	
1,1'-Oxybis[2,3,4,5,6-pentabromobenzene	1163-19-5	314	
Isocyclocitral-S	1335-66-6	448	
4-(Chloroacetyl)-morpholine	1440-61-5	525	
Tertbutylstyrene	1746-23-2	750	
N,N'-Dimethyl-, phenyl ester phosphorodiamidic acid	1754-58-1	530	
Pentachloromethoxybenzene	1825-21-4	617	
1,1,2,3,3,3-Hexachloro-1-propene	1888-71-7	435	
2,6-Difluorobenzonitrile	1897-52-5	91	
(2,4-Dichlorophenoxy)-2-butoxyethyl ester acetic acid	1929-73-3	83	
2,3,5-Trichloro-1H-pyridin-4-one	1970-40-7	76	
Pentachloropyridine	2176-62-7	622	
Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	2303-16-4	14	
1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta[cd]pentalene	2385-85-5	556	
1-Naphthaleneacetic acid, methyl ester	2876-78-0	502	
2,2-Bis(bromomethyl)-1,3-propanediol	3296-90-0	322	
Tetraethyl dithiopyrophosphate	3689-24-5	760	
Octyl methoxycinnamate	5466-77-3	593	
2,6-Difluorobenzenamine	5509-65-9	90	
1,3-Benzenediol, disodium salt	6025-45-2	210	
2,2',2''-Nitrilotris-sulfate (salt) ethanol	7376-31-0	778	
2,2a,3,3,4,7-Hexachlorodecahydro-(1.alpha.,2.beta.,2a.beta.,4.beta.,4a.beta.,5.beta.,6a.beta.,6b.beta.,7R*)-1,2,4-methenocyclopenta[cd]pentalene-5-carboxaldehyde	7421-93-4	551	
3,3'-Dimethylbenzidine	7563-59-9	118	
Toxaphene	8001-35-2	772	
Chlorostyrene	8063-96-5	Added	
2,2-Dibromo-2-cyanoacetamide	10222-01-2	311	
N-Methyl-N-nitrosoethanamine	10595-95-6	582	
Aroclor 1260	11096-82-5	655	
Aroclor 1254	11097-69-1	533	
Aroclor 1268	11100-14-4	657	

Target Analyte List: USEPA 8270
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TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8270C (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (continued) (handled as TICs if found)			
Aroclor 1221	11104-28-2	651	
Aroclor 1232	11141-16-5	652	
Aroclor 1248	12672-29-6	654	
4-Chloro-2-cyclopentylphenol	13347-42-7	134	
Decabromobiphenyl	13654-09-6	313	
Tetrachlorophenol	25167-83-3	759	
Dinitrophenol	25550-58-7	354	
Hexachlorocyclohexane	27154-44-5	431	
1,1'-Biphenyl, ar,ar,ar,ar,ar',ar',ar',ar'-octabromo-	27858-07-7	592	
1,1'-Biphenyl, phenoxy-	28984-89-6	Added	
Octachlorostyyrene - Pentachloro(trichloroethenyl)benzene	29082-74-4	Added	
1-(3-Chlorophenyl)ethanone	29731-15-5	281	
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3.alpha.,5a.alpha.,6.beta.,9.beta.,9a.alpha.)-6,9-methano-2,4,3-benzodioxathiepin	33213-65-9	548	
Aroclor 1262	37324-23-5	656	
(4-[4-(hydroxy-diphenyl-methyl)-1-piperidyl]-1-(4-tert-butylphenyl)-butan-1-ol	50679-08-8	8	
Tert-butylstyrene	50976-19-7	751	
Aroclor 1242	53469-21-9	653	
Benzenamine, N,N-dimethyl-, sulfate (1:1)	58888-49-6	348	
Heptachlorostyrene	61255-81-0	Added	
PBB	67774-32-7	Added	
3,5-Dichloro-2,6-dimethyl-1H-pyridin-4-one	68821-99-8	304	
Pentachlorostyrene	83484-75-7	Added	
Dimethyl 2,3,5,6-tetrachlorobenzene-1,4-dicarboxylate	87209-56-1	341	
2-ethoxyethyl 2-[4-[3-chloro-5-(trifluoromethyl)pyridin-2-yl]oxyphenoxy]propanoate	87237-48-7	107	
Hexachlorostyrene	90301-92-1	Added	
2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)- benzenesulfonamide	219714-96-2	558	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 1613-B
Chemical Method References and Reporting Limits
TR & USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 1613B (40 CFR 136, as amended)
Test Procedure: Solvent extraction, HR/LR GC/MS or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	79	1.0 ng/kg TEQ
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	3268-87-9	26	1.0 ng/kg TEQ
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	37	1.0 ng/kg TEQ
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	28	1.0 ng/kg TEQ
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	39001-02-0	25	1.0 ng/kg TEQ
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	31	1.0 ng/kg TEQ
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	39	1.0 ng/kg TEQ
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	78	1.0 ng/kg TEQ
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	29	1.0 ng/kg TEQ
1,2,3,4,8,9-Hexachlorodibenzofuran	55684-94-1	30	1.0 ng/kg TEQ
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	75	1.0 ng/kg TEQ
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	38	1.0 ng/kg TEQ
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	34	1.0 ng/kg TEQ
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	35	1.0 ng/kg TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	27	1.0 ng/kg TEQ
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	73	1.0 ng/kg TEQ
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	36	1.0 ng/kg TEQ
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
None			

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8041
Chemical Methods, References, and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8041 (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; derivatization; GC/FID, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
2,4-Dinitrophenol	51-28-5	88	0.8
2,3,4,6-Tetrachlorophenol	58-90-2	74	0.8
4-Chloro-3-methyl-phenol	59-50-7	613	0.28
2,6-Dichlorophenol	87-65-0	92	0.33
Pentachlorophenol	87-86-5	621	0.8
2,4,6-Trichlorophenol	88-06-2	82	0.33
2-Nitrophenol	88-75-5	598	0.33
2-(1-Methylpropyl)-4,6-dinitrophenol	88-85-7	351	0.2
2-Methylphenol	95-48-7	591	0.33
2-Chlorophenol	95-57-8	102	0.33
2,4,5-Trichlorophenol	95-95-4	80	0.33
4-Nitrophenol	100-02-7	650	0.8
2,4-Dimethylphenol	105-67-9	87	0.33
4-Methylphenol	106-44-5	615	0.33
3-Methylphenol	108-39-4	488	0.33
Phenol	108-95-2	626	0.33
2,4-Dichlorophenol	120-83-2	Added	0.33
2-Methyl-4,6-dinitrophenol	534-52-1	111	0.8
Tetrachlorophenol	25167-83-3	759	TBD
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
2,2'-Methylenebis[3,4,6-trichloro]phenol	70-30-4	434	
4,4'-(1-Methylethylidene)bisphenol	80-05-7	128	
2-(1-Methylpropyl)phenol	89-72-5	603	
2-Chloro-4-phenyl-phenol/3-Chloro[1,1'-biphenyl]-4-ol	92-04-6	99	
4-(1,1-Dimethylethyl)phenol	98-55-4	694	
4-Chloro-2-(phenylmethyl)-phenol	120-32-1	588	
O-(2,4-Dichlorophenyl) O-methylisopropylphosphoramidothioate	299-85-4	563	
2-Cyclohexyl-4,6-dinitrophenol dicyclohexylamine salt	317-83-9	11	
4-Chloro-2-phenyl-phenol	607-12-5	136	
4-Chloro-2-cyclopentylphenol	13347-42-7	134	
Dinitrophenol	25550-58-7	354	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8081
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8081A (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]	50-29-3	127	0.02
1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene	57-74-9	272	0.025
1,2,3,4,5,6-Hexachloro-,(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta)-cyclohexane	58-89-9	417	0.02
3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1aR,2R,2aS,3S,6R,6aR,7S,7aS)-rel-2,7:3,6-Dimethanonaphth[2,3-b]oxirene	60-57-1	327	0.02
3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1aR,2R,2aR,3R,6S,6aS,7S,7aS)-rel-2,7:3,6-dimethanonaphth[2,3-b]oxirene	72-20-8	550	0.02
1,1'-(2,2,2-Trichloroethylidene)bis[4-methoxy-benzene]	72-43-5	495	0.02
1,1'-(2,2-Dichloroethylidene)bis[4-chlorobenzene]	72-54-8	125	0.02
1,1'-(Dichloroethenylidene)bis[4-chlorobenzene]	72-55-9	126	0.02
1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-Methano-1H-indene	76-44-8	425	0.02
1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene	77-47-4	432	0.02
Pentachloronitrobenzene	82-68-8	620	0.02
1,2-Dibromo-3-chloropropane	96-12-8	45	0.01
Hexachlorobenzene	118-74-1	429	0.02
Aldrin - 1,2,3,4,10,10-Xexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-1,4:5,8-dimethanonaphthalene	309-00-2	532	0.02
1,2,3,4,5,6-hexachloro-,(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.beta.,6.beta.)Cyclohexane	319-84-6	174	0.02
1,2,3,4,5,6-Hexachloro-,(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.beta.,6.beta.)-cyclohexane	319-85-7	220	0.02
1,2,3,4,5,6-Hexachlorocyclohexane	319-86-8	315	0.02
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-(1R,4S,4aS,5R,8S,8aR)-rel-1,4:5,8-dimethanonaphthalene	465-73-6	449	0.02
Ethyl 2,2-bis(4-chlorophenyl)-2-hydroxy-acetate	510-15-6	283	
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide,(3.alpha.,5a.beta.,6.alpha.,9.alpha.,9a.beta.)-6,9-methano-2,4,3-benzodioxathiepin	959-98-8	547	0.02
2,3,4,5,6,7,7-Heptachloro-1a,1b,5,5a,6,6a-hexahydro-,(1aR,1bS,2R,5S,5aR,6S,6aR)-rel-2,5-Methano-2H-indeno[1,2-b]oxirene	1024-57-3	426	0.02
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide-6,9-methano-2,4,3-benzodioxathiepin	1031-07-8	549	0.02
2-Chloro-N-(1-methylethyl)-N-phenyl- acetamide	1918-16-7	684	
Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	2303-16-4	14	0.02
1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta[cd]pentalene	2385-85-5	556	0.05

Target Analyte List: USEPA 8081
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8081A (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes (continued)			
1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-(1R,2S,3aS,4S,7R,7aS)-rel-4,7-methano-1H-indene	5103-71-9	158	0.02
1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-(1R,2R,3aS,4S,7R,7aS)-rel-4,7-methano-1H-indene	5103-74-2	554	0.02
2,2a,3,3,4,7-Hexachlorodecahydro-(1.alpha.,2.beta.,2a.beta.,4.beta.,4a.beta.,5.beta.,6a.beta.,6b.beta.,7R*)-1,2,4-methenocyclopenta[cd]pentalene-5-carboxaldehyde	7421-93-4	551	0.02
Toxaphene	8001-35-2	772	0.17
6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3.alpha.,5a.alpha.,6.beta.,9.beta.,9a.alpha.)-6,9-methano-2,4,3-benzodioxathiepin	33213-65-9	548	0.02
1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-, (1.alpha.,2.beta.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene	39765-80-5	Added	0.02
Extended Target Analytes			
1-Chloro-2-[2,2-dichloro-1-(4-chlorophenyl)ethenyl]benzene (o,p'-DDD)	53-19-0	60	TBD
1,2,3,4,5,6,7,8,8-Nonachloro-2,3,3a,4,7,7a-hexahydro-(1.alpha.,2.alpha.,3.alpha.,3a.alpha.,4.beta.,7.beta.,7a.alpha.)- 4,7-methano-1H-indene (cis Nonachlor)	5103-73-1	Added	TBD
2,3,4,5,6,6a,7,7-Octachloro-1a,1b,5,5a,6,6a-hexahydro-, (1a.alpha.,1b.beta.,2.alpha.,5.alpha.,5a.beta.,6.beta.,6a.alpha.)- 2,5-methano-2H-indeno[1,2-b]oxirene (Oxychlordane)	27304-13-8	Added	TBD
Pentachloro(trichloroethenyl)benzene (Octachlorostyrene)	29082-74-4	Added	TBD
Heptachlorostyrene	61255-81-0	Added	TBD
Polybrominated biphenyls (PBB)	67774-32-7	Added	TBD
Pentachlorostyrene	83484-75-7	Added	TBD
Hexachlorostyrene	90301-92-1	Added	TBD

Target Analyte List: USEPA 8081
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8081A (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Other Site-Specific COI (handled as TICs if found)			
Hexachloroethane	67-72-1	428	
3,5-Dibromo-N-(4-bromophenyl)-2-hydroxybenzamide	87-10-5	748	
1,2,3-Trichlorobenzene	87-61-6	40	
1,2,3,4,5-Pentabromo-6-chloro-cyclohexane	87-84-3	24	
1,2-Dichlorobenzene	95-50-1	47	
1,2,4,5-Tetrachlorobenzene	95-94-3	42	
1-Chloro-2,4-dinitrobenzene	97-00-7	352	
1-(4-Chlorophenyl)-ethanone	99-91-2	557	
1,4-Dichlorobenzene	106-46-7	56	
Bis(2-chloro-1-methylethyl)ether	108-60-1	222	
Bis(2-chloroethyl) ether	111-44-4	224	
Bis(2-chloroethoxy)methane	111-91-1	223	
1,3-Dichlorobenzene	541-73-1	51	
Pentachlorobenzene	608-93-5	618	
1,2,3,4-Tetrachlorobenzene	634-66-2	32	
1,2,3,5-Tetrachlorobenzene	634-90-2	33	
1,1'-Oxybis[2,3,4,5,6-pentabromobenzene	1163-19-5	314	
Pentachloromethoxybenzene	1825-21-4	617	
1,1,2,3,3,3-Hexachloro-1-propene	1888-71-7	435	
2,2-Bis(bromomethyl)-1,3-propanediol	3296-90-0	322	
4-Chlorophenyl phenyl ether	7005-72-3	137	
2,2-Dibromo-2-cyanoacetamide	10222-01-2	311	
Decabromobiphenyl	13654-09-6	313	
Hexachlorocyclohexane	27154-44-5	431	
1,1'-Biphenyl, ar,ar,ar,ar,ar',ar',ar',ar'-octabromo-	27858-07-7	592	
1-(3-Chlorophenyl)ethanone	29731-15-5	281	
2-ethoxyethyl 2-[4-[3-chloro-5-(trifluoromethyl)pyridin-2-yl]oxyphenoxy]propanoate	87237-48-7	107	
2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)- benzenesulfonamide	219714-96-2	558	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8082
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8082 (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
Aroclor 1260	11096-82-5	655	0.01
Aroclor 1254	11097-69-1	533	0.01
Aroclor 1268	11100-14-4	657	0.01
Aroclor 1221	11104-28-2	651	0.02
Aroclor 1232	11141-16-5	652	0.01
Aroclor 1248	12672-29-6	654	0.01
Aroclor 1262	37324-23-5	656	0.01
Aroclor 1242	53469-21-9	653	0.01
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
None			

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8121
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8121 (SW-846, rev. Sep. 1994)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
1-Chloro-2-[2,2-dichloro-1-(4-chlorophenyl)ethenyl]benzene (o,p'-DDD)	53-19-0	60	TBD
1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene	77-47-4	432	TBD
Pentachloronitrobenzene	82-68-8	620	TBD
Hexachlorobenzene	118-74-1	429	TBD
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
None			

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8141
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8141 (SW-846, rev. Sep. 1994)
Test Procedure: Solvent extraction; GC/N-P, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
O-[4-[(Dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester phosphorothioic acid	52-85-7	139	TBD
O,O-Diethyl O-(4-nitrophenyl) ester phosphorothioic acid	56-38-2	611	0.05
O,O-Dimethyl S-[2-(methylamino)-2-oxoethyl] ester phosphorodithioic acid	60-51-5	338	0.2
O,O-Diethyl O-pyrazinyl ester phosphorothioic acid	297-97-2	586	
O,O-Dimethyl O-(4-nitrophenyl) ester phosphorothioic acid	298-00-0	507	0.04
O,O-Diethyl S-[(ethylthio)methyl] ester phosphorodithioic acid	298-02-2	639	0.02
O,O-Diethyl S-[2-(ethylthio)ethyl]ester phosphorodithioic acid	298-04-4	366	0.05
Phosphorothioic acid, O,O-dimethyl O-(2,4,5-trichlorophenyl) ester (Ronnel)	299-84-3	339	0.05
O,O-Diethyl O-(3,5,6-trichloro-2-pyridinyl) ester phosphorothioic acid (Chlorpyrifos)	2921-88-2	294	0.05
O,O-Dimethyl O-(3,5,6-trichloro-2-pyridinyl) ester phosphorothioic acid	5598-13-0	340	TBD
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
O-(2,4-Dichlorophenyl) O-methylisopropylphosphoramidothioate	299-85-4	563	
methyl-2-chloro-4-(1,1-dimethylethyl)phenyl methyl ester phosphoramidic acid	299-86-5	564	
N,N'-Dimethyl-, phenyl ester phosphorodiamidic acid	1754-58-1	530	
Tetraethyl dithiopyrophosphate	3689-24-5	760	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 8151
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 8151A (SW-846, rev. Dec. 1996)
Test Procedure: Solvent extraction; GC/ECD, GC/MS, or GC/MS/MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
2,2-Dichloropropanoic acid	75-99-0	72	0.5
Pentachlorophenol	87-86-5	621	0.01
2-(1-Methylpropyl)-4,6-dinitrophenol	88-85-7	351	0.2
2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP)	93-72-1	66	0.3
2,4,5-Trichlorophenoxyacetic acid (2,4-T)	93-76-5	65	0.5
2-methyl-4-chlorophenoxyacetic acid (MCPA)	94-74-6	345	0.3
2-(2,4-Dichlorophenoxy)acetic acid (2,4-D)	94-75-7	67	0.2
4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid	1918-02-1	771	0.5
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
2,2-Dichloro-2-(2,4,5-trichlorophenoxy)ethyl ester propanoic acid	136-25-4	379	
2-Chloropropionic acid	598-78-7	103	
(2,4-Dichlorophenoxy)-2-butoxymethylethyl ester acetic acid	1320-18-9	121	
(2,4-Dichlorophenoxy)-2-butoxyethyl ester acetic acid	1929-73-3	83	
Acetic acid, (2,4-dichlorophenoxy)-, compd. with N-methylmethanamine	2008-39-1	69	
2-(3,5,6-Trichloropyridin-2-yl)oxyacetic acid	55335-06-3	70	
Haloxyfop-methyl	69806-40-2	423	

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 6010/6020
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 6010B/6020A (SW-846, rev. Dec. 1996)
Test Procedure: Acid Digestion; ICP-OES/ICP-MS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
Aluminum	7429-90-5	176	0.02
Iron	7439-89-6	445	0.02
Lead	7439-92-1	457	0.02
Lithium	7439-93-2	465	0.02
Magnesium	7439-95-4	469	0.02
Manganese	7439-96-5	486	0.02
Nickel	7440-02-0	571	0.02
Potassium	7440-09-7	672	0.02
Silver	7440-22-4	713	0.02
Sodium	7440-23-5	715	0.02
Strontium	7440-24-6	728	0.02
Thallium	7440-28-0	764	0.02
Tin	7440-31-5	767	0.02
Titanium	7440-32-6	Added	0.02
Antimony	7440-36-0	199	0.02
Arsenic	7440-38-2	204	0.02
Barium	7440-39-3	207	0.02
Beryllium	7440-41-7	219	0.02
Boron	7440-42-8	228	0.02
Cadmium	7440-43-9	244	0.02
Chromium	7440-47-3	295	0.02
Cobalt	7440-48-4	300	0.02
Copper	7440-50-8	301	0.02
Vanadium	7440-62-2	Added	0.02
Zinc	7440-66-6	797	0.02
Calcium	7440-70-2	245	0.02
Selenium	7782-49-2	710	0.02
Extended Target Analytes			
Gold	7440-57-5	421	TBD
Other Site-Specific COI (handled as TICs if found)			
None			

Notes:
TBD = To Be Determined

Target Analyte List: USEPA 7471
Chemical Method References and Reporting Limits
TR and USR GeoMorph Site Characterization QAPP
Midland Soils Site Characterization QAPP

Test Reference: USEPA 7471A (SW-846, rev. Dec. 1996)
Test Procedure: Acid Digestion; CVASS detection

Parameter	CAS No.	Dow ID	Reporting Limits (mg/kg)
Standard Target Analytes			
Mercury	7439-97-6	490	0.05
Extended Target Analytes			
None			
Other Site-Specific COI (handled as TICs if found)			
None			

Notes:
TBD = To Be Determined

Appendix E
Human Health Risk Assessment
Work Plan Attachments

Attachment E-1

Technical Memoranda Supporting HHRA

Agricultural Tilling Particulate Emissions Assessment, 9/17/2007

Technical Memorandum: Agricultural Tilling Particulate Emissions Assessment

This memorandum describes an approach to integrate agricultural tilling particulate dust emissions into the Michigan Department of Environmental Quality (MDEQ) Part 201 generic particulate soil inhalation criteria (PSIC) for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs). A prior draft of this evaluation was provided on April 12, 2007, and was discussed with MDEQ at subsequent meetings in May and June. This memorandum provides a revised PSIC that integrates agricultural tilling dust emissions together with residential dust emissions.

In accordance with Part 201 administrative rule 706a(9), the equations used by MDEQ to develop the PSIC must be used when deriving site-specific cleanup criteria. Consequently, this assessment modified the Part 201 PSIC to include dust generated by agricultural activities in addition to the dust generated by wind and by driving on a residential driveway, which are already in the default equation.

The draft U.S. Environmental Protection Agency (EPA) AP-42 particulate emission factor equation was reviewed in developing PM-10 emissions from agricultural tilling activities. The draft EPA equation differs from that used by MDEQ to derive the Part 201 generic PSIC and is not a final document from EPA, but the draft EPA approach has also been applied in this memorandum at the request of MDEQ and is described in sections subsequent to the description of derivation of the PSIC.

All equations, input parameters, and parameter descriptions for the generic PSIC, the proposed agricultural PSIC, and the PSIC derived using the draft AP-42 are summarized in Table 1, along with sources for the agricultural scenario input parameters.

Residential Particulate Soil Inhalation Criteria

In accordance with Part 201 Rule 726(2), the generic residential PSIC is calculated as follows:

$$\text{PSIC} = \frac{\text{TR} \times \text{AT}}{\text{IURF} \times \text{EF} \times \text{ED} \times \left(1/\text{PEF}\right)} \qquad \text{(Equation 1)}$$

where:

PSIC	(particulate soil inhalation criteria)	=	chemical-specific, μg/kg or ppb
TR	(target risk level)	=	10^{-5}
AT	(averaging time)	=	25,550 days (70 years × 365 days/year)
IURF	(inhalation unit risk factor)	=	chemical-specific $(\mu g/m^3)^{-1}$
EF	(exposure frequency)	=	350 days/year
ED	(exposure duration)	=	30 years
PEF	(particulate emission factor)	=	site-specific, m^3/kg

In accordance with Part 201 Rule 738(8), the IURF is calculated in the same manner as cancer risk screening levels for inhalation risk under Part 55 in the Air Pollution Control section of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451). MDEQ's Part 201 program has not established a cancer slope factor for PCDD/Fs (see Table 4 of Rule 299.5752).[1]

In accordance with Part 201 Rule 726(4), the generic residential particulate emission factor (PEF) is calculated as follows:

$$PEF = (QC) \ / [(E_w \times (1 - V)) + E_v] \qquad \text{(Equation 2)}$$

where:

QC	(dispersion factor for 1/2 acre)	=	82.33, g/m^2-second per kg/m^3
E_w	(emission resulting from wind)	=	calculated, Equation 3, g/m^2 per second
E_v	(emission from vehicle traffic)	=	calculated, Equation 4, g/m^2 per second
V	(vegetative cover)	=	0.5 (50%), (residential) unitless

Emissions resulting from wind (E_w) are calculated as follows:

$$E_w = (0.036*(U_m/Ut_{adj})\text{^}3*F(x))/3600 \qquad \text{(Equation 3)}$$

where:

U_m	(mean wind speed at 7m)	=	4.62 m/s
Ut_{adj}	(adjusted threshold friction velocity)	=	9.51 m/s
F(x)	(function constant)	=	0.48, unitless

The annual emission rate of PM10 from vehicle traffic averaged over the year and expressed in grams per meters squared per second (E_v) is calculated as follows:

$$E_v = E_{v\_yr}*CF_{g\_kg} / (CF_{s\_y}*A) \qquad \text{(Equation 4)}$$

where:

E_{v_yr}	(emissions of PM10 per year)	=	calculated, Equation 5, kg/yr
CF_{g_kg}	(conversion factor, g/kg)	=	1,000 g/kg
CF_{s_y}	(conversion factor, sec/yr)	=	31,536,000 sec/yr
A	(site area)	=	1,965 m^2 (0.5 acre – 58 m^2 house)

[1] The MDEQ Air Quality Division, which administers Part 55, uses an IURF of 44.6 (μg/m^3)$^{-1}$, which is derived from a 1985 EPA oral cancer slope factor (CSF) of 156,000 (mg/kg-day)$^{-1}$. The oral CSF used to develop the Part 201 footnoted soil direct contact criterion is 75,000 (mg/kg-day)$^{-1}$, which is based on a 1990 pathology working group re-analysis of rat liver tumors using the National Toxicology Program's (NTP) liver tumor classification scheme. Although additional evaluation of the most appropriate CSF is under discussion with MDEQ for the site related risk assessment activities, use of these CSF for the evaluation of the dust exposure pathway is considered appropriate as a conservative first step (see Footnote R 299.5750(O) *S*) for purposes of this PSIC only.

The average annual emission rate of PM10 from vehicle traffic expressed in kg/yr (E_{v_yr}) is calculated as:

$$E_{v\_yr} = E_{V\_VKT} * D\_yr \qquad \text{(Equation 5)}$$

where:

E_{v_VKT}	(emissions of PM10 per vehicle km traveled)	=	calculated, Equation 6, kg/km
D_yr	(total distance driven per year)	=	140 km/yr

The total distance traveled per year (D_yr) was calculated based on 10 round trips per day on a 20-m long driveway 350 days per year (20 one-way trips/day × 20 m/trip × 350 days/year × 1 km/1,000 m).

Average yearly emissions from vehicle traffic per vehicle kilometer traveled (E_{v_VKT}) are calculated as follows:

$$E_{v\_VKT} = k*1.7*(s/12)*(S/48)*(W/2.7)\text{^}0.7*(w/4)\text{^}0.5*((365-p)/365) \qquad \text{(Equation 6)}$$

where:

k	(Particle size multiplier)	=	0.35, unitless
s	(Silt content)	=	15 percent
S	(Mean vehicle speed)	=	20 km/hr
W	(Mean vehicle weight)	=	2 Mg (2,000 kg)
w	(Mean number of wheels)	=	4, unitless
p	(number of days with >0.01 in. precipitation)	=	135 days

Agricultural Particulate Soil Inhalation Criteria

This section describes the proposed derivation of a PSIC that integrates particulate emissions associated with agricultural tilling activities (i.e., farm equipment vehicle traffic [E_v]), with the residential vehicle emissions and wind emissions currently accounted for in the derivation of the generic residential PSIC. That is, these emissions are in addition to emissions already modeled and calculated as part of the Part 201 generic residential PSIC. The exposed population, or receptor, for this integrated exposure is a resident who also conducts or neighbors farming activities (e.g., drives tractors and tills fields during planting and harvesting, and/or drives a residential unpaved road at the same farm) that generate particulate emissions.

For the agricultural tilling exposure scenario, a factor has been added to account for emissions associated with agricultural tilling activities in fields neighboring residential areas. Emissions resulting from these activities are common to larger areas than assumed in the generic residential scenario, such that dispersion will be specific to the tilling and harvesting activities in the fields. PSICs have been calculated for the agricultural tilling scenario assuming two farm

sizes: a 32-acre farm and a 200-acre farm. In Midland County in 2002, the U.S. Department of Agriculture identified 84,190 acres in farms, with the average size of a farm as 166 acres. However, because this evaluation seeks to consider the concentration of PCDD/Fs that could represent a risk level greater than 10^{-5}, the farm size would represent the size of the area at the concentration of the PSIC, which should be a considerably smaller area.[2] Although these farm sizes are thought to be overestimates of affected agricultural areas, they have been used here as a health protective means to evaluate this pathway.

To represent this exposure scenario and to integrate it with the Part 201 Rule 726(2) equation, Equation 1 is modified as follows:

$$PSIC_{ag} = \frac{TR \times AT}{IURF \times EF \times ED \times 1/PEF_{ag}} \qquad \text{(Equation 7)}$$

All parameters and inputs are as in Equation 1, with the exception of PEF_{ag}, which is calculated by modifying Equation 2 as follows:

$$PEF_{ag} = (QC) \; / \left[(E_w \times (1 - V)) + E_{v\_ag} + E_{v\_res} \right] \qquad \text{(Equation 8)}$$

In Equation 8, E_{v_res} is equivalent to the E_v parameter in the residential scenario described in Equation 2. In addition, the term E_{v_ag} is introduced to account for emissions from agricultural vehicle traffic during tilling activities.

where:

QC	(dispersion factor for 32 and 200 acres)	=	31.83 and 26 g/m^2-second per kg/m^3 applied here for 32 and 200 acre farms, respectively (see text). These replace generic values of 41.55 and 34.98, g/m^2-second per kg/m^3 (generic) for 32 and 200 acre farms.
E_w	(emission resulting from wind)	=	calculated, Equation 3, g/m^2 per second same as generic
Ev_res	(emission from residential vehicle traffic)	=	calculated, Equation 4, g/m^2 per second same as generic
Ev_ag	(emission from agricultural vehicle traffic)	=	calculated, Equation 4, g/m^2 per second
V	(vegetative cover)	=	0.25 (25%), (agricultural) unitless

The dispersion factor for the Midland area was modified based on input provided by MDEQ on a conference call on June 7, 2007. Specifically, values of 31.83 g/m^2-second per kg/m^3 for a 32-acre site, 27 g/m^2-second per kg/m^3 for a 100-acre site, and 21.61 g/m^2-second per kg/m^3 for a 500-acre site were provided based on modeling using the Midland airport monitoring data. In the analysis for the 200-acre site provided here, a value of 26 g/m^2-second per kg/m^3 was input

[2] http://www.nass.usda.gov/Census/Pull_Data_Census

as an estimate.[3] Emissions resulting from wind and residential traffic are unchanged in this proposed application from those in the generic PSIC. The vegetative cover assumption applied here takes into account the fact that fields in cultivation can go from having no cover to having complete cover. Exponent staff had conversations with Michigan State University agricultural extension staff member Mr. Paul Gross, who indicated that 25 percent assumed cover would be a low end estimate of this value. Because lower percent coverage values reduce the final PSIC value, the 25 percent estimate has been applied as a health-protective assumption (Gross 2007, pers. comm.).

Average annual emissions from agricultural vehicle traffic are calculated using the same equation as E_v for residential vehicles (Equation 5), but with modified input assumptions to account for differences in distance traveled and in vehicle size, weight, and operating conditions. Thus, both E_{V_VKT} and D_yr are calculated differently for E_{v_ag}. First, the distance traveled per tillage event is estimated by assuming that a tractor pulling a tilling implement traverses a path along the length (L) of the field, turns and comes back along a second path, turns again and traverses the length along a third path, and so on until the entire field has been tilled (Figure 1). The total distance traveled per tillage would be the product of the length of the field and the width of the field (FW) divided by tiller width (TW) (Figure 1). Further, multiplying by the total number of tilling events would give the total distance traveled each year:

$$D\_\_yr = \text{tillage events} \times L \times FW/(TW \times 1000\text{m/km}) \qquad \text{(Equation 9)}$$

where:

Tillage events	(number of tillage events per year)	=	7, unitless
L	(length of field)	=	360 and 900 m for 32 and 200 acre square fields, respectively
FW	(field width)	=	360 and 900 m for 32 and 200 acre square fields, respectively
TW	(tiller width)	=	7 m

The number of tilling events per year was set at seven following comment from MDEQ. This amount includes one pass to prepare the field at the beginning of the season, one pass to plant, two passes to spray, and up to three to harvest. This issue was also discussed with Michigan State University agricultural extension staff member Mr. Paul Gross, who indicated that this amount of tillage would be a health protective assumption. Mr. Gross added that in some cases little or no tillage is conducted during the season (Gross 2007, pers. comm.). The size of the tiller assumed was derived from information provided at the John Deere web site, which showed tiller sizes ranging from 1.8 to 14 meters in width with an average of 7 meters (Deere 2007). The initial 5-m tiller size assumed was judged by Mr. Gross as perhaps being too small for effective use.

[3] This estimate was derived from MDEQ with documentation provided by email on September 11, 2007.

Second, the average yearly emissions from vehicle traffic per vehicle kilometer traveled (E_{v_VKT}) is calculated using Equation 6, as in the residential scenario, but with the following input parameters:

where:

K	(particle size multiplier)	=	0.35, unitless
‘s	(silt content)	=	18 percent
S	(mean vehicle speed)	=	10 km/hr
‘w	(mean vehicle weight)	=	14 Mg (14,000 kg)
W	(mean number of wheels)	=	8, unitless
P	(number of days with >0.01in. precipitation, not applicable)	=	0 days

The particle size multiplier is unchanged from the generic criteria for residential soils. The silt content was identified in the Documentation for AP-42 (described further below), which gives a range of silt content from 1.7 to 88 percent in fields tested in deriving the equation. In the absence of site-specific data, AP-42 recommends a value of 18 percent, which has been applied here. The tractor speed was also based on documentation within AP-42, which provided a range of speeds from 8 to 10 miles per hour (pg 2-4). The upper end of this range has been applied as a health protective measure. The mean vehicle weight represents the heaviest tractor identified on the John Deere web site with an additional 2 Mg added for other equipment pulled by the tractor (Deere 2007). The parameter for number of days without precipitation is not applicable for the agricultural portion of the calculation because it is assumed that all tilling would occur on dry days. Therefore, no further adjustment is necessary to account for vehicle miles on rainy days when dust would not be generated.

The application of these factors results in only a small modification of the PEF. This is the case even if these factors are modified upward. This appears to be because the emissions from wind are the dominant factor. Application of these factors results in the following PSICs for PCDD/F as TEQ:

CSF for PCDD/F	Residential PSIC	Agricultural
Application of CSF of 156,000 $(mg/kg\text{-}day)^{-1}$	71 µg/kg average (71,000 ppt)	22 µg/kg (22,000 ppt) for a 32-acre field 18 µg/kg (18,000 ppt) for a 200-acre field
Application of CSF of 75,000 $(mg/kg\text{-}day)^{-1}$	148 µg/kg average (148,000 ppt)	47 µg/kg (47,000 ppt) for a 32-acre field 37 µg/kg (37,000 ppt) for a 200-acre field

These values would be applicable to a statistically representative average of the concentration over the area evaluated (i.e., a 32-acre farm or a 200-acre farm) rather than on a point-by-point basis. We propose that these input variables be reviewed by MDEQ and this approach be adopted to derive screening values for agricultural soils for evaluation of this potential exposure pathway. Based on this evaluation, however, the average soil concentration necessary to result in ambient dust concentrations that would be of concern is markedly higher than that likely to be found in agricultural or residential soils. Therefore, this exposure pathway results in no significant exposure or risk to residents or farmers and need not be considered further in the risk

assessment. Once these input variables and results are reviewed and accepted, we propose that this analysis be finalized and used to exclude any proposed dust sampling (ambient or occupational) or conducting any quantitative evaluation of this pathway in subsequent risk assessment activities.

Comparison with AP-42 Agricultural Particulate Emissions

In addition, to the modified MDEQ approach, PSICs were calculated for the agricultural tilling scenario using the default agricultural dust emissions calculation provided in the emission factor documentation for AP-42, Section 9.1, Tilling Operations (U.S. EPA 1995).

As with the modified MDEQ approach described above, the AP-42 approach uses equations similar to the residential scenario up to and including Equation 4 (E_{v_ag}). However, the AP-42 approach does not use any of the remaining equations to derive the average annual emission rate of PM10 from vehicle traffic expressed in kg/yr (E_{v_yr}). Rather, AP-42 summarizes the results of field measured dust emission rates under various tilling conditions. However, as in all the other calculations shown here, the final derivation of a PSIC includes the same residential dust from a driveway as included in the generic PSIC.

In Table 4-2 of the AP-42 documentation, U.S. EPA (1995) presents a range of mean total dust emission rates of 5.3 to 6.7 pounds per acre for various tilling operations. The average value of 5.7 pounds per acre was used for this calculation. The total dust emissions per year can be calculated by multiplying by the number of tillages per year and the total number of acres, and converting from pounds to kilograms.

For a 32-acre farm, the total vehicle dust emissions are calculated as:

$$E_{v\_yr} = 5.7 \text{ lbs/acre-tillage} \times 0.4536 \text{ kg/lb x tillages/yr} \times 32 \text{ acres} = 579 \text{ kg/yr}$$

For a 200-acre farm, the total vehicle dust emissions are calculated as:

$$E_{v\_yr} = 5.7 \text{ lbs/acre-tillage} \times 0.4536 \text{ kg/lb} \times \text{tillages/yr} \times 200 \text{ acres} = 3{,}620 \text{ kg/yr}$$

Applying these $E_{v\text{-}yr}$ values as input to Equation 4, as described in the agricultural scenario above, PSIC of 19 and 9 μg/kg are derived for 32- and 200-acre farms, respectively, using the CSF of 156,000 $(\text{mg/kg-day})^{-1}$. If the CSF of 75,000 $(\text{mg/kg-day})^{-1}$ is applied, PSICs of 40 and 18 μg/kg are calculated for 32- and 200-acre farms, respectively.

References

Deere. 2007. Products & equipment quickfind. Available at: www.deere.com/en_US/ deerecom/equipment_quickfind/index.html. Accessed July 10, 2007. Deere & Company, USA/Canada.

Gross, P. 2007. Personal communication (telephone conversation with L. Yost, Exponent, St. Paul, MN, on June 7, 2007, regarding agricultural practices on the Tittabawassee River.) Michigan State University Agricultural Extension, Isabella County.

U.S. EPA. 1995. Emission factor documentation for AP-42 Section 9.1, tilling operations. Draft Report. Prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factor and Inventory Group. Midwest Research Institute.

Table 1. Calculation of particulate soil inhalation criteria (PSIC) incorporating agricultural tilling particulate emissions

	32-acre field		200-acre field					
	Agricultural scenario	Agricultural scenario based on AP-42	Agricultural scenario	Agricultural scenario based on AP-42	Generic residential scenario	Units	Description	Source
Particulate Inhalation Soil Criteria (PSIC)								
PSIC	22	19	18	9	71	ug/kg	Particulate soil inhalation criteria (PSIC)	Calculation (see below: Equation 1.)
PSIC	47	40	37	18	148	ug/kg	PSIC application of 75,000 (mg/kg-day)$^{-1}$ CSF	
Equation 1. Particulate Soil Inhalation Criteria. Calculated as: PSIC = (TR*ATc)/(IURF*EF*ED*1/PEF)								
TR	1E-05	1E-05	1E-05	1E-05	1E-05		Target risk	MDEQ Inhalation Soil Criteria, p. 14
AT	25550	25550	25550	25550	25550	days	Averaging time	MDEQ Inhalation Soil Criteria, p. 14
IURF	44.6	44.6	44.6	44.6	44.6	(ug/m^3)$^{-1}$	Inhalation unit risk factor [156,000 (mg/kg-day)$^{-1}$ CSF]	Derived from 156,000 mg/kg-day CSF see sheet 2
EF	350	350	350	350	350	d/y	Exposure frequency	MDEQ Inhalation Soil Criteria, p. 14
ED	30	30	30	30	30	years	Exposure duration	MDEQ Inhalation Soil Criteria, p. 14
PEF	4.11E+07	3.49E+07	3.26E+07	1.57E+07	1.30E+08	m^3/kg	Particulate emission factor	MDEQ Soil Inhalation Criteria, P 26; and Calculation (see below Equations 2 and 8)
Equation 2. Particulate emissions factor from wind and vehicles. Calculated as: PEF = QC/((Ew*(1-V))+Ev)								
For agricultural and AP-42 calculations, Ev = Ev_ag_com = Ev_ag + Ev_res (see Eq. 8)								
QC	31.83	31.83	26	26	82.33	(g/m^2-s)/(kg/m^3)	Dispersion factor	MDEQ provided via conference call 6-7-07. Value for 200 acres approximated from 27 for 100 acres and 21.61 for 500 acres provided.
Ew	5.5E-07	5.5E-07	5.5E-07	5.5E-07	5.5E-07	g/m^2/s	Emission resulting from wind	MDEQ Inhalation Soil Criteria, p. 20 (Equation 3)
Ev	3.6E-07	5.0E-07	3.8E-07	1.2E-06	3.6E-07	g/m^2/s	Emission from vehicle traffic (residential, or ag. and res.)	MDEQ Inhalation Soil Criteria, Attachment A
Ev_ag	4.3E-09	1.4E-07	2.7E-08	8.9E-07	--	g/m^2/s	Annual average emission from ag. vehicle traffic	Calculation (see below Equation 9)
Ev_res	3.6E-07	3.6E-07	3.6E-07	3.6E-07	--	g/m^2/s	Additional emmission from ag. residence	MDEQ Inhalation Soil Criteria, Attachment A (Equation 4)
Ev_ag_com	3.6E-07	5.0E-07	3.8E-07	1.2E-06	--	g/m^2/s	Combined agricultural scenario emission	
V	0.25	0.25	0.25	0.25	0.5	unitless	Vegetative cover	Gross 2007, pers. Comm.
Equation 3. Emissions from wind. Calculated as: Ew= (0.036*(Um/Utadj)^3*F(x))/3600								
constant	0.036	0.036	0.036	0.036	0.036	g/m2/hr	Theoretical constant	MDEQ Inhalation Soil Criteria, Attachment A
sec/hr	3600	3600	3600	3600	3600	seconds/hr	Conversion factor	MDEQ Inhalation Soil Criteria, Attachment A
Um	4.62	4.62	4.62	4.62	4.62	m/s	Mean wind speed at 7m	MDEQ Inhalation Soil Criteria, Attachment A
Utadj	9.51	9.51	9.51	9.51	9.51	m/s	Threshold friction velocity at 7m	MDEQ Inhalation Soil Criteria, Attachment A
F(x)	0.48	0.48	0.48	0.48	0.48	unitless		MDEQ Inhalation Soil Criteria, Attachment A
Equation 4. Annual average emissions from vehicle traffic. Calculated as: Ev= Ev_yr*CFg_kg / (CFs_y*A)								
For agricultural and AP-42 calculations, includes the sum of the residential and agricultural emissions.								
Site_acres	32	32	200	200	0.5	acres	Area of site acres	Applied 32 and 200 acres for agricultural http://www.nass.usda.gov/Census/Pull_Data_Census. Residential from MDEQ Soil Criteria, Attachment A
A	129500	129500	809372	809372	1965.37	m^2	For agricultural: Area of site (acre x 4046.86 m^2/acre. For residential 0.5 acre-58 m^2 house.	Farm see above. Residential from MDEQ Soil Criteria, Attachment A
CFg/kg	1000	1000	1000	1000	1000	g/kg	Conversion factor	
CFs/y	3.154E+07	3.154E+07	3.154E+07	3.154E+07	3.154E+07	sec/yr	Conversion factor	
Ev_yr	17.7	579	111	3620	22.2	kg/yr	Emissions PM10 per year	Calculation (see below Equation 5)
Equation 5. Emissions PM10 per year: Calculated as Ev_yr= EV_VKT*D_yr								
For AP-42 calculations, calculated as: 5.7lbs/acre x 0.4536kg/lb x A_ag x 7 tillage events year								
Ev_VKT	0.1368		0.1368		0.1583	kg/km	Average yearly emissions PM10 per vehicle-km of travel	Calculation (see below Equation 8)
res drive					20	m	Driveway length 20 lengths per day	
D_yr_res					140	kilometers/yr	Residential kilometers per year 10 round trips/day * 350 days	MDEQ Inhalation Soil Criteria, Attachment A
D_yr_ag	129		809			kilometers/yr	Vehicle km driven per year (Length squared * 7 tillage events/year)/tiller width - converated to km from m)	Calculation (see tillage events Equation 9 below)

Table 1. Calculation of particulate soil inhalation criteria (PSIC) incorporating agricultural tilling particulate emissions

	32-acre field		200-acre field					
	Agricultural scenario	Agricultural scenario based on AP-42	Agricultural scenario	Agricultural scenario based on AP-42	Generic residential scenario	Units	Description	Source
Equation 6. Average yearly emissions PM10 per vehicle-kilometer of travel. Calculated as: Ev_VKT = k*1.7*(s/12)*(S/48)*(W/2.7)^0.7*(w/4)^0.5*((365-p)/365)								
k	0.35		0.35		0.35	unitless	Particle size multiplier (based on PM10)	MDEQ Inhalation Soil Criteria, Attachment B
s	18		18		15	percent	Silt content of soil/road surface	Documentation for AP-42, page 4-6, silt content ranged from 1.7 to 88% in fields tested in deriving equation. In the absence of site specific data, AP-42 recommends value of 18%.
S	10		10		20	km/h	Mean vehicle speed	Documentation for AP-42, pg 2-4 ranged from 8-10 km/hr.
W	14		14		2	Mg	Mean vehicle weight	MDEQ Inhalation Soil Criteria, Attachment B for resident;Tractor assumpion largest John Deere model and assuming 2 Mg additional for other equipment
w	8		8		4	unitless	Mean number of wheels	MDEQ Inhalation Soil Criteria, Attachment B, Professional judgment regarding tractor with tiller
p	305		0		135	days	Number of days on which a vehicle does not generate dust (for residential it is the number of days with more than 0.01 inches of precipitation. For agricultural scenario p is the number of days use is reduced because of rain - 0 here.)	MDEQ Inhalation Soil Criteria, Attachment B
Equation 7. Particulate Soil Inhalation Criteria. Calculated as: PSICag = (TR*ATc)/(IURF*EF*ED*1/PEFag)								
PSICag	22	19	18	9	--		All parameters and imputs the same as Equation 1 except PEF_{ag}. (see Equation 8)	
Equation 8. Particulate emissions factor from wind and agricultural vehicles. Calculated as: PEFag = QC/((Ew*(1-V))+Ev_ag+Ev_res)								
PEFag	4.11E+07	3.49E+07	3.26E+07	1.57E+07	--		See Equation 2 above and text for basis	
Equation 9. Vehicle kilometers driven per year. Calculated for agricultural vehicles as: D_yr = tillage events*L*FW/(TW*1000m/km)								
tillage events	7.0		7.0				Tillage events per year, assumed 7 complete traverses of the field.	
L	360		900			m	Length of site (length of side = square root of area for square field)	MDEQ Inhalation Soil Criteria, Attachment B
FW	360		900			m	Width of site (width of side = square root of area for square field)	MDEQ Inhalation Soil Criteria, Attachment B
TW	7		7			m	Tiller width (John Deere tillers range in size from 1.8 to 14 with a mean of 7 m. Seven m selected as conservative estimate. Also considered conservative by Mr. Gross MSU.	http://www.deere.com/specsapp/CustomerSpecificationServlet?sbu=Ag&pciModel=0856XN&displayModelName=856%20Row%20Crop%20Cultivator&tM=FR&pNbr=0856XN

Note: -- - not applicable

Homegrown Produce Pathway

9/20/2007

Home-Grown Produce Pathway

This memorandum provides a follow-up to discussions regarding the homegrown fruit and vegetable pathway at our March 21, 2007 meeting with MDEQ and is intended to provide the reviews requested at that time. This memo was initially provided on April 12, 2007, was subsequently discussed with MDEQ and is provided here unchanged from the April 12, 2007 version. The available site-specific data, reviews conducted by EPA of this pathway, and limited available scientific literature all suggest that homegrown produce consumption is not a substantial source of exposure to polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) present in soils. Thus, it is proposed that this pathway be discussed qualitatively and eliminated within the Human Health Risk Assessment (HHRA) rather than conducting quantitative risk estimates for this pathway. Five types of data or analyses of the homegrown vegetable pathway are described here:

- Additional analyses of site-specific biomonitoring data from the University of Michigan Dioxin Exposure Study (UMDES) evaluating serum PCDD/Fs as toxic equivalent quotients (TEQs) (excluding PCB coplanar congeners) in people who consume homegrown fruits or vegetables. The additional analyses included evaluation of the influence of soil TEQs on serum TEQs among those who consume homegrown produce

- Limited site-specific data on TEQs in soil and field crop produce collected and analyzed by the Michigan Department of Agriculture (MDA)

- A brief overview of relevant papers available to consider the produce consumption pathway.

- A summary of other regulatory evaluations of the produce consumption pathway that considered the influence of this pathway relative to other pathways and

- Conclusions from these materials regarding the relative importance of the produce consumption pathway.

UMDES Analysis of TEQ Biomonitoring Data

As discussed at our March 21, 2007 meeting with MDEQ, Dr. Garabrant, lead investigator of the UMDES directed additional analyses of a potential relationship between total TEQ (for PCDD/Fs only) in soil and serum of those who consume fruits and vegetables from gardens including gardens with PCDD/Fs in soil. The homegrown produce pathway had been considered previously, but the prior report was based on an evaluation of the relationship between homegrown produce consumption and serum TEQ combining both PCDD/Fs and coplanar PCBs. In addition, the prior work did not look specifically at the interaction between soil, fruits or vegetables, and serum. The attached report from the UMDES researchers details the findings of the assessment evaluating the relationship between concentrations of PCDD/F in

soil, consumption of homegrown produce, and serum PCDD/F levels of UMDES study participants from the Midland area and from the Tittabawassee Floodplain. The report made the following conclusions:

- PCDD/F_TEQ concentrations in garden soil was not related to PCDD/F TEQ in serum

- The interaction between soil and the number of meals of garden produce was not predictive of the PCDD/F_TEQ in serum for either root vegetables or for fruits and vegetables.

- These findings "mean that the effect of eating root vegetables [or other home grown fruits or vegetables] from contaminated soil is not significantly different from the effect of eating root vegetables from soil having no contamination."

This finding can be considered together with the prior more general UMDES evaluation of the influence of produce consumption. The prior evaluation determined that consumption of fruits and vegetables was associated with lower serum concentrations of PCDD/Fs and PCBs (UMDES brochure[1] 2006 page 17). Specifically, the UMDES evaluated the effect of eating vegetables on blood concentrations of PCDD/Fs and PCBs, and found that "[i]n general, people who ate more fruit and vegetables have similar or lower levels of PCDD/Fs and PCBs in their blood as compared to people who eat fewer fruit and vegetables" and that this "is largely true whether or not the fruit and vegetables come from the contaminated areas or are bought from a store." In particular "[p]eople who ate root vegetables from the Tittabawassee River, Saginaw River, and Saginaw Bay Floodplains do not have higher levels of dioxins in their blood" (UMDES 2006, Findings).

The prior evaluation indicated that consumption of homegrown produce was a positive influence in terms of being associated with lower overall TEQ serum values (for PCDD/Fs and PCBs combined) as compared with overall TEQ serum values for the general public, but uncertainties remained as to whether PCDD/Fs in garden soil were related to serum TEQs for garden produce consumers. This reflects both the fact that higher levels of vegetable consumption probably result in lower meat consumption and that vegetables are low in PFDD/F and PCB concentrations, and hence a lower dietary exposure to these residues occurs in these consumers. The recent evaluation indicated that soil concentrations were not a predictor of serum TEQ for produce consumers.

Replacement of garden soil and relocation of garden beds was offered, as part of the IRA offered to residents in the Priority 1 and Priority II areas in the City of Midland and along Tittabawassee River. Soils in 58 gardens were replaced in Priority 1 and II areas at the request of residents in these areas. These garden soil replacements were done after the UMDES investigation. Although the UMDES evaluation ultimately shows no link between soil and

[1] http://www.sph.umich.edu/dioxin/PDF/UMDES%20Brochure_FINAL_08042006.pdf

serum TEQ in garden vegetable consumers, supporting no response was needed, the garden soil replacement has effectively interrupted this potential exposure pathway on these properties.

Tittabawassee River Floodplain Area Data on PCDD/Fs in Soil and Crops

Data were gathered by the Michigan Department of Agriculture seeking to evaluate a potential relationship between PCDD/Fs in soil and crops within the Tittabawassee River floodplain area. Although these data comprised a limited number of samples of soils and co-located crops, they did not suggest a relationship between soil and soybean or corn crops even where soil concentrations were as high as 2,000 ppt (Pers. Comm. Brian Hughes MDA April 9, 2007). These data are being reconstructed by MDA and will be provided when available.

Overview of Scientific Literature Evaluating Vegetable Uptake of PCDD/Fs

A review of the scientific literature on plant uptake was conducted. There were 34 peer-reviewed papers examined on the subject; however, a number related to non-food plants and most included air deposition as an important transport pathway. While some crops can take up dioxins and furans (as well as related chlorinated compounds); the amount reported in these studies is usually quite low and often confined to surface contamination or the peel. It was reported that zucchini appear to take soil-bound residues up into the fruit, but still had levels that are 50 fold lower than the surrounding soils.

The quality of the experimental data represented in the studies reviewed is limited because only a few produce or crop species were studied, and many of the studies had poor experimental design and low numbers (e.g. many of the studies only involved a few, if any replicates). For instance, in studies covering over three decades, only about 12 zucchini have been chemically analyzed in studies of soil uptake.

Consideration of Home-Grown Vegetable Pathway in EPA Assessments

The 2003 exposure assessment component of the US EPA Dioxin Reassessment did not include exposure through fruits and vegetables, as this exposure was considered insignificant. (US EPA 2003, Part 1, Volume II, Chapter 4[2]). Vegetable oils were the only input into the dietary components from vegetables (see Table 4-30 and Figure 4-7), and are not relevant for this discussion. The (2006) NAS review of the PCDD/F exposure assessment document did not find the need to revise the US EPA's conclusion on this subject.

US EPA (2002) also conducted an analysis of consumption of home grown vegetables as part of their risk evaluation for their biosolids rule and concluded that that ingestion of fruits and vegetables are minor contributors to exposure and risk.

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[2] http://www.epa.gov/ncea/pdfs/dioxin/nas-review/pdfs/part1_vol2/dioxin_pt1_vol2_ch04_dec2003.pdf

Conclusions

The site-specific data indicate that the exposure pathway from ingestion of homegrown vegetables does not contribute to exposure to soil-bound residues. Other non-site specific data and analyses reviewed also indicated an insignificant potential for exposure through this pathway. Specifically, the UMDES biomonitoring data indicated that serum TEQs in individuals who consume homegrown vegetables (or store-bought vegetables) are lower than those who do not. Moreover, the recent additional analyses indicated that serum TEQs were not related to soil TEQs in those who consume homegrown vegetables. Thus, neither garden soil nor the vegetables grown in these gardens result in any significant PCDD/F exposure for consumers. Further, mitigations of a number of area gardens conducted after the UMDES biomonitoring was completed have now functionally interrupted this potential pathway in many existent gardens and eliminated the opportunity for collection of garden soils and vegetable that would be needed to further study the relationship in these cases. Additionally, such action appears not to have been needed in retrospect based on lack of significant exposure.

Data from the scientific literature are insufficient to estimate uptake into vegetables. The findings of the comprehensive site-specific biomonitoring study are consistent with the conclusions of prior regulatory bodies that determined the vegetable garden pathway is not an important contributor to PCDD/F exposures. Therefore, no further qualitative or quantitative analyses of this pathway are warranted and it is proposed that this pathway be dropped from further consideration in the risk assessment.

References

EPA 2002. Exposure Analysis for Dioxins, Dibenzofurans, and CoPlanar Polychlorinated Biphenyls in Sewage Sludge - Technical Background Document DRAFT EPA. Office of Water. Washington, DC. Available at http://www.epa.gov/waterscience/biosolids/tbd.pdf

EPA. 2003. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft. Part I: Estimating Exposure to Dioxin-Like Compounds. Available at: http://www.epa.gov/ncea/pdfs/dioxin/nas-review/. Accessed October 24, 2006. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Exposure Assessment and Risk Characterization Group, Washington, DC.

NAS. 2006. Health risks from dioxin and related compounds: evaluation of the EPA reassessment. National Academies of Science, National Research Council, Committee on EPA's Exposure and Human Health Reassessment of TCDD and Related Compounds. Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. The National Academies Press, Washington, D.C.

Attachment: UMDES Analysis Provided March 29, 2007

March 29, 2007

The question was raised at the dioxin HHRA meeting on 3/21/07 whether people whose soil was highly contaminated and who ate vegetables from their own property had elevated blood dioxin levels. Dr. Garabrant indicated that the UMDES data could answer this question. To answer this question, the following things were done:

1. The TEQ of the garden soil was recalculated using the 2005 WHO TEF values, restricting the TEQ to the 17 PCDD and PCDF congeners (the 12 PCB congeners were not included).

2. The blood TEQ was recalculated using the 2005 WHO TEF values, restricting the TEQ to the 17 PCDD and PCDF congeners (the 12 PCB congeners were not included).

3. The regression analyses were re-run using the models we have already completed, which include all significant predictors. The outcome variable was the $\log_{10}$(blood TEQ) and the following predictors were forced into the model:

    a. the soil dioxin TEQ from the garden soil,

    b. the number of meals of root vegetables that were grown on the participant's property during the last 5 years

    c. an interaction term which multiplied the soil TEQ by the number of meals of root vegetables that were grown on the participant's property during the last 5 years.

    d. the number of meals of fruits and vegetables that were grown on the participant's property during the last 5 years

    e. an interaction term which multiplied the soil TEQ by the number of meals of fruits and vegetables that were grown on the participant's property during the last 5 years.

Predictors	**Estimate**	**P-value**
Main effects		
soil TEQ (NOT PCBs) concentration for garden soil (Soil Contact Zone)	0.0004054	0.240

The number of meals of **root vegetables** that were grown on the participant's property during the last 5 years	0.0000015	0.963
The number of meals of **other fruit or vegetables** that were grown on the participant's property during the last 5 years	-0.0000061	0.753
Interaction terms		
soil TEQ (NOT PCBs) concentration for Soil Contact x The number of meals of **root vegetables** that were grown on the participant's property during the last 5 years	0.0000008	0.341
soil TEQ (NOT PCBs) concentration for Soil Contact x The number of meals of **other fruit or vegetables** that were grown on the participant's property during the last 5 years	-0.0000003	0.691

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The results show that

1. The soil TEQ from the garden soil was not a significant predictor of blood TEQ (parameter estimate 0.0004054, p = 0.240)

2. The number of meals of root vegetables that were grown on the participant's property during the last 5 years was not a significant predictor of the blood TEQ (parameter estimate 0.0000015, p = 0.963)

3. The interaction term between root vegetable meals and soil TEQ was not a significant predictor of the blood TEQ (parameter estimate 0.0000008, p = 0.341). The parameter estimate from the interaction terms mean that the effect of eating root vegetables from contaminated soil is not significantly different from the effect of eating root vegetables from soil having no contamination.

4. Similar results were observed for the number of meals of other fruit or vegetables that were grown on the participant's property during the past 5 years. The parameter estimate from the interaction terms mean that the effect of other fruits or vegetables from contaminated soil is not significantly different from the effect of eating root vegetables from soil having no contamination.

Overview of Draft Sensitivity Analysis

Technical Memorandum

Overview of Draft Sensitivity Analysis

June 29, 2007

Overview of the Draft Sensitivity Analysis

The following is a brief overview of the preliminary sensitivity analysis prepared for Dow at the request of MDEQ. This analysis was conducted to meet two objectives proposed by MDEQ:

1. Identify likely key exposure pathway/receptor combinations (to allow concentration on the most important pathway/receptor combinations in more detailed risk estimates).

2. Identify the parameter uncertainties that are most important for each receptor (to allow concentration on the most important uncertainties for more detailed risk estimates).

The first objective was interpreted to require an ordering of dose estimates (from largest to smallest) by receptor. The second to require an ordering (from largest to smallest) of the relative importance of parameter uncertainties on pathway dose estimates. For definiteness, the measure of dose evaluated in this analysis is lifetime average daily dose for an individual randomly chosen from those exposed through any particular pathway. Dose is considered an acceptable surrogate for risk in this preliminary analysis, since the relation between dose and cancer risk is independent of pathway and receptor for current regulatory dose-response relations. The analysis is currently limited to evaluation of doses of PCDD/PCDFs expressed as TEQs.

It must be emphasized that the results obtained here are preliminary, and may change when further data become available. All values used here are based on measurements, but often not of the precise situation required for the pathway/receptor evaluated — there is an extrapolation that often takes the form of a representativeness assumption (certain measurements are assumed to be adequately representative for the pathway/receptor evaluated). These representativeness assumptions are not spelled out explicitly in this preliminary document (it is intended that they will all be explicit in the HHRA, and there should be many fewer than needed here). One example is provided by the relatively limited concentration measurements currently available for various media (*e.g.* in soil and food items), necessitating the use (until the measurements become available) of extrapolations from what has been measured.

An exposure pathway is defined here as the course a chemical takes from a source to an exposed receptor. Exposure pathways consist of the following four elements: 1) a source; 2) a mechanism of release, retention, or transport of a chemical in a given medium (*e.g.*, air, water, soil); 3) human contact with the medium (*i.e.*, exposure point); and 4) a route of exposure (*i.e.*, ingestion, dermal contact, or inhalation). If any of these elements is missing, the pathway is considered incomplete (*i.e.*, it does not present a means of exposure). Only those exposure pathways judged to be potentially complete are to be quantified in the HHRA. Some of the exposure pathways evaluated here are entirely hypothetical and may not represent the activities of any one individual or group of individuals.

Table 1 shows the receptors and pathways evaluated in this preliminary analysis. They correspond to those specified in the Tittabawassee River Floodplain Remedial Investigation Work Plan, with two exceptions: the vegetable consumption pathway and the agricultural dust

pathway are not included here as those are undergoing analysis separately. There are a total of 16 receptors and 42 pathway receptor combinations listed in Table 1.

Table 1. Receptors considered in sensitivity analysis

Receptor	Pathway(s)
Residential—adult	Soil ingestion Soil contact
Residential—child	Soil ingestion Soil contact
Worker—adult	Soil ingestion Soil contact
Hunter—adult	Soil ingestion Soil contact (regular) Soil contact (muddy hands) Surface water ingestion Dermal contact with surface water Consumption of wild game
Child of hunter	Consumption of wild game
Fish-eating angler—adult	Soil ingestion Soil contact (regular) Soil contact (muddy hands) Soil contact (muddy feet) Surface water ingestion Dermal contact with surface water Consumption of sport-caught fish
Fish-eating child of anglers	Consumption of sport-caught fish
Recreational (non-fishing, non-hunting) visitor—adult	Soil ingestion Soil contact (regular) Soil contact (muddy hands) Surface water ingestion Dermal contact with surface water
Recreational (non-fishing, non-hunting) visitor—teen	Soil ingestion Soil contact (regular) Soil contact (muddy hands) Surface water ingestion Dermal contact with surface water
Recreational (non-fishing, non-hunting) visitor—child	Soil ingestion Soil contact (regular) Soil contact (muddy hands) Surface water ingestion Dermal contact with surface water
Adult eating farm-produced meat	Consumption of farm produced meat
Child eating farm-produced meat	Consumption of farm produced meat
Adult eating farm-produced eggs	Consumption of farm produced eggs
Child eating farm-produced eggs	Consumption of farm produced eggs
Adult eating farm-produced dairy	Consumption of farm produced dairy products
Child eating farm-produced dairy	Consumption of farm produced dairy products

Selection of Parameter Inputs

The principal step in the analysis was to evaluate estimates for mean and standard deviation (either uncertainty or variability, whichever is larger) for each parameter used in the pathway models. The values were selected to be representative for the particular pathway, receptor, and local area (the Tittabawassee River Flood Plain). To that end the most appropriate available data were located for each parameter. Where flood plain specific information is available, it was used. Next in priority were the same data sources (in some cases using more recent data) used by MDEQ for evaluation of their default parameter estimates. Then other sources were consulted as appropriate, using Midwest-specific information where available, then national information.[1] The parameter estimates, and the sources of data, are described in more detail in the accompanying document "Initial parameter estimates for the Tittabawassee River sensitivity analysis and risk assessment."[2]

Soil and Wild Game Data

Concentrations in soil and wild game were obtained from measurements taken in the Tittabawassee flood plain by the University of Michigan, by Dow contractors, or by MDEQ. Soil and food concentrations for the various receptor/pathway combinations were obtained by selecting the most closely approximating measurements (*e.g.*, for soil and wild game) or using observed or expected correlations (*e.g.*, for domestic livestock, using the same proportionality between meat concentrations and soil concentrations as observed for wild game on the Tittabawassee River; for milk and eggs, using the relation between milk or egg concentrations and soil concentrations obtainable from the literature).

Specifically:

- For residential soil, the UMDES data identified as "soil contact" concentrations for the Midland Saginaw Floodplain area were used. The same soil concentrations were used as the basis for estimating agricultural product concentrations. For workers, the full range of soil concentrations observed in the Ecological Support Sampling (CH2MHill, 2004) was used. For Hunters and Fishers, the range of area average concentrations observed in the Ecological Support Sampling was used.

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[1] The data selected were representative, but are not necessarily the best available. For example, more information from the UMDES will improve representativeness as well as reducing uncertainties, more data from the other surveys used here will also be usable, and better approaches may be used to improve representativeness in evaluating those surveys.

[2] We wish to emphasize again that these are preliminary estimates, and the detail provided here and in the accompanying documentation is still very sketchy — it omits much technical description, and does not provide the implementations of the analyses, so that independent replication would be difficult or impossible. This is because these are preliminary analyses that do not use all available data. In the HHRA, more data will be analyzed, full details will be provided, and all the implementations of the analyses performed will also be provided, allowing complete independent replication.

- Wild game concentration data were from Entrix (2004). Evaluation of deer muscle, deer liver, turkey, and squirrel muscle concentrations combined with consumption rate data indicated that the turkey concentrations were the most appropriate for this analysis, so they were used.

- Fish data were drawn from measurements taken at the Dow dam or Smith's Crossing (from Dow NPDES reports from 1985 to 2006).

- Agricultural products: TEQs in agricultural products were estimated assuming a linear relation between TEQ concentration in the product and in soil. For meat, the relation was estimated from the local wild game data (Entrix, 2004) combined with the Ecological Support Sampling (CH2MHill, 2004). For milk and eggs, published data allowed evaluation of a linear relationship between concentration in soil and concentration in the agricultural product.

Exposure Duration and Frequency

Residence time was estimated with the same methodology as used by EPA (and hence MDEQ) applied to more recent survey information (using Midwest-specific moving rates and national death rates). Initial estimates for other exposure durations and exposure frequencies were in most cases extracted from the University of Michigan Dioxin Exposure Study (UMDES) questionnaire results for the flood plain (or from larger groups if they all appeared equivalent). For the rarer exposures (muddy hands and muddy feet), the nominal values provided in the HHRA work plan have been applied.

Soil Ingestion Rates

The soil ingestion rate distribution used is that published by the Calabrese group, and the estimate for adults is from the same authors, adjusted to incorporate an assumption that adult ingestion rates are, on average, less than child ingestion rates.

Dermal Exposure Estimates

Absorption efficiency estimates were obtained from experimental studies on animals.

Soil adherence and contact area estimates were obtained using the Kissel data, as listed by the U.S. Environmental Protection Agency (EPA).

Consumption rate estimates

Consumption rates for meat, fish, eggs, and dairy products were obtained from UMDES, with children presumed to eat at the same rate (meals/year) as their parents. Adult fish meal sizes come from a regional survey, with other meal size estimates (child- and adult-specific) primarily

from the USDA/NHANES national survey (What We Eat In America, using the 2003–2004 data set).

Surface Water Pathways

Because PCDD/F congeners have extremely low water solubility and are not typically detected in surface water, the surface water pathways have assumed a zero concentration value in this analysis. To the extent that other CoPCs are identified in surface water, surface water contact pathways will need to be re-evaluated.

Body Weights and averaging time

Body weights use national averages for appropriate age ranges. The averaging time applied here is 70 years consistent with MDEQ and EPA guidance for evaluation of carcinogenic effects.

Method of Analysis

A sensitivity analysis evaluates the effect on a particular result of changing each input, one-by-one. An importance analysis then adds information on how uncertain or variable each input is, to determine the inputs contributing most to the uncertainty or variability in the result. For the randomly chosen person evaluated in this analysis, variability and uncertainty are indistinguishable.

The results in this case are lifetime average daily doses (ADDs) for PCDD/F toxicity equivalents for each receptor. The mean estimates for ADDs were estimated, as described in the remedial investigation work plan. There are several reasons for choosing the mean estimate, among them:

- The mean estimate of the ADDs may be calculated from mean estimates of the parameters with very few assumptions about distributions; the mean therefore provides a stable starting point for the sensitivity analysis.
- Mean estimates for the parameters, hence for the ADD, can usually be obtained more easily and more accurately than any other estimate.
- Use of the mean gives stable and comparable statistics for all parameters, and allows computation of comparable estimates of ADDs for different pathways and receptors. Such estimates can therefore be meaningfully added across pathways and compared between receptors.

The sensitivity measures how much an ADD changes when one parameter is changed. A convenient measure of this is the fractional change of the ADD divided by the fractional change in the parameter, and this is the measure of sensitivity that is calculated.

Given the sensitivities of the ADDs, it is possible to determine the relative importance of further information about any given parameter by multiplying the sensitivity of the ADD with respect to that parameter by an estimate of how uncertain one is about the parameter.

A convenient, standardized measure of how uncertain one is about a parameter is its standard deviation, or its coefficient of variation (the standard deviation divided by the mean). The standard deviation also has the advantage of being relatively easy to calculate, and of being the statistic most often calculated as a measure of variation or uncertainty (it has various other nice properties as well). It is necessary to use some standardized measure of uncertainty or variability for each parameter, otherwise you are comparing apples and oranges in evaluating the effects on the ADD.

A convenient estimate of the relative importance of a parameter for a given ADD can be obtained by multiplying the coefficient of variation of a parameter by the sensitivity of the ADD to that parameter. The result gives a standardized relative uncertainty or variability in the ADD because of the uncertainty or variability in the parameter. The standardization (to use the same type of measure of uncertainty, and the same [mean] estimator for the ADD) means that it is meaningful to compare the results of these calculations between pathways and receptors.

Results

The following tables show the relative importance of the parameters for the receptors examined. The higher the relative importance, the more the importance of obtaining further details about the variability or uncertainty of that parameter. These tables use the abbreviations for receptors shown in Table 2 and the abbreviations for parameters shown in Table 3. The "Parameter" entry in Table 4 through Table 19 shows the name of the parameter, and the receptor for which the value of that parameter is initially defined; there are many parameters that are common between receptors and pathways (at least in this initial analysis), so variation of a single parameter estimate may have an effect on ADDs estimated for multiple receptors through multiple pathways.

Table 2. Abbreviations for receptors

Receptor Abbreviation	Meaning
Res_C	Residential child
Res_A	Residential adult
Worker	Worker exposure to soil (adults)
Hunt_C	Children of Hunt_A
Hunt_A	Adult hunters in River Study Area who consume game
Fish_C	Children of Fish_A
Fish_A	Adult anglers on the Tittabawassee River who consume fish
Teen	Recreational visitor (teen)
Child	Recreational visitor (child)
Recreate	Recreational visitor (adult)
Meat_C	Children who eat non-game meat raised in the study area
Meat_A	Adults who eat non-game meat raised in the study area
Eggs_C	Children who eat eggs produced in the study area
Eggs_A	Adults who eat eggs produced in the study area
Milk_C	Children who eat milk (and products) produced in the study area
Milk_A	Adults who eat milk (and products) produced in the study area

Table 3. Abbreviations for parameters

Parameter Abbreviation	Unit	Meaning
AEd	--	Absorption efficiency for dermal exposure
AEi	--	Absorption efficiency for ingestion exposure
AFd	mg/cm^2	Adherence factor for regular dermal exposures
AFm	mg/cm^2	Adherence factor for muddy hand dermal exposure
AFt	mg/cm^2	Adherence factor for muddy feet dermal exposure
AT	D	Averaging time
BW	Kg	Body weight
Ca	mg/kg fat	Concentration of contaminant in dairy products, referred to the fat fraction
Ce	mg/kg	Concentration of contaminant in eggs
Cf	mg/kg	Concentration of contaminant in fish
Cg	mg/kg	Concentration of contaminant in wild game
CLf	--	Cooking and trimming loss in fish
CLg	--	Cooking and trimming loss in wild game
CLm	--	Cooking and trimming loss in farm-produced meat

Parameter Abbreviation	Unit	Meaning
Cm	mg/kg	Concentration of contaminant in farm-produced meat
Cs	mg/kg	Concentration of contaminant in soil
Cw	mg/kg	Concentration of contaminant in water
ED	Y	Exposure duration
EFd	D/y	Exposure frequency for regular soil contact
EFm	D/y	Exposure frequency for muddy hand contact with soil
EFs	D/y	Exposure frequency for soil ingestion
EFsw	D/y	Exposure frequency for dermal contact with surface water
EFt	D/y	Exposure frequency for muddy feet contact with soil
EFw	D/y	Exposure frequency for water ingestion
IRa	meals/y	Ingestion rate for dairy products
IRe	egg/y	Ingestion rate for eggs
IRf	meals/y	Ingestion rate for fish
IRg	meals/y	Ingestion rate for wild game
IRm	meals/y	Ingestion rate for farm-produced meat
IRs	mg/day	Ingestion rate for soil
IRw	L/d	Ingestion rate for water
Megg	kg/egg	Mass of an egg
MSa	kg fat/meal	Meal size for dairy products (fat basis)
MSf	kg/meal	Meal size for fish
MSg	kg/meal	Meal size for wild game
MSm	kg/meal	Meal size for farm-produced meat
PC	cm/hr	Permeation constant for contaminant
SAd	cm^2	Surface area for regular dermal contact with soil
SAm	cm^2	Surface area for muddy hand contact with soil
SAsw	cm^2	Surface area for dermal contact with surface water
SAt	cm^2	Surface area for muddy feet contact with soil
TD	hr/d	Period of dermal contact with surface water

Relative Importance of Parameters in Exposure Pathways

The following tables show the relative importance of each parameter in the exposure pathways.

Table 4. Relative sensitivities for the residential adult (Res_A)

Relative Sensitivity	Parameter
6.150	Res_A; Cs
0.940	Res_A; ED
0.825	Res_A; IRs
0.330	Res_A; Aed
0.241	Res_A; Afd
0.227	Res_A; BW
0.215	Res_A; Aei
0.119	Res_A; Efd
0.031	Res_A; Sad
0.016	Res_A; Efs

Table 5. Relative sensitivities for the child resident (Res_C)

Relative Sensitivity	Parameter
6.150	Res_A; Cs
0.672	Res_C; IRs
0.418	Res_C; Afd
0.352	Res_A; Aed
0.250	Res_C; ED
0.211	Res_A; Aei
0.160	Res_C; BW
0.062	Res_C; Efd
0.024	Res_C; Sad
0.016	Res_C; Efs

Table 6. Relative sensitivities for the Worker receptor

Relative Sensitivity	Parameter
1.670	Worker; ED
0.713	Res_A; IRs
0.690	Worker; Cs
0.504	Res_A; Aed
0.227	Res_A; BW
0.221	Worker; Efd
0.202	Worker; Afd
0.185	Res_A; Aei
0.158	Worker; Efs
0.047	Worker; Sad

Table 7. Relative sensitivities for the hunter who consumes game–adult (Hunt_A receptor)

Relative Sensitivity	Parameter
1.450	Hunt_A; ED
0.908	Hunt_A; Irg
0.735	Hunt_A; MSg
0.479	Hunt_A; Cg
0.244	Res_A; Aed
0.227	Res_A; BW
0.219	Hunt_A; Efm
0.176	Hunt_A; Afm
0.099	Hunt_A; Cs
0.083	Hunt_A; CLg
0.045	Hunt_A; Efs
0.025	Res_A; IRs
0.022	Hunt_A; Sam
0.006	Res_A; Aei
0.006	Hunt_A; Afd
0.001	Hunt_A; Sad

Table 8. Relative sensitivities for children who consume game (Hunt_C receptor)

Relative Sensitivity	Parameter
1.100	Hunt_C; Irg
0.890	Hunt_C; MSg
0.580	Hunt_A; Cg
0.250	Res_C; ED
0.160	Res_C; BW
0.100	Hunt_A; CLg

Table 9. Relative sensitivities for the angler who consumes fish–adult (Fish_A receptor)

Relative Sensitivity	Parameter
2.018	Fish_A; Irf
1.410	Fish_A; ED
0.304	Fish_A; Cf
0.278	Fish_A; CLf
0.270	Fish_A; MSf
0.227	Res_A; BW
0.203	Fish_A; Aft
0.170	Res_A; Aed
0.073	Hunt_A; Cs
0.033	Fish_A; Efs
0.031	Fish_A; Efm
0.026	Res_A; IRs
0.020	Fish_A; Afm
0.010	Fish_A; Sat
0.007	Res_A; Aei
0.006	Hunt_A; Afd
0.004	Hunt_A; Sam
0.001	Hunt_A; Sad

Table 10. Relative sensitivities for the child who consumes fish (Fish_C receptor)

Relative Sensitivity	Parameter
2.320	Fish_A; Irf
0.350	Fish_A; Cf
0.319	Fish_A; CLf
0.310	Fish_C; MSf
0.250	Res_C; ED
0.160	Res_C; BW

Table 11. Relative sensitivities for the recreational visitor–adult

Relative Sensitivity	Parameter
1.665	Recreate; EFs
1.100	Recreate; ED
0.684	Res_A; Aed
0.596	Res_A; IRs
0.275	Recreate; Cs
0.227	Res_A; BW
0.195	Recreate; Cs
0.189	Recreate; Afm
0.155	Res_A; Aei
0.142	Recreate; Afd
0.042	Hunt_A; Sam
0.022	Recreate; Sad

Table 12. Relative sensitivities for the recreational visitor–teen receptor

Relative Sensitivity	Parameter
1.236	Res_A; Aed
0.607	Teen; Afm
0.433	Recreate; Cs
0.238	Res_A; IRs
0.220	Teen; BW
0.146	Recreate; Cs
0.123	Teen; Afd
0.093	Teen; Sam
0.062	Res_A; Aei
0.023	Teen; Sad

Table 13. Relative sensitivities for the recreational visitor–child receptor

Relative Sensitivity	Parameter
1.429	Res_A; Aed
0.847	Teen; Afm
0.605	Recreate; Cs
0.316	Recreate; Efs
0.250	Res_C; ED
0.160	Res_C; BW
0.130	Child; Sad
0.092	Res_C; IRs
0.052	Recreate; Cs
0.037	Child; Afd
0.029	Res_A; Aei
0.004	Child; Sad

Table 14. Relative sensitivities for the consumer of home grown meat products–adult (Meat_A receptor)

Relative Sensitivity	Parameter
6.150	Meat_A; Cm
1.400	Meat_A; Irm
0.940	Res_A; ED
0.675	Meat_A; MSm
0.227	Res_A; BW
0.100	Hunt_A; CLg

Table 15. Relative sensitivities for the consumer of home grown meat–child (Meat_C receptor)

Relative Sensitivity	Parameter
6.150	Meat_A; Cm
1.400	Meat_A; Irm
0.660	Meat_C; MSm
0.250	Res_C; ED
0.160	Res_C; BW
0.100	Hunt_A; CLg

Table 16. Relative sensitivities for the consumer of home-grown eggs–adult (Eggs_A receptor)

Relative Sensitivity	Parameter
6.158	Eggs_A; Ce
1.700	Eggs_A; Ire
0.940	Res_A; ED
0.227	Res_A; BW

Table 17. Relative sensitivities for the consumer of home-grown eggs–child (Eggs_C receptor)

Relative Sensitivity	Parameter
6.158	Eggs_A; Ce
1.700	Eggs_C; Ire
0.250	Res_C; ED
0.160	Res_C; BW

Table 18. Relative sensitivities for the consumer of home-grown dairy products–adult (Milk_A receptor)

Relative Sensitivity	Parameter
6.330	Milk_A; Ca
0.940	Res_A; ED
0.880	Milk_A; Ira
0.700	Milk_A; Msa
0.227	Res_A; BW

Table 19. Relative sensitivities for the consumer of home-grown dairy products (Milk_C receptor)

Relative Sensitivity	Parameter
6.330	Milk_A; Ca
0.880	Milk_A; Ira
0.700	Milk_C; Msa
0.250	Res_C; ED
0.160	Res_C; BW

Relative Exposure Estimates for Pathways

Table 20 shows the mean ADD estimates for each of the exposure pathways, in decreasing order of size, and as such shows the relative importance of these pathways given the assumptions applied and concentration estimates based on currently available data.

It is also possible to make a rough estimate of an upper confidence limit on ADD. We compute the total CV for each pathway as well as the mean; and the central limit theorem suggests that the distribution for the ADD for each pathway will be approximately lognormal no matter what the distributions for the individual parameters. Treating the ADD as lognormal then allows the upper confidence limit estimate; and Table 21 shows such a 95th percentile estimate. This should be treated as a very rough approximation; we are omitting potentially very important uncertainties[3] (specifically, in the estimates of variability) that could substantially affect upper confidence limits. However, with current estimates the order does not change substantially from the order of mean estimates.

[3] These omitted uncertainties affect upper confidence limits, but not the mean estimates.

Table 20. Summary of mean exposure estimates for all pathways evaluated

Mean Estimate (mg/kg-day)	Pathway
2.3E-09	Eggs_C: Consumption of eggs
1.8E-09	Eggs_A: Consumption of eggs
1.5E-10	Milk_C: Consumption of dairy products
1.2E-10	Milk_A: Consumption of dairy products
4.3E-11	Fish_C: Consumption of sport-caught fish
3.9E-11	Fish_A: Consumption of sport-caught fish
1.8E-11	Hunt_A: Consumption of wild game
1.6E-11	Hunt_C: Consumption of wild game
6.8E-12	teen: Soil contact (muddy hands)
6.6E-12	Meat_A: Consumption of farm-produced meat
6.3E-12	Meat_C: Consumption of farm-produced meat
6.2E-12	child: Soil contact (muddy hands)
3.6E-12	Worker: Soil ingestion
3.1E-12	Fish_A: Soil contact (muddy feet)
3.1E-12	Hunt_A: Soil contact (muddy hands)
2.5E-12	Res_C: Soil ingestion
2.5E-12	teen: Soil ingestion
1.7E-12	teen: Soil contact (regular)
1.6E-12	Worker: Soil contact
1.3E-12	Fish_A: Soil contact (muddy hands)
1.1E-12	Fish_A: Soil ingestion
8.0E-13	Res_A: Soil ingestion
7.7E-13	child: Soil ingestion
7.1E-13	Res_C: Soil contact
5.0E-13	Hunt_A: Soil ingestion
2.9E-13	Fish_A: Soil contact (regular)
2.4E-13	Recreate: Soil ingestion
2.1E-13	child: Soil contact (regular)
2.1E-13	Res_A: Soil contact
1.3E-13	Hunt_A: Soil contact (regular)
1.2E-13	Recreate: Soil contact (muddy hands)
6.3E-14	Recreate: Soil contact (regular)
0	All surface water pathways

Table 21. Summary of 95th percentile estimates for all pathways evaluated

95th %ile Estimate (mg/kg-day)	Pathway
7.4E-09	Eggs_C: Consumption of eggs
5.4E-09	Eggs_A: Consumption of eggs
5.1E-10	Milk_C: Consumption of dairy products
3.6E-10	Milk_A: Consumption of dairy products
1.6E-10	Fish_C: Consumption of sport-caught fish
1.5E-10	Fish_A: Consumption of sport-caught fish
6.8E-11	Hunt_A: Consumption of wild game
5.8E-11	Hunt_C: Consumption of wild game
2.6E-11	teen: Soil contact (muddy hands)
2.4E-11	child: Soil contact (muddy hands)
2.0E-11	Meat_C: Consumption of farm-produced meat
1.9E-11	Meat_A: Consumption of farm-produced meat
1.4E-11	Worker: Soil ingestion
1.0E-11	Hunt_A: Soil contact (muddy hands)
1.0E-11	Fish_A: Soil contact (muddy feet)
8.9E-12	Res_C: Soil ingestion
7.8E-12	teen: Soil ingestion
6.3E-12	teen: Soil contact (regular)
6.1E-12	Worker: Soil contact
5.0E-12	Fish_A: Soil contact (muddy hands)
4.3E-12	Fish_A: Soil ingestion
3.0E-12	child: Soil ingestion
2.5E-12	Res_A: Soil ingestion
1.9E-12	Hunt_A: Soil ingestion
1.8E-12	Res_C: Soil contact
1.0E-12	Fish_A: Soil contact (regular)
9.0E-13	Recreate: Soil ingestion
7.6E-13	child: Soil contact (regular)
5.0E-13	Res_A: Soil contact
4.5E-13	Recreate: Soil contact (muddy hands)
4.5E-13	Hunt_A: Soil contact (regular)
2.1E-13	Recreate: Soil contact (regular)
0	All surface water pathways

Conclusions

Although these findings must be viewed as preliminary, they do demonstrate a method for evaluating the relative importance of individual parameters and of pathways proposed for consideration in the HHRA work plan through application of the approach proposed there together with the current data (e.g. soil) and estimates of concentrations (e.g., food items) in potential site media. As Tables Table 4 through Table 19 demonstrate, the concentration term is often the most sensitive variable and thus more resolution on actual concentrations will improve risk estimates and may result in a different outcome in the relative importance of pathways as shown in Table 20. Ingestion rates are also often a highly sensitive variable; these were estimated from the UMDES result for fish, game, and farm raised dairy and meat, indicating the importance of getting better resolution on some of those results from UM.[4] Exposure duration is also a highly sensitive variable for several pathways (*e.g.*, the hunter and the worker) and thus this variable should be considered carefully. As is always the case with HHRA exposure estimates, these estimates are only representative for individuals who engage in the particular activities evaluated; in some cases this is a very small fraction of the population.

[4] Slightly better resolution of the percentiles will help, but perhaps more important in some cases is the fraction of the respondents currently partaking in the activities.

Initial parameter estimates for the Tittabawassee River sensitivity analysis and risk assessment.

June 29, 2007

Contents

1. General considerations

1.1. Variability and uncertainty

In most (perhaps all) cases, the estimate accounts for either variability or uncertainty for this initial evaluation, choosing the one with expected largest CV if both apply. The usual approach is to describe a variability distribution by estimating the parameters of that distribution, and simultaneously estimate the uncertainties in those parameters. By choosing the distribution description sufficiently generally, this should capture the major uncertainties involved. Here, for parameters expected to have substantial variability, we generally estimate only the mean and CV of variability distributions, without attempting to estimate the uncertainties in these parameters. For parameters that are primarily not variable (they are the same for all members of the exposed population), or for which we cannot distinguish any variability, we estimate uncertainties.

Subsequent analysis (for the full PRA) will evaluate the uncertainties in the variability parameters, and all correlations (either between variability distributions, or between our estimates of those distributions), but that requires performing more detailed analysis; it usually requires estimating the full distributions for both variability and uncertainty.

For a randomly chosen individual in the exposed population, there is no difference between variability and uncertainty, provided we do not have any further information about the individual that is correlated with the parameter under examination.

In this evaluation the values and sources identified by MDEQ in their regulations and as described in the Dow work plan have been used as a starting point for developing the mean values and the coefficient of variation. Where these assumptions were not available (*e.g.*, for receptors not considered in MDEQ regulations) other guidance (*e.g.*, EPA guidance or other as identified in the following text) or site-specific data (*e.g.* UMDES data) were applied. This memorandum summarizes the basis for selection of each of the parameters.

The concentration terms applied in each calculation have been derived as a best estimate available prior to completion of the remedial investigation and feasibility study. When concentration data are available, the method of evaluation will likely change in several cases, and the relative importance of variables evaluated here may shift.

1.2. Sensitivity analysis

A sensitivity analysis may be used as part of the evaluation of which parameters should be examined in more detail. In this analysis the sensitivity s of a result R (e.g. a risk estimate) with respect to a parameter z is defined by

$$s = \frac{\partial \ln R}{\partial \ln z} = \frac{z}{R}\frac{\partial R}{\partial z}$$

so s shows the relative change in the result for a given relative change in the input z. That is, for small changes, the relative change in the result R is approximately[1] s times the relative change in input z.[2]

1.3. Evaluation of importance for further study

The importance of knowing more about a particular parameter can be estimated by evaluating the absolute or relative change in the result for a "typical" change in that parameter corresponding in size somehow to the uncertainty in that parameter. Comparing the relative importance of multiple parameters requires evaluating the size of the change in result for "typical" uncertainties in each parameter. This requires defining "typical" in some standardized way in order to avoid comparing apples and oranges. A convenient standardized way of defining a "typical" change is to relate it to the uncertainty or variability standard deviation. For our evaluation, we use the coefficient of variation (CV), since the product of CV and the sensitivity (as defined in Section 1.2) gives the approximate relative change in the result for a change of 1 standard deviation in the parameter. A relative importance for further study for each parameter z_i can thus be obtained by evaluating the products

$$CV_i \times s_i$$

[1] The "approximately" is required because this is exactly true only for infinitesimal changes in input, or for linear relationships between result and input.

[2] Technical note: the derivative is strictly a partial derivative, because we keep other parameters fixed. However, in (some) other parameters may depend on the one of interest; if this is so, those dependencies may be either included or excluded. Thus the exact partial derivative needed will depend on circumstances. The implementation has to allow for the selection of the dependent and independent parameters; the current spreadsheet does this by color coding dependent parameters.

where *i* labels the parameter. The initial evaluation seeks to determine the relative importance of knowing more about either the variability, the uncertainty, or both; so we start by evaluating the larger of these for each parameter, and compute the sensitivities.

The sensitivity is strictly defined at a particular set of the input values for the parameter. For this initial evaluation, we use the mean values for all the input parameters, and estimate the mean value of the result. The reasons for this are multiple:

- The mean value of each parameter is typically more readily estimated than any other, using a wider variety of data, and using the minimum in distributional assumptions (*e.g.* the mean values of some parameters can be estimated accurately from data that provides no further information about the distribution — for example, surveys across populations taken at one time, like food and use of time surveys, may provide accurate mean value estimates, assuming constancy of the distribution in calendar time, but no information on the distribution of individual long term averages).
- Such estimates tend to also be minimum variance estimates, so they are typically most accurately estimated.
- For the type of model used here, the mean value of the result can be computed from the mean value of the input parameters with almost no assumptions about distributions (see Section 20).

2. Residential — adult

2.1. Soil ingestion

2.1.1. Soil concentration Cs

An interim estimate for soil concentration is obtained from the UMDES data, using the soil contact concentrations observed for the floodplain (Table 1).

Table 1 Soil concentrations in ppt for the "soil contact" data set from UMDES

Zone	N	Mean	S.E.	Median	75th %ile	95th %ile	Min.	Max.
M/S FP	132	64.4	14.5	10.3	40.4	250.1	1.8	2951.8

The distribution of concentrations is assumed to be lognormal, and a lognormal variability distribution estimated from these data by estimating the two parameters, μ and σ of the underlying normal distribution (see Section 18.1).

The resulting estimates are $\mu = 2.36$ and $\sigma = 1.913$, corresponding to an estimated mean of 65.9 ppt or ng/kg, or 6.59×10^{-5} mg/kg, and a coefficient of variation of 6.15.

2.1.2. Soil ingestion rate IRs

MDEQ default for adult soil ingestion: 100 mg/day.

The best available information is given by Stanek *et al.* (1997). Their best mean estimate is 10 mg/day with SD of 94 mg/day (uncertainty estimate; in the introductory text of the paper only).

The distribution given in the text appears to be for individual days, rather than the desired long-term average, so needs substantial further analysis.

It is generally agreed that the adult soil ingestion rate is likely to be lower than that for children, at least on average. On the other hand, the extreme adult soil intake rates may be higher for adults, since they may partake in activities (aside from work activities) that entail considerable contact with soil (*e.g.* gardening). The best current estimate for children is (see Section 3.1.2) a mean of 32.8 mg/d with CV 0.86. Thus it seems likely that the mean adult intake is lower than 32.8 mg/d, and the measurement with mean 10 mg/d imposes a prior that is effectively uniform over the range 0 to 32.8, hence a mean of 16.4 with uncertainty CV 0.58. And we shall assume a variability CV equal to the child, 0.86, for this initial estimate.

2.1.3. Exposure duration for soil ingestion ED

MDEQ default: 24 y

The exposure duration used by MDEQ[3] corresponds to an upper end estimate (approximately the 95th percentile) for duration of residence at the same address, with durations weighted according to the national age distribution in the late 1980s and national moving rates appropriate to that era. More recent moving rate information is available from Current Population Survey (see http://www.census.gov/population/www/socdemo/migrate.html) and may be used in the procedure of Johnson and Capel (1992) to estimate the duration of residence for a person initially of age 1 year (as appropriate for the population analyzed here). Since moves are commonly only short distances, and may be to other areas of Midland that may also be contaminated (although possibly at a different concentration), the appropriate moving rates may not be from one residence to another, but from one residence to a residence outside of Midland. A conservative under-estimate of this may be obtained using the moving rate out of the original county of residence; and we propose the use of rates estimated for the Midwest to approximate the geographic location, rather than national data. For this interim evaluation we use average moving rates for the Midwest from 2000-2005 (both sexes combined) from the Current Population Survey (http://www.census.gov/population/www/socdemo/migrate/cps2005-5yr.html, specifically http://www.census.gov/population/socdemo/migration/cps2005-5yr/tab01-3.xls, and probabilities for deaths by single year for 2003 from the United States life table (http://www.cdc.gov/nchs/data/nvsr/nvsr54/nvsr54_14.pdf) to estimate the probability to remain within Midland as a function of age (Figure 1 and Table 2). Table 2 is obtained using a replication of the methodology of Johnson and Capel (1992), with a minor modification for more realism (the calculation is done in units of 1 year; instead of adding 1 year to the difference between integer final and starting ages, as in Johnson and Capel, 1992, the starting age is decremented and final age is incremented by a uniform random [0,1] value in order to interpolate between single years, and the difference between these adjusted values is used). For completeness, it is assumed that no children under age 1 move from Midland.

[3] The Exposure Factors Handbook, cited as the source by MDEQ, relies on analyses by Israeli and Nelson (1992) and Johnson and Capel (1992), both of which obtain practically identical results using slightly different methodologies and data sources. The underlying assumptions are very similar.

Table 2 Calculated values at 1 year intervals for the probability to not remain in Midland county.

Duration	Probability	Duration	Probability	Duration	Probability	Duration	Probability
0	0						
1	0.075813	26	0.857152	51	0.966603	76	0.988049
2	0.145763	27	0.872086	52	0.967462	77	0.988761
3	0.210362	28	0.885456	53	0.968305	78	0.989469
4	0.258714	29	0.895371	54	0.96952	79	0.990172
5	0.304084	30	0.90443	55	0.970698	80	0.990884
6	0.346666	31	0.912707	56	0.971855	81	0.99159
7	0.386638	32	0.920272	57	0.972963	82	0.992285
8	0.424162	33	0.927185	58	0.97406	83	0.992999
9	0.445228	34	0.931277	59	0.974909	84	0.993634
10	0.46554	35	0.935147	60	0.975756	85	0.994258
11	0.485099	36	0.938806	61	0.976941	86	0.994867
12	0.503956	37	0.942265	62	0.978101	87	0.995455
13	0.52214	38	0.945534	63	0.979218	88	0.996019
14	0.541443	39	0.947878	64	0.979964	89	0.996552
15	0.560004	40	0.95013	65	0.980702	90	0.997051
16	0.577895	41	0.952295	66	0.981437	91	0.997511
17	0.608167	42	0.954374	67	0.982172	92	0.997931
18	0.636342	43	0.956368	68	0.982904	93	0.998307
19	0.677658	44	0.957985	69	0.98349	94	0.998638
20	0.71429	45	0.959549	70	0.984091	95	0.998925
21	0.746761	46	0.961069	71	0.984694	96	0.999168
22	0.775546	47	0.96254	72	0.985315	97	0.99937
23	0.801053	48	0.963964	73	0.985944	98	0.999534
24	0.821853	49	0.964855	74	0.986637	99	0.999664
25	0.840472	50	0.965735	75	0.98734	100	1

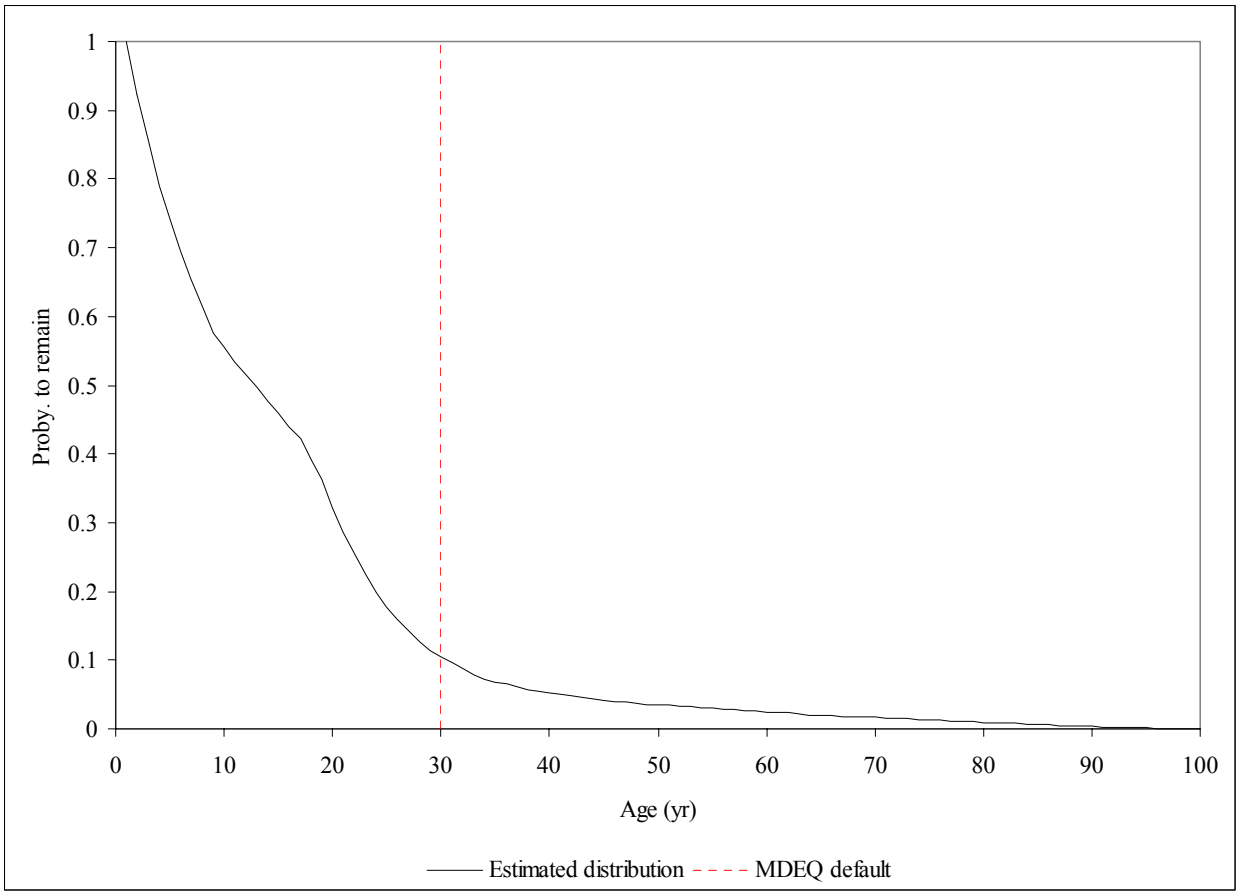

Figure 1 Estimated probability to remain in Midland as a function of age for those initially 1 year old (Note: the 30 year default corresponds to 6 years as a child and 24 years as an adult).

For adults (all over age 6), the distribution of probabilities to remain residing in Midland County is obtained from these by normalizing to the probability to remain at age 6 (this is a duration of 5 y in Table 2). Using a trapezoidal rule estimate, the mean residence time as an adult is 15.5 y, with a (variability) SD of 14.6 y, for a CV of 0.94.

2.1.4. Exposure frequency for soil ingestion EFs

Standard default value for EPA and MDEQ is 350 d/y.

This is primarily to take account of periods of non-residence (*e.g.* holidays), since soil ingestion is supposed to encompass dust ingestion indoors also. There do not appear to be any surveys that measure this particular period. For this interim evaluation, use the nominal value with a CV of 7/350 = 0.02 (SD guessed as 7 d).

2.1.5. Relative absorption efficiency from soil AEi

A site-specific absorption efficiency is available from the pilot bioavailability study (Exponent, 2005). The swine data are used since swine are considered better surrogates for humans. Tables 15a, 15b, and 16 of that study show the TEQ-weighted bioavailability relative to corn oil of Midland soil to be 23% with a CV of approximately 0.23 (using ND = 1/2 DL).

The analysis using ND = DL gives an estimated relative bioavailability of 29%, a factor 1.26 higher. It is highly unlikely that all the non-detects would be at their respective detection limits, but treating the value obtained using ND = DL as having as much as a 1 in 20 chance introduces an uncertainty that can be represented by an additional CV of 0.14. Adding this to the estimated 0.23 gives 0.27 CV (they add in quadrature). So the bioavailability is treated as 23% with an uncertainty of 0.27.

2.1.6. Body weight BW

EPA and MDEQ standard default value 70 kg.

For this interim approach, we use the estimates provided by Portier *et al*. (2007) corresponding to NHANES III data (Table II of Portier *et al.*, 2007). The required body weight is an average over ages approximately 6 to 70 (actually, it should be convolved with the probability for remaining in Midland, but we will omit that for this interim approach), and the variability of that average. These averages are strictly not available, since they require longitudinal data on the same individuals. We approximate by assuming that everybody stays on the same percentile of the population distribution at all ages; then the average of the mean weights will be the same as the mean of the average weights, and we can estimate the CV by averaging CVs at individual ages over the same age range (the CVs do not vary substantially with age). For men and women combined, this gives a mean of 70.5 kg, with CV 0.227.

2.1.7. Averaging time AT

This is a nominal time selected to correspond with the toxicity criterion used. This initial evaluation is for cancer, for which an appropriate averaging period is 70 y = 25550 d.

2.2. Soil dermal contact

2.2.1. Soil concentration Cs

This is necessarily equal to the soil concentration for soil ingestion, see Section 2.1.1.

2.2.2. Soil contact surface area SAd

EPA and MDEQ default value 5800 cm^2.

The soil contact area is obtained by assumptions on what part of the body may be exposed. Variability in the fraction of the body that is exposed is taken into account by the evaluation of the adherence factor — in fact, the whole body is exposed to some extent, but the average amount adhering varies between body parts and between people. Variability in absolute surface area for any body part corresponds to variability in weight, and is highly correlated with it. Since body area is approximately proportional to the 2/3 power of body weight, the CV for surface area is approximately 2/3 the CV for body weight, or about 0.15. This is approximately the same for all age ranges.

Currently leave the soil contact area at its nominal value.

2.2.3. Exposure frequency for soil contact EFd

MDEQ default value 245 d.

The justification for this value is (MDEQ, 2005):
"The exposure frequency for dermal contact, dermal exposure frequency (EFd) is 245 days per year for the residential scenario and represents outdoor soil exposure. The residential EFd takes into account the U.S. EPA's recommendation to consider local weather conditions (*e.g.*, snow cover, frozen soil). It is assumed that Michigan winters last 4 months (120 days) making soil unavailable for contact."

The implicit assumption (plausible only for the highest-end exposures) is that anybody who can possibly come into contact with soil will come into contact with it. The MDEQ explicitly cites the 1992 EPA memo (EPA, 1992a), but that has been superseded by EPA (1995). Actually, MDEQ (2005) erroneously references the direct contact algorithms to that 1992 memo.

EFH makes reference to the dermal exposure document (EPA, 1992b), which essentially relies on Hawley (1985), who evaluate only hypothetical exposures.

NHAPS (Tsang and Klepeis, 1996) shows that in the Midwest region, 639/2102 respondents were in a residential outdoor situation for 1 minute or more on the random day sampled (Table DLNr-20 for the former number, Table 14 for the latter). Thus the expected average number of d/y potentially leading to residential soil contact is about 111, which is not too far off 1/2 the 245 d/yr MDEQ value. So approximate the variability distribution as uniform for this initial evaluation (will probably overestimate CV), with a minimum of 0 and maximum of 245 d/y (and everyone assumed to be potentially exposed). [Note: the NHAPS statistic includes children; we can do a better job by using the raw data.] That gives a mean of 122.5 d/y and a standard deviation of 70.7 d/y, or a CV of 0.577.

2.2.4. Adherence factor for soil contact AFd

EPA and MDEQ default value is 0.07 mg/cm^2.

The nominal value is given in MDEQ (2001, 2005), and is essentially that of EPA, ultimately traceable to EPA (2004a) [MDEQ, 2001, refers to discussions with EPA while EPA was writing EPA, 2004a, and indicating that no changes were expected]. The value used is the "50th percentile" for gardeners (Exhibit C-2 of EPA, 2004a). The calculations cannot evaluate long-term average values; what is obtained are variability distributions for single events/days. However, the "50th percentile" and "95th percentile" values obtained for landscapers, gardeners, and irrigation installers are not much different, although somewhat higher than for groundskeepers.

For this evaluation, the "50th percentile" and "95th percentile" values given by EPA are applied and it is assumed that they are estimates of long-term averages. Average Landscaper/rockery, Gardeners, Irrigation installers to obtain an intimate soil contact category, then mix with Groundskeepers (70% vs 30% for the intimate soil contact value) to obtain estimated nominal

50th and 95th percentiles of a variability distribution. The result has mean 0.04 mg/cm^2 and CV 1.17.[4]

2.2.5. Exposure duration ED

This is necessarily identical to the exposure duration for soil ingestion, See Section 2.1.3.

2.2.6. Absorption fraction AEd

Nominal value 1.75%.

The nominal value is near the mid-point of the range described in EPA (1992b) for TCDD. That used data from three studies: Poiger and Schlatter (1980), Shu *et al*. (1988), and EPA (1991a). Repeating roughly EPA's analysis (not taking account of experimental uncertainties, and not correcting for organic carbon), gives an estimate with a mean of 1.2% with CV 1.56. This is entirely an uncertainty. It might be possible to correlate with organic carbon (using a model?). We also have to investigate different congeners.

2.2.7. Body weight

Necessarily equal to body weight for soil ingestion, see Section 2.1.6

2.2.8. Averaging time

Nominal value, see Section 2.1.7

3. Residential — child

3.1. Soil ingestion

3.1.1. Soil concentration Cs

This is necessarily identical to the residential soil concentration for adults, see Section 2.1.1.

3.1.2. Soil ingestion rate IRs

EPA and MDEQ default value 200 mg/d.

For this initial evaluation, we use the distribution of child soil ingestion rate published by Stanek *et al*. 2001 and shown in Figure 2, where the ingestion rate is plotted on the X axis (with a logarithmic scale), and the probability in the form of a z-score (the inverse normal of the probability) on the Y axis.[5] This has been fitted[6] by a distribution curve consisting of a mixture

[4] This is heuristic and will be revisited. It may be possible to get average relative fractions for the activities from NHAPS, and we can obviously combine the Kissel observations (http://depts.washington.edu/jkspage/) the same way as did EPA, or do better

[5] These scales have been chosen to provide a graphical display that adequately shows the distribution without unreasonably squashing of any parts of it.

[6] The fitting procedure was approximate, to accurately fit the upper part of the curve and give reasonable values for the bottom end. The SD given by Stanek *et al*. for each percentile with positive value was treated as giving an independent estimate for the CV at that percentile, and maximum likelihood estimation then used. All negative values were treated as positive, but unknown, by ignoring them except insofar as they affect the percentiles. This approach can be improved by a known statistical procedure (but I have to code the required integrals, and it will clearly make very little difference).

of two lognormal distributions, that incorporates no upper bound on ingestion rate (Figure 2). The fitted cumulative probability distribution is given by

$$\mathrm{P}(d) = \alpha\Phi\left(\frac{\ln(d/m_1)}{s_1}\right) + (1-\alpha)\Phi\left(\frac{\ln(d/m_2)}{s_2}\right) \quad (1)$$

where

$$\begin{aligned} \alpha &= 0.8606 \\ m_1 &= 28.599 \quad \text{mg/d} \\ s_1 &= 0.7462 \\ m_2 &= 1.438 \quad \text{mg/d} \\ s_2 &= 0.6937 \end{aligned}$$

where $\Phi(\bullet)$ is the standard cumulative normal distribution.

The median estimate for the fitted distribution is 24.5 mg/day, the mean is 32.8 mg/day, and the 95th percentile is 92.2 mg/day. The SD of this distribution is 28.1 mg/day, so the CV is 0.86, treated as a variability distribution. While the measurements are not long-term averages, they are here treated as such.

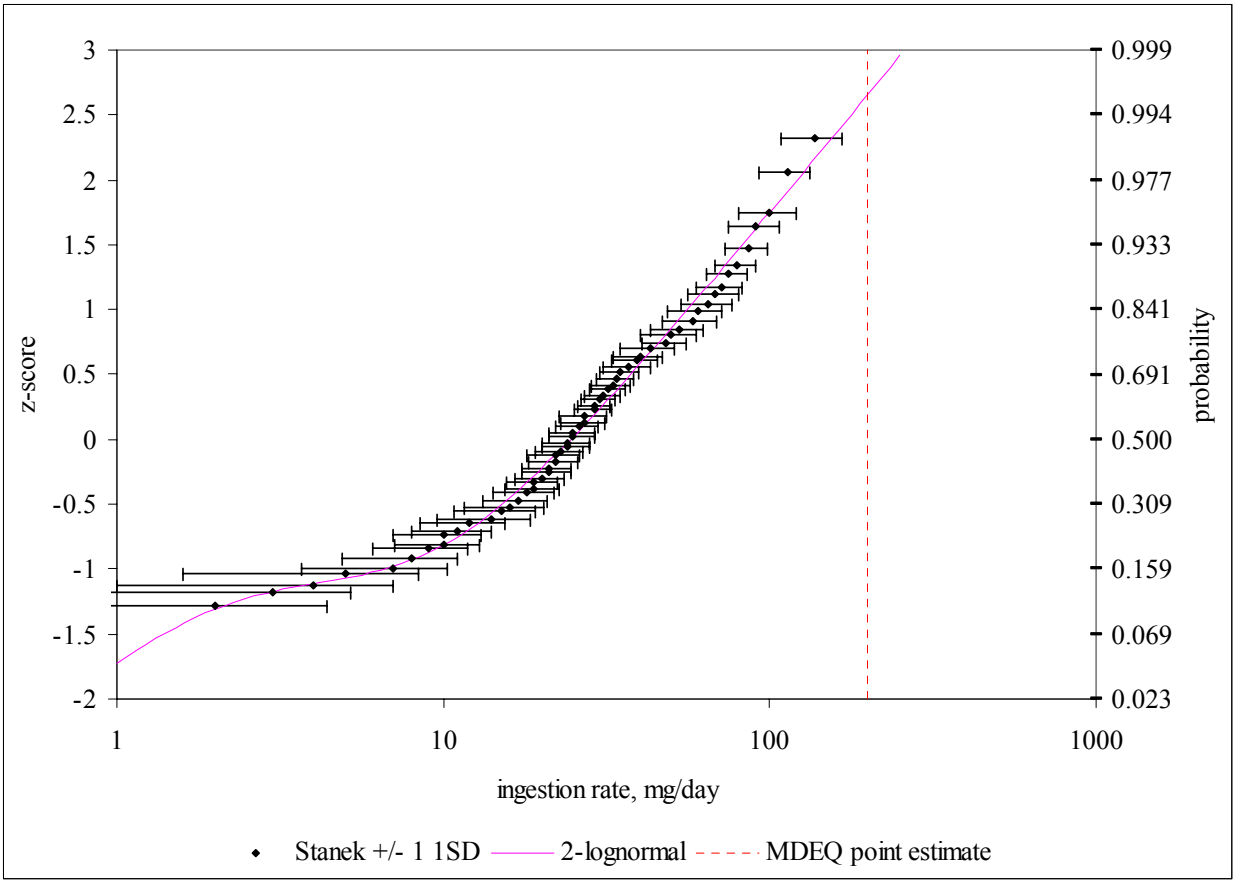

Figure 2 Child soil ingestion rate estimates (Stanek et al., 2001) and fitted distribution.

3.1.3. Exposure duration ED

MEDQ and EPA default value 6 y.

See the discussion in Section 2.1.3. Application of the same methodology for children ages 0 through 6 inclusive gives a mean residence time of approximately 5.2 y with SD of 1.3 y (a CV of 0.25). Of course, there is a high correlation between this distribution and the adult one, if we were to track individuals; but that is ignored here for the initial calculation.

3.1.4. Exposure frequency for soil ingestion EFs

For this initial evaluation, use the same value as for adult soil ingestion, Section 2.1.4 (350 d/y, with CV of 0.02).

3.1.5. Relative absorption efficiency from soil AEi

This is assumed to be identical for adults and children; see Section 2.1.5. It is quite plausibly different on average, but the differences are likely within the uncertainties.

3.1.6. Body weight BW

MDEQ and EPA default value 15 kg.

See the discussion in Section 2.1.6. Using the same approach and data gives a mean of 14.4 kg, with CV of 0.16.

3.1.7. Averaging time AT

See Section 2.1.7.

3.2. Soil dermal contact

3.2.1. Soil concentration Cs

This is necessarily equal to the soil concentration for ingestion, see Section 3.1.1.

3.2.2. Soil contact surface area SAd

Nominal value 2670 cm^2.
For the risk assessment additional evaluation may be conducted to account for pre-activity loading, and for agreement between body parts used to estimate surface areas or loading and what Kissel *et al.* measured [or suitable extrapolation].

These calculations follow the same approach as discussed in Section 2.2.2. This gives a nominal mean of 2670 cm^2, with CV of $(2/3) \times 0.16 = 0.11$.

3.2.3. Exposure frequency for soil contact EFd

MDEQ default value 245 d.

The nominal value is an estimated maximum based on weather conditions permitting soil contact. See the discussion of Section 2.2.3. Again, the nominal value corresponds to a high end situation. NHAPS shows (Tsang and Klepeis, 1996, Table 9 and Table DLNr-20) that 201/499 children aged 1–4, and 353/703 children aged 5–11, were outside at their residence more than 1 minute on random days in the year [this covers all regions; a better estimate might be obtained through use of the raw data by selecting just the Midwest]. The mean of the variability distribution for frequency of (residential) soil contact for children 0–6 is thus around 147 d/y to 183 d/y, and the maximum will be close to the nominal value of 245 d/y. Since all children are likely to be outside at home for multiple days/y, we can approximate this for this initial evaluation by using a mean of 165 d/yr, max 245 d/yr, and extrapolate linearly to a minimum of about 85 d/yr (*i.e.* assume a uniform distribution). That gives a mean of 165 d/yr with sd of $160/\sqrt{12} = 46$ d/yr, or a CV of 0.28.

3.2.4. Adherence factor for soil contact AFd

EPA and MDEQ default value 0.2 mg/cm^2.
For the risk assessment additional evaluation may be conducted to account for pre-activity loading, and for agreement between body parts used to estimate surface areas or loading and what Kissel *et al.* measured [or suitable extrapolation].

The nominal value is given in MDEQ (2001, 2005), and is essentially that of EPA, ultimately traceable to EPA (2004a) [MDEQ, 2001, refers to discussions with EPA while EPA was writing EPA (2004a), and indicating that no changes were expected]. EPA (2004a) states that the 0.2

mg/cm^2 was based on the "95th percentile" weighted factor for children at a day-care center, or the "50th percentile" factor for children playing in wet soil.

Examining the raw data (all from Kissel *et al.* work, http://depts.washington.edu/jkspage/) there are data on 42 children who were either playing in the greenhouse (wet or dry soil) or were in the daycare groups and were under age 7. The ages of those playing in the greenhouse are not given on Kissel's web site (http://depts.washington.edu/jkspage/) and the paper has been requested but not yet reviewed. EPA selected those in daycare and those in wet soil at the greenhouse, and did various calculations that are somewhat awry.

Looking at the 42 children, the distributions of ln(loading) on any body part (hands, arms, legs, faces, and feet) are pretty well lognormal, and the logarithms are reasonably correlated (correlation coefficients up to around 0.5). Either face or feet measurements are missing in every case.

Approach for initial evaluation (using the 42 measured children):
(a) Fit linear models in the logarithm of loading rates to predict the missing measurement (face or feet) from hands, arms, and legs (correlation coefficient achieved is about 0.77);
(b) Use predicted missing value and estimate weighted loading, using as weights the fractions of total body surface areas given in EPA (2004a) for hands, arms, legs, faces, and feet;
(c) Assume each measurement corresponds to a long-term average (this probably results in an overestimate of variability).

The resultant distribution is consistent with lognormal, with (arithmetic) mean 0.14 mg/cm^2 and CV 1.9. Treat this as a variability distribution.

3.2.5. Exposure duration ED

Identical to that for child soil ingestion, see Section 3.1.3.

3.2.6. Absorption fraction AEd

Set equal to the absorption fraction for adults, see Section 2.2.6. It is possible that children absorb a different fraction of contaminants in soil on their skin, but currently any difference has to be considered part of the uncertainty in this quantity.

3.2.7. Body weight BW

Identical to that for child soil ingestion, see Section 3.1.6

3.2.8. Averaging time AT

Nominal value, see Section 2.1.7.

4. Worker (adult)

4.1. Soil ingestion

4.1.1. Soil concentration Cs

Needs the distribution of soil concentrations in areas plausibly used by workers (presumably those zoned commercial/industrial/farm). This also should have the full range of values observed for local concentrations, since a worker may stay within one locality (*i.e.* use each measurement as an exposure point concentration; not the area average).

For this analysis, approximate the soil concentration using the range of values seen in the Ecological Risk Assessment Support Sampling (CH2MHill, 2004).[7] The distribution of values has a mean of 1800 ng/kg = 1.8×10^{-3} mg/kg with CV 0.69.

4.1.2. Soil ingestion rate IRs

MDEQ default value 100 mg/d.

In the absence of any better information, use the value for adult soil ingestion rate, see Section 2.1.2. It is not clear whether this should be considered distinct from the generic "adult soil ingestion."

4.1.3. Exposure duration ED

MDEQ default value 21 y.

The nominal value for "industrial/commercial ED is 21 years (estimated to be 90th percentile) and is based on 1991 statistics from the United States Department of Labor" (MDEQ, 2005; citing EPA, 1991b). However, the reference cited by MDEQ as the basis for this value (that is, EPA, 1991b) does not cite 21 y as the 90th percentile, but instead cites 25 y as the 95th percentile. Moreover, EPA (1991b) cites "Bureau of Labor Statistics. 1990. Statistical summary: tenure with current employer as of January 1987. (Transmitted via facsimile, 7 September 1990)." Moreover, these statistics are for the distribution of current employment tenure among those currently employed, not total employment tenure for a person entering employment. The survey used could only obtain the employment tenure up to the time of survey, so is biased as an estimate of total employment tenure (in fact, it is biased high — long employment tenures are over-sampled). Lastly, the statistics are now at least 16 years out of date. To correct these problems, we perform the analysis anew.

The Current Population Survey (http://www.census.gov/cps/) provides access to microdata including supplemental surveys on employment tenure. The January 2000 supplemental survey included 53,317 observations of employment tenure, and provided sampling weights for each observation. Taking those observations at face value (no adjustments for sex, geography, *etc*. other than the weighting given by the U.S. Census Bureau), the distribution of current

[7] There is a 2006 update that has a few more soil samples; not used here. Including them gives a slightly lower mean and higher CV (not significantly different).

employment tenure[8] is shown in Figure 3 and on an alternate scale in Figure 4. In these figures, $S(t)$ is the probability to report a current employment tenure longer than t, and it is approximated here by[9]

$$S(t) = \alpha \exp(-t/t_1) + \beta \exp\left(-(t/t_2)^{\gamma}\right) + (1-\alpha-\beta)\exp(-t/t_3)$$

The approach described in Section 19.1 may then be used to estimate mean and standard deviation of total employment tenure.

Fitting[10] this functional form for S gives roughly

$\alpha = 0.512537$
$\beta = 0.469507$
$\gamma = 1.427$
$t_1 = 22.48$ months
$t_2 = 165.0$ months
$t_3 = 0.1$ months

[8] Employment tenure is the length of time with the current employer; strictly, we need the length of time in the current location, but the former should be a very good surrogate for the latter.

[9] This functional form does not necessarily satisfy the constraints of Section 19.1.2 for all values of the parameters; however, at the parameter values selected, it satisfies the required constraints.

[10] Pseudo-likelihood method; the estimated survey weights for the observed employment tenures were accumulated into one month periods of employment tenure up to 396 months, then by longer periods, and an "effective number" in each period obtained by applying those weights to the total number of observations. These effective numbers were then treated as though they formed a multinomial sample, with probabilities predicted by the model for $S(t)$. The value of t_3 was essentially arbitrarily selected. This is because the fitting is done entirely using cumulative 1 month data, not the data with shorter reported times. Unfortunately, the survey methodology is not reliable for the shorter times, because many people did not report to better than 1 year or 1 month accuracy, and clearly, from the months versus years values obtained in the survey, many people reported inconsistently at short times (the number of months of employment they reported do not agree with the number of years they reported).

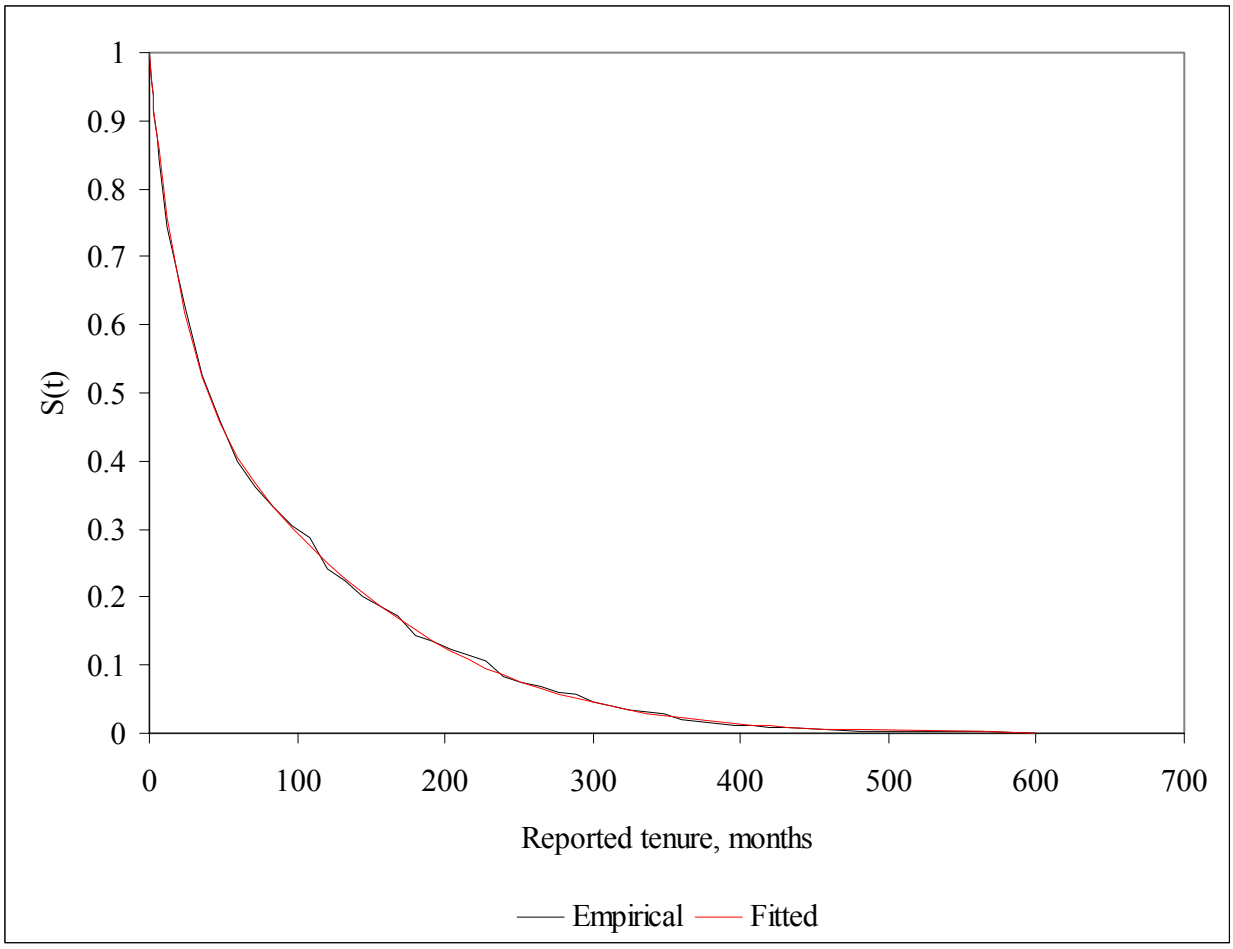

Figure 3 Empirical and fitted distribution of current employment tenure (U.S. 2000 data)

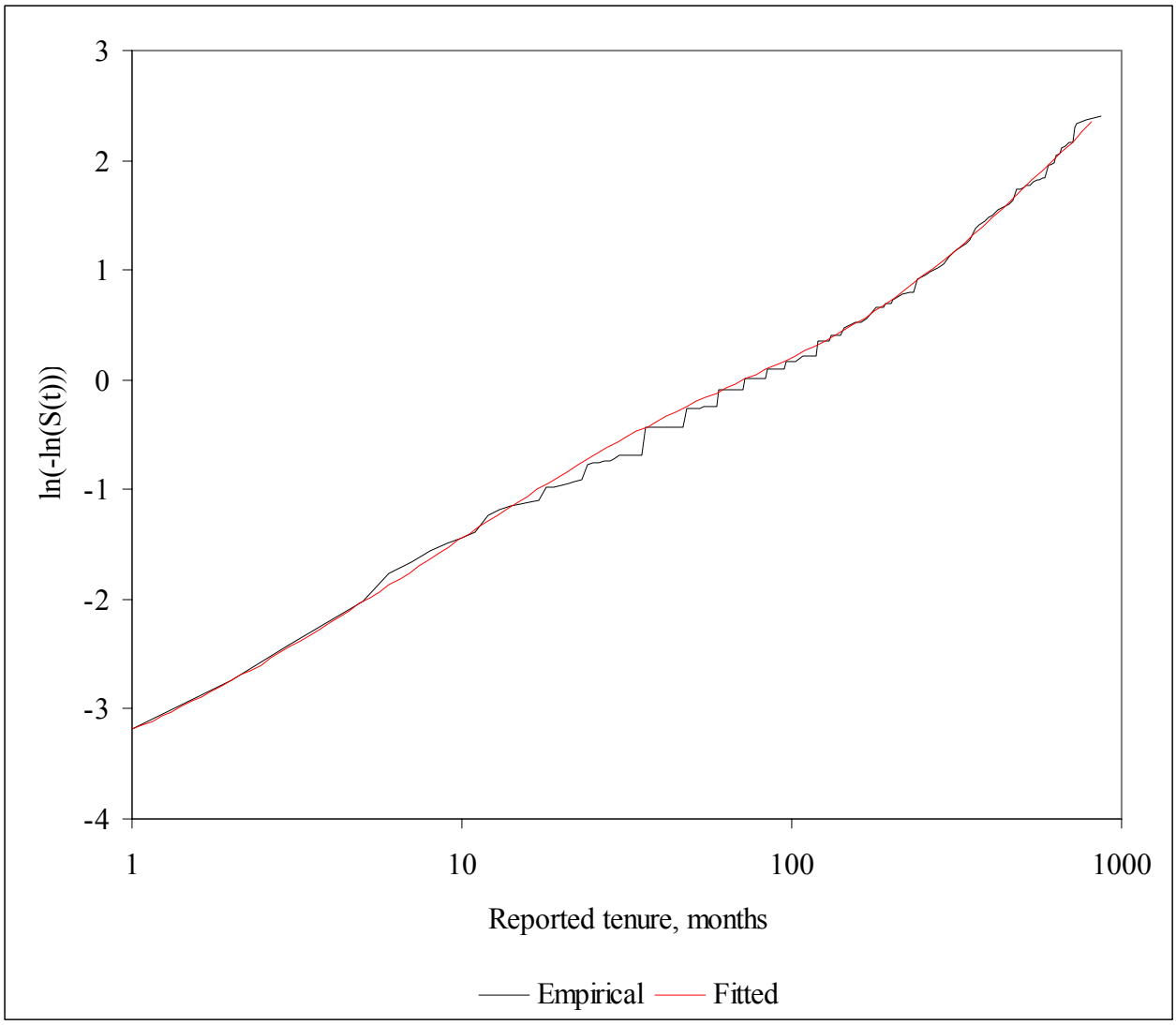

Figure 4 Empirical and fitted distribution of current employment tenure (alternate scale) (U.S. 2000 data).

The short-time component, with $t_3 = 0.1$ months, is evaluated only very roughly using these data, since I accumulated all times to the next higher month in the fitting. However, the estimate $p(0)$ depends very strongly on t_3. This problem can be overcome by evaluating the distribution of total job tenure for all tenures lasting more than 1 month. That is what I do here. I simply shift the origin of time by one month,[11] and add one month to the resulting estimates, to obtain the distribution of total employment tenures conditional on the employment lasting at least 1 month.

Specifically, make the substitution

[11] The estimates are fairly stable with respect to the length of offset used; theoretically, of course, they are unlikely to be completely independent of the offset because of the conditional nature of the estimates so obtained (hypothesis, not yet checked: they would be independent only for a pure exponential function).

$$S(t) \longleftarrow \frac{S(t+t_0)}{S(t_0)}$$

for an offset time t_0, and carry out the analysis of Section 19.1 on the newly defined $S(t)$, subsequently adding t_0 to the calculated mean (there is no adjustment to the variance).

This gives a mean job tenure of 44.1 months (3.67 y) with a standard deviation of 74 months (6.1 y), or a CV of 1.67. For this distribution, the median is 1.7 y, 90th percentile 8.7 y, 95th percentile 17.4 y.

4.1.4. Exposure frequency for soil ingestion EFs

MDEQ default value 245 d/y

MDEQ (2005) states (without citation) that U.S. EPA recommends an EF of 250 days/y for industrial/commercial scenarios, and subtracts an additional 5 days for sick leave and vacation time. RAGS 1A does not give any specific number (other than 365 days/y). The "Standard Default Exposure Factors" Supplemental Guidance to RAGS 1A (EPA, 1991b, Section 3.0) gives 250 days/y (50 weeks at 5 days/wk). RAGS 1E gives (Exhibit 3-5) 250 d/y for RME, and 219 d/y for Central Tendency, citing to RAGS 1A for the RME (see Section 3.2; neither value is actually given in RAGS 1A and the source of 219 d/yr is not specified).

The American Time Use Survey (2005; see http://www.bls.gov/news.release/atus.t04.htm) shows that for all employed persons, 67.8% worked on an average day, so the average days/y worked is approx. 247.5. This will be primarily a variability distribution. We can guess that some persons work most days, perhaps 350 d/y (*e.g.* farmers), and some much less, perhaps 150 d/y, even in the long term. So we can estimate the variability as around $200/\sqrt{12} = 58$ or less, giving a CV of about 0.23 or less.

4.1.5. Relative absorption efficiency from soil AEi

This is set equal to that for soil ingestion in adult residents, see Section 2.1.5.

4.1.6. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. This should probably be considered independent of the resident adult body weight, and might be more appropriately defined for a distinct age range.

4.1.7. Averaging time AT

Nominal value, see Section 2.1.7

4.2. Soil dermal contact

4.2.1. Soil concentration Cs

Necessarily equal to the soil concentration for soil ingestion, see Section 4.1.1.

4.2.2. Soil contact surface area SAd

MDEQ default value 3300 cm^2.

For the risk assessment additional evaluation may be conducted to account for pre-activity loading, and for agreement between body parts used to estimate surface areas or loading and what Kissel *et al.* measured [or suitable extrapolation].

See the discussion at Section 2.2.2. The measurements of dermal adherence correspond to a different surface area (face, forearms, and hands), see Section 4.2.4, corresponding to an area of 2479 cm^2, with a CV of 0.15 (see Section 2.2.2 discussion).

4.2.3. Exposure frequency for soil contact EFd

MDEQ default value 160 d/y.

The MDEQ derives the nominal value as based on 365 d/y minus 120 d/y of winter, minus another 21 d/y for vacations and sick leave, and 5 d/wk (365-120-21)×5/7.

NHAPS (Tsang and Klepeis, 1996) shows that in the Midwest region, 309/2102 respondents were in an "other outdoor" situation for 1 minute or more on the random day sampled (Table DLNr-50 for the former number, Table 14 for the latter). Thus the expected average number of d/y potentially leading to "other outdoor" soil contact is about 54, about 1/3 the potential maximum of about 160 d/y estimated by MDEQ. Approximate the variability distribution as triangular for this initial evaluation (will probably overestimate CV), with a minimum of 0 d/y, maximum of 160 d/y, and mean of 54 d/y. [Notes. The NHAPS statistic includes children. The coding for this "other outdoor" is fairly inclusive, and includes locations that do not correspond to on-the-job exposures, so this is probably an overestimate. Again, we can do a better job by using the raw data.] That gives a mode of 2 d/y, mean of 54 d/y and a standard deviation of 38 d/y, or a CV of 0.70.

4.2.4. Adherence factor for soil contact AFd

MDEQ and EPA default value 0.2 mg/cm^2.
(For the risk assessment additional evaluation may be conducted to account for pre-activity loading, and for agreement between body parts used to estimate surface areas or loading and what Kissel *et al.* measured [or suitable extrapolation].)

MDEQ (2005) has separate estimates for Commercial III, Commercial IV, and Industrial categories, and cites MDEQ (2001) which has a discussion referencing the 1999 version of EPA (2004a), but separating commercial and industrial uses and recommending different values for each. All are based on the measurements of Kissel *et al.* (http://depts.washington.edu/jkspage/). The highest estimates are for the Industrial category, and are based on Kissel *et al*.'s measurements on construction workers, equipment operators, and utility workers. For this initial evaluation, use this group. MDEQ assumes exposure to head, hands, and forearms, so we use those with weighting equal to the areas of these body parts as given in EPA (2004a), except using "faces" in place of "heads". These sum to a total area of 2479 cm2, so use that in place of the nominal value (see note above: we should do the extrapolation using a suitable body part and extrapolating to that area before averaging over body parts). Applying the weights to all the individual measurements gives a distribution of weighted averages that is consistent with

lognormal with mean 0.24 mg/cm^2 and SD 0.15 mg/cm^2, for a CV of 0.64. Assume that this distribution corresponds to a variability distribution for long-term average.

4.2.5. Exposure duration ED

Necessarily equal to the exposure duration for soil ingestion, see Section 4.1.3.

4.2.6. Absorption efficiency from dermal contact, AEd

Assumed to be the same as for soil contact in adults, see Section 2.2.6.

4.2.7. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. This should probably be considered independent of the resident adult body weight, and might be more appropriately defined for a distinct age range.

4.2.8. Averaging time AT

Nominal value, see Section 2.1.7.

5. Hunter — adult

5.1. Soil ingestion (hunter, adult)

5.1.1. Soil concentration Cs

The soil concentrations seen by hunters will vary with the location that they do their hunting. Since this is likely to be different on every hunting occasion, an appropriate estimate of exposure point concentration is an area average over the areas hunted. The Ecological Risk Assessment Support Sampling (CH2MHill, 2004) measured the soil concentration at four locations used for ecological sampling,[12] and found mean soil concentrations ranging from 945 to 3183 ng/kg. The distribution of the mean soil concentration had mean 1800 ng/kg = 1.8×10^{-3} mg/kg, and a CV of 0.56. These estimate are used here to represent mean and potential variability in the area averages experienced by hunters until better data become available.

5.1.2. Soil ingestion rate IRs

EPA and MDEQ default value for residents of 100 mg/d.

We have no specific information on soil ingestion rates for hunters. By default, use the adult resident soil ingestion rate, Section 2.1.2. This might lead to double-counting of ingestion rates, but the concentration terms will likely be different.

5.1.3. Exposure duration for soil ingestion, EDs

The UMDES study questionnaire, Question E8, gives a distribution of years hunted around the TR floodplain. The question was asked of all participants, and the responses provided so far do not distinguish current hunters from ex-hunters. The exposure duration for soil ingestion is taken to be identical with the exposure duration for hunting, since soil ingestion events associated with hunting occur only during hunting. The responses to Question E8 for the TR floodplain form a

[12] There is a 2006 update that has a few more soil samples; not used here.

distribution that can be reasonably fitted by a lognormal (using the method of Section 18.1 and treating the responses as continuous), with mean 12.9 y and CV 1.8. However, a lognormal with such a large CV is unreasonable for this variable (since it implies a relatively large fraction of the population hunting more years than their lifetime). Treating the observed distribution as being discrete (the unit being 1 year) and fitting a double exponential function with a maximum period of 85 years (see Section 19.2.1 for the theory, Section 19.2.2 for the practice, and Section 18.3 for the method of fitting), leads to an estimate of mean exposure time of 12.2 y with CV 1.45 (if the observed distribution corresponds to completed lifetime exposure), or a mean of 7.2 y with CV 1.5 (if the observed distribution corresponds to current exposures only). For most pathways, this distribution is unimportant by itself (it is the product of ED and EF that matters, and that is estimated separately, see Section 5.1.4). However, a principal exposure pathway (eating of wild game) does not use the product of exposure duration and exposure frequency. For now, use the estimate of 12.2 y with CV of 1.45 (as though the observations correspond to completed lifetime exposure).

5.1.4. Exposure frequency for soil ingestion EFs

The exposure frequency for soil ingestion is taken to be identical to the frequency for hunting events, since the other parameters are normalized (where necessary) to this hunting event frequency. The UMDES study questionnaire, Question E8, gives a distribution of total (lifetime) days of hunting around the TR floodplain, but does not distinguish those respondents who are current hunters from those who are not. Fitting a lognormal (using the methodology of 18.1) gives a mean of 127 d and CV of 4.1 for lifetime total days hunting. This assumes that the observed distribution corresponds to total lifetime exposure (*i.e.* that none of the respondents still hunt, and none of them will hunt again). However, such a distribution is highly unlikely, since it corresponds to a small fraction of hunters who hunt for extreme periods. Most of the CV is contributed by estimated total time hunting larger than 3000 days (8.2 years), for example (which would require more than a month per year hunting for a lifetime). Using instead a more plausible distribution, a double-exponential with a maximum of 3000 days (see Section 19.2.1 for the theory, Section 19.2.2 for the practice, and Section 18.3 for the method of fitting) for the survival function leads to an estimated mean of 127 d, with CV 3.03, if the observed distribution is interpreted as total lifetime exposure, or 45 d with CV 2.2 if the observations is interpreted as current hunting duration.

For this initial estimate, and consistent with the discussion of exposure duration (Section 5.1.3), we use the former estimate (as though the observations correspond to completed lifetime exposure).

Dividing by the exposure duration distribution then gives a mean of 10.4 d/y, with CV of 1.5. This ensures a reasonably consistent set of estimates, and allows the exposure duration to be as variable as estimated (and only the exposure duration is used in at least one pathway, whereas wherever exposure frequency is used, it is always used in conjunction with the exposure duration).

5.1.5. Relative absorption efficiency from soil AEi

This is set equal to that for soil ingestion in adult residents, see Section 2.1.5.

5.1.6. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. This should probably be considered independent of the resident adult body weight, and might be more appropriately defined for a distinct age range.

5.1.7. Averaging time AT

Nominal value, see Section 2.1.7

5.2. Soil dermal contact (hunter, adult)

5.2.1. Soil concentration Cs

This is necessarily equal to the soil concentration for soil ingestion, see Section 5.1.1.

5.2.2. Soil contact surface area SAd

MDEQ default value for workers of 3300 cm^2.

The nominal value has been chosen as for the worker. Hunters do not generally perform operations with soil, so the closest surrogates in the Kissel *et al*. dataset are probably groundskeepers. EPA (2004a) combined measurements on face, forearms, hands, and lower legs for this dataset, but exposure on the legs was extremely limited (the groundskeepers wore long pants); so for this initial assessment we evaluate faces, forearms, and hands, using the surface areas given in EPA (2004a) (average males and females). This gives a surface area of 2479 cm^2 (see Sections 4.2.2 and 4.2.4; but since we are evaluating different sets of data, the surface areas are not considered equivalent in our analysis), and as discussed in Section 2.2.2 we estimate a CV of 0.15.

5.2.3. Exposure frequency for soil contact EFd

The exposure frequency for soil contact is taken to be identical to the exposure frequency for hunting events since all other parameters are normalized (where necessary) to those hunting event occurrences. See Section 5.1.4.

5.2.4. Adherence factor for soil dermal contact AFd

MDEQ and EPA default value for residents of 0.07 mg/cm^2.

The groundskeeper data of Kissel *et al.* (as summarized in EPA, 2004a) evaluated as discussed in Section 5.2.2 for this initial evaluation give weighted estimates for adherence factors that are consistent with a lognormal distribution. The estimated mean and SD are 0.033 mg/cm^2 and 0.03 mg/cm^2 respectively, for a CV of 0.95.

5.2.5. Exposure duration for soil dermal contact, ED

The exposure duration for soil dermal contact is necessarily the same as that for soil ingestion, see Section 5.1.3.

5.2.6. Absorption efficiency from dermal contact, AEd

Assumed to be the same as for soil contact in adults, see Section 2.2.6.

5.2.7. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

5.2.8. Averaging time AT

Nominal value, see Section 2.1.7.

5.3. Muddy hands soil contact

5.3.1. Soil concentration Cs

The soil concentration for these events is necessarily the same as for soil ingestion, see Section 5.1.1. These events are still sufficiently frequent that the exposure point concentration should be an area average.

5.3.2. Soil contact area for muddy hand events SAm

No nominal value.

The soil contact area for muddy hand events is equal to the area of the hands. For this initial evaluation, we use the average of male and female hand areas given by EPA (2004a), 904 cm^2, and incorporate a CV of 0.15 as discussed in Section 2.2.2.

5.3.3. Exposure frequency for muddy hand events EFm

Muddy hand events are guessed (in the absence of further data) to occur every other day of exposure for hunters. This implies a mean exposure frequency of 5.2 d/y, with CV of 1.5 (see Section 5.1.4). This exposure frequency should be highly correlated with that for soil ingestion and regular soil contact.

5.3.4. Adherence factor for muddy hand events AFm

No nominal value.

Use “pipe layers in wet soil” as a surrogate, and assume that the variation observed in the experimental data correspond to personal long-term average variability. The observed distribution is consistent with lognormal, although there are clear systematic deviations (a mixture of two lognormals is far better). The mean is 4.3 mg/cm^2 with CV 1.2 (a mixture of two lognormals gives essentially the same parameter estimates).

5.3.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 5.1.3.

5.3.6. Absorption efficiency from soil AEd

Assumed to be the same as for soil contact by an adult, see Section 2.2.6.

5.3.7. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

5.3.8. Averaging time AT

Nominal value, see Section 2.1.7.

5.4. Surface water ingestion

5.4.1. Surface water concentration Cw

Effectively zero for dioxins/furans, so this section can be omitted.

5.4.2. Ingestion rate of surface water IRw

Nominal value 0.01 L/d.

Leave at the nominal value, since this it is irrelevant for dioxins/furans.

5.4.3. Exposure frequency for surface water ingestion EFw

The exposure frequency for surface water ingestion is taken to be identical to the exposure frequency for hunting events since all other parameters are normalized (where necessary) to those hunting event occurrences. See Section 5.1.4.

5.4.4. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 5.1.3.

5.4.5. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

5.4.6. Averaging time AT

Nominal value, see Section 2.1.7.

5.5. Dermal contact with surface water

5.5.1. Surface water concentration Cs

Necessarily the same as for water ingestion, Section 5.4.1.

5.5.2. Water contact surface area SAsw

Nominal value 4500 cm^2

Left at the nominal value for now, since surface water concentration taken to be zero for dioxins/furans.

5.5.3. Length per event of surface water contact TD

Nominal value 1 hr/d

Left at the nominal value for now, since surface water concentration taken to be zero for dioxins/furans.

5.5.4. Exposure frequency for surface water contact EFsw

The exposure frequency for surface water contact is taken to be identical to the exposure frequency for hunting events since all other parameters are normalized (where necessary) to those hunting event occurrences. See Section 5.1.4.

5.5.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 5.1.3.

5.5.6. Permeability constant PC

No nominal value, chemical specific. Potentially body part specific also.

Not evaluated for now. Not relevant for dioxins/furans.

5.5.7. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

5.5.8. Averaging time AT

Nominal value, see Section 2.1.7.

5.6. Consumption of wild game

5.6.1. Concentration in wild game Cg

No nominal value.

ENTRIX (2004) measured the concentration of PCDD/PCDF in wild game from three sampling locations along the Tittabawassee river, a reference area (Ref), Smith's Crossing (SC), and Imerman Park (IP). The game sampled were deer, turkey, and squirrels. Edible portions of muscle tissue were sampled and analyzed, and deer livers were separately analyzed. Turkey was analyzed skin-on for the most part (and I assume eaten skin-on also).

The mean concentrations obtained (using 2005 TEF, 0.5*DL for ND) are shown in Table 3.

Table 3 Mean concentrations in wild game taken in three locations (2005 TEF, 0.5*DL for ND, in ng/kg wet weight)

Location	Ref	SC	IP
Deer muscle	0.063	0.13	0.37
Deer liver	0.49	7.4	42.6
Turkey	0.17	7.3	Est. 21
Squirrel	0.067	0.32	0.92

There is a clear gradient down the river, and deer liver is being induced at the higher concentrations. Consumption of deer liver is identified as infrequent in the UMDES evaluation

and is not included in this evaluation. Turkey was not measured separately in IP (the one turkey obtained from IP is included in the mean from SC), but is estimated here at 21 ng/kg based on both deer muscle and squirrel being about 3 times higher in IP than in SC. Hunters are unlikely to hunt in just one place along the river, but they may hunt in one general area, so the gradient down the river should be considered to represent a variability. Since the most highly exposed hunters will sample many game, the mean concentration is the appropriate measure for any particular area. As a rough estimate, assume a linear increase in concentration along the TR, ranging from zero to the value in IP. Then the distribution of long-term average exposure concentrations to which hunters may be exposed is uniform, between zero and the value in IP.

The objective is to obtain a summary measure that gives a reasonable estimate of the product of concentration, ingestion rate, and meal size for the worst case. Examining this product for deer, turkey (+duck) and squirrel (=other small animals) shows that the product for turkey is highest, even at the upper percentiles (and using turkey+duck would only underestimate by 15% for the sum of all three). So for this initial estimate, use the turkey data. Treating the exposure concentration as varying linearly along the river from zero to the value at IP gives a mean of 10.5 ng/kg = 1.05×10^{-5} mg/kg, with a CV of 0.58. [For deer, the mean concentration is 0.18 ng/kg, for squirrel, 0.46 ng/kg, both with CV 0.58].

5.6.2. Cooking and trimming loss for wild game CL

The estimate for concentration used initially (see Section 5.6.1) is skin-on concentration in turkey. The CL should correspond approximately to loss of fat during cooking. Examining those papers that looked specifically at meat (generally beef; Hori 2005, Petroske 1998, Schecter 1998) gives a CL of about 0.55 ± 0.1 (uncertainty) roughly. (A better estimate may be available for fat loss from the USDA Food And Nutrient Database For Dietary Studies FNDDS at http://www.ars.usda.gov/Services/docs.htm?docid=12089; this possibility has not yet been checked).

5.6.3. Ingestion rate of wild game IRg

UMDES questions about number of wild game meals in the last 5 years were used in estimating ingestion rates: G6d asks about of whitetail deer or venison, G7b about wild turkey, pheasant, grouse, quail or woodcock, G8a about wild duck or goose, G9a about squirrel or wild rabbit, and G10b about other wild meats, all from the TR floodplain. At the 95th percentile, deer is 156 meals/5 years (n=104); turkey is 60 meals/5 yrs (n=44), duck is 10 meals/5 yrs (n=20), squirrel is 60 meals/5 yr (n=21), and other wild meats had fewer than 4 respondents (no estimates given). Deer meat is clearly the largest category, and G6b and G6c combined indicate that about 6% of deer eaters also ate the liver of the deer.

The distributions of meals/5 y for deer or venison from the TR floodplain, from the Saginaw River or Bay floodplain (UMDES question G6e), and from other areas (UMDES question G6f) all are reasonably approximated by lognormals. The first two are consistent with being the same, with a mean of 53.5 meals/5 y, and CV of 2.6, giving an annual average of 10.7 meals/y with variability CV of 2.6. The distribution for meals/y from other areas is distinct, having larger mean and variability (97 meals/5 y and CV 3.7).

For wild turkey, *etc*., the distribution (UMDES question G7b) appears to be adequately fit by a lognormal with mean 2.9 meals/yr and CV 1.55; and there is not much difference apparent (not formally fitted) for the Saginaw FP or other areas (UMDES questions G7c, G7d).

For wild duck or goose, the distribution (UMDES question G8a) appears to be adequately fit by a lognormal with mean 1.2 meals/yr and CV 0.69. There may be differences for the Saginaw FP or other areas (not formally fitted).

For squirrels and wild rabbits, the data presented (UMDES question G9a) appear very odd, primarily because they are driven[13] largely by the 2 "M/S Out FP" responders who must have eaten 60 meals/5 yr. Using the larger response rates from the "other areas" (UMDES question G9c) gives a mean of 3.2 meals/5 yr, with CV 2.0.

Combining these into a single number of meals/y (makes various strong assumptions that cannot be checked without further UMDES data), gives a mean of about 18 meal/y with CV 1.62. The relative weights (at the means) for deer, turkey+duck, and squirrel, are 0.60:0.22:0.18 (these could be used for the concentration calculation, but it turns out that turkey dominates, see Section 5.6.1).

The principal exposure (see Section 5.6.1) arises from turkey. This was combined with duck (on the assumption that a bird hunter would hunt both). A hunter might take all sorts of game, but for this evaluation bird and deer consumptions are evaluated separately, assuming roughly that a deer hunter wouldn't also hunt birds, and vice versa. The combination that has the largest product of (meals/yr), (meal size) and (concentration) is turkey/duck (and combining all together increases the product by about 9% at the mean, 15% at an upper 95%ile). Combining turkey and duck consumption gives a mean of 4 meals/year, with CV 1.1 (variability).

5.6.4. Meal size for wild game MSg

Deer:
The NHANES/USDA survey (WWEIA, 2003–2004) contains multiple records for deer/venison consumption. Omitting those for store-bought deer, and the single record for a snack (deer jerky), leaves 24 records for self-caught or gifted deer eaten at a main meal. The mean consumption (all ages) is 144 g/meal, with CV 0.90 (using 1-day weights for those sampled on the first day, 2-day weights for those sampled on the second day; this is incorrect, but will do for the moment: the correct procedure for this situation is unclear — even whether there is one. One person ate venison both days.) For this initial estimate, assume that the variation seen in WWEIA is an adequate measure of long-term variability between individuals.

Turkey (surrogate for wild game birds):
The NHANES/USDA survey (WWEIA, 2003–2004) contains 506 records for turkey (main codes only, for turkey meat alone). Using all these for now gives meal size of 103 g, CV 0.91 (same caveats as for deer; only one record was self-caught/raised turkey). For adults (ages 7 and

[13] The UMDES "total" results are largely driven by the "M/S Out FP" and "Jackson/Calhoun" areas, which have relative weights of about 0.45 and 0.50 respectively. The M/S FP and M/S Near FP have weights about 0.01, and the M/S Plume area has weight about 0.03.

over), the estimate is 107 g, CV 0.89. This is the value used (see Section 5.6.1) to obtain a reasonably representative estimate.

Squirrel, rabbit, *etc.*
The NHANES/USDA survey (WWEIA, 2003–2004) contains only 6 records involving consumption of squirrel, ground hog, opossum, beaver, raccoon, armadillo, wild pig, rabbit, turtle, or frog. Using just those (all ages) gives a meal size of 83 g, CV 0.68.

5.6.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 5.1.3.

UMDES question F2 & F3 give total years eating game meat; but this is not necessarily connected with exposures to meat from the TR floodplain. The exposure duration for the latter is taken from UMDES question E8 (Section 5.1.3).

5.6.6. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

5.6.7. Averaging time AT

Nominal value, see Section 2.1.7.

6. Child of hunter

6.1. Consumption of wild game

6.1.1. Concentration in wild game Cg

The concentration in wild game for the children of hunters is necessarily equal to that for hunters, see Section 5.6.1.

6.1.2. Contamination loss for wild game CLg

The cooking and trimming contamination loss for wild game eaten by children is taken to be equal to the loss for wild game eaten by adults. See Section 5.6.2.

6.1.3. Ingestion rate of wild game IRg

For this initial estimate, use the same estimate as for adults, see Section 5.6.3.

6.1.4. Meal size for wild game MSg

Using the turkey data from WWEIA (2003–2004, see Section 5.6.4) for those aged 1 through 6 inclusive (55 records) gives a mean of 47 g/meal, with CV 0.89. Use this as an initial estimate for long-term average and variability.

6.1.5. Exposure duration ED

No nominal value.

For this initial estimate, assume that any hunter hunts long enough that their children always eat the same as the hunter. So use the same value as for Soil Ingestion, Section 3.1.3.

6.1.6. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. See discussion in Section 5.1.6.

6.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

6.1.8. Body weight BW

Set equal to body weight for a resident child, see Section 3.1.6

6.1.9. Averaging time AT

Nominal value, see Section 2.1.7.

7. Fish-eating angler — adult

7.1. Soil ingestion

7.1.1. Soil concentration Cs

For this initial estimate, set equal to the concentration for the hunter, see Section 5.1.1. This is strictly incorrect, since fishers will be exposed to difference locations than hunters; but it is the best we have at the moment.

7.1.2. Soil ingestion rate IRs

EPA and MDEQ default value for residents 100 mg/d.

There is no specific information on soil ingestion rates for anglers. By default, use the adult resident soil ingestion rate, Section 2.1.2. This might lead to double-counting of ingestion rates, but the concentration terms will likely be different.

7.1.3. Exposure duration ED

The UMDES question E2 gives the number of years fishing in the TR, which is what is required for soil ingestion and contact. Using a double-exponential survival function with a discrete time unit of 1 y, and an upper bound of 85 y (see Section 19.2 for the methodology, and Section 18.3 for the method of fitting), results in mean fishing period estimates of 11.0 y (CV 1.41) if the observations are of lifetime exposures, or 3.9 y (CV 2.1) if they are current exposures. The observations area actually mixed, since the UMDES was not limited to current fishers. For this initial evaluation, we use the value of 11.0 years with CV 1.41. Further information from the UMDES results should clarify matters.

7.1.4. Exposure frequency EFs

The UMDES question E2 gives the total number of days fishing up to the time of the UMDES, for both current and former fishers. Analyzing the "overall" data assuming a discrete time analysis (1 day unit; methodology Section 19.2; method of fitting Section 18.3) gives estimates of 281 d (CV 2.29) if the observations are of total time, and 19 d (CV 5.3) if the observations are entirely of current fishers). For this initial estimate assume the former. Dividing by exposure duration (assuming no correlations) gives an exposure frequency estimate of 25.7 d/y, with CV 1.05.

7.1.5. Absorption efficiency AEi

This is set equal to that for soil ingestion in adult residents, see Section 2.1.5.

7.1.6. Body weight BW

For the initial evaluation, set equal to the body weights for resident adults, see Section 2.1.6. This should probably be considered independent of the resident adult body weight, and might be more appropriately defined for a distinct age range.

7.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

7.2. Soil contact (regular)

7.2.1. Soil concentration Cw

Necessarily the same as for soil ingestion, Section 7.1.1

7.2.2. Soil contact area for regular events SAd

Proposed nominal value 3300 cm^2.

The proposed nominal value is based on the worker (see Sections 4.2.2 and 4.2.4). All measurements of adherence factor are based on Kissel's data. Fishers, like hunters, will generally not be regularly and deliberately working with soil or muddy materials, nor performing activities that would cause extensive contact with soil. Such contact might occur occasionally while establishing a convenient place from which to fish, or when handling wet fish that have been dragged over dirt. As a first approximation, use the same surrogates (groundskeepers) as for hunting. This gives a soil contact area of 2479 cm2 with CV of 0.15 (see Section 5.2.2).

7.2.3. Exposure frequency for soil contact EFd

The exposure frequency for soil contact is taken to be identical to the exposure frequency for fishing events since all other parameters are normalized (where necessary) to those fishing event occurrences. See Section 7.1.4.

7.2.4. Adherence fraction for soil contact AFd

Proposed nominal value 0.07 mg/cm^2.

The proposed nominal value is based on the MDEQ adult value (see Section 2.2.4). For this evaluation, use the same value as for the adult hunter, using groundskeeper data as surrogates (see Section 5.2.4). The estimated mean and SD are 0.033 mg/cm^2 and 0.03 mg/cm^2 respectively, for a CV of 0.95.

7.2.5. Exposure duration Ed

The exposure duration for soil contact is the same as that for soil ingestion, since the exposure opportunities are identical, see Section 7.1.3.

7.2.6. Absorption efficiency for soil contact AEd

Absorption efficiency for soil contact is taken to be identical with that for an adult resident, see Section 2.2.6.

7.2.7. Body weight BW

Body weight is taken to be the same as for an adult resident, see Section 2.1.6.

7.2.8. Averaging time AT

Averaging time is nominal, see Section 2.1.7.

7.3. Soil contact (muddy hands)

7.3.1. Soil concentration Cs

The soil concentration for muddy hand events is necessarily the same as that for soil ingestion, since the exposure opportunities are essentially the same and the averaging will be essentially the same (although the muddy hand event is assumed to occur only on half the occasions). See Section 7.1.1).

7.3.2. Soil contact area for muddy hand events SAm

Same as for the adult hunter, see Section 5.3.2.

7.3.3. Exposure frequency for muddy hand events EFm

Muddy hand events are assumed to occur every other day of fishing, giving an exposure frequency of 13.6 d/y with a CV of 1.05 (see Section 7.2.3 and 7.1.4).

7.3.4. Adherence factor for muddy hand events AFm

The closest surrogates in the Kissel data are probably reed gatherers. For hunters, we used pipe layers in wet soil; but fishers will be likely in more watery situations where material will wash off. Evaluating these (only 4 data points, consistent with normal or lognormal; use lognormal) gives a mean adherence factor of 0.79 mg/cm^2 with CV of 0.68.

7.3.5. Exposure duration ED

Identical to the exposure duration for fishing, see Section 7.1.3.

7.3.6. Absorption efficiency AEd

Assumed identical to that for adult resident soil contact, see Section 2.2.6.

7.3.7. Body weight BW

Assumed identical to that for an adult resident, see Section 2.1.6.

7.3.8. Averaging time AT

Nominal value, see Section 2.1.7.

7.4. Soil contact (muddy feet)

7.4.1. Soil concentration Cs

The soil concentration for muddy feet events is assumed to be the same as that for soil ingestion. See Section 7.1.1). Since muddy feet events are so rare, the variability for soil concentration may be higher, because there are so few events during a lifetime that the spatial distribution of soil concentrations may not get averaged out. However, stick with the values used for soil ingestion for this initial estimate.

7.4.2. Soil contact area for muddy feet events SAm

We are assuming one foot being muddied. Take 1/2 the male/female average given in EPA (2004a), Exhibit C-1, or 612.5 cm^2, and assign a CV of 0.15 (see Section 2.2.2).

7.4.3. Exposure frequency for muddy feet events EFm

This is assumed to occur with frequency of 1/yr. Set CV to zero for both variability and uncertainty; we have no data on actual occurrence.

7.4.4. Adherence factor for muddy feet events AFm

We can expect any fisher who loses a shoe to subsequently wipe off as much muck as possible. The appropriate surrogate from Kissel's data would probably be reed-gatherers (one of four lost a shoe during the activities) and kids-in-mud. Using these, but trimming the lowest two (no obvious exposure) gives a mean of 37 mg/cm^2 with CV 2.9.

7.4.5. Exposure duration ED

Same as for fishing duration, see Section 7.1.3.

7.4.6. Absorption efficiency AEd

Same as for adult resident soil contact, see Section 2.2.6.

7.4.7. Body weight BW

Same as for adult resident, see Section 2.1.6.

7.4.8. Averaging time AT

Nominal value, see Section 2.1.7.

7.5. Surface water ingestion

7.5.1. Surface water concentration Cw

The surface water concentration for fishers is taken to be the same as that for hunters, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1. Currently effectively zero.

7.5.2. Ingestion rate of surface water IRw

Nominal value 0.01 L/d.

Leave at the nominal value, since this pathway does not contribute for dioxins/furans.

7.5.3. Exposure frequency for surface water ingestion EFw

The exposure frequency for surface water ingestion is taken to be identical to the exposure frequency for fishing events since all other parameters are normalized (where necessary) to those fishing event occurrences. See Section 7.1.4.

7.6. Surface water dermal contact

7.6.1. Surface water concentration Cw

Identical to the surface water concentration for water ingestion, since the contact and ingestion opportunities are identical; see Section 7.5.1.

7.6.2. Water contact surface area SAsw

Nominal value, 4500 cm^2.

The nominal value is 25% of total body surface area. Using EPA (2004a) Exhibit C-1, this gives 4,538 cm2 with CV 0.15 (see Section 2.2.2).

7.6.3. Length per event of surface water contact TD

Nominal value 1 h/d.

Left at the nominal value for now.

7.6.4. Exposure frequency for surface water contact EFsw

The exposure frequency for surface water contact is taken to be identical to the exposure frequency for fishing events since all other parameters are normalized (where necessary) to those fishing event occurrences. See Section 7.1.4.

7.6.5. Exposure duration ED

Identical to the exposure duration for fishing, see Section 7.1.3.

7.6.6. Permeability constant PC

No nominal value, chemical specific. Potentially body-part specific also.

Not evaluated for now. Not relevant for dioxins/furans.

7.6.7. Body weight BW

Same as for adult resident, see Section 2.1.6.

7.6.8. Averaging time AT

Nominal value, see Section 2.1.7.

7.7. Consumption of sport-caught fish

7.7.1. Concentration in sport-caught fish Cf

Mean and SD of TEQ for Walleye fillets and Carp fillets (Dow dam and Smith's Crossing) were obtained from Dow reports (Dow 1985, 1987, 1990, 1993, 1995, 1997, 1999, 2002, 2006; with TEQ estimated in some cases). These were treated as representative of sport fish and bottom fish. Fit an exponential decline to the TEQ mean data, with the possibility for additional uncertainty (beyond the measured SD), and predict 2007 concentrations. For Walleye, the exponential trend is not significant (but leave it in for the prediction), and the additional uncertainty is zero (but leave it in). Predicted 2007 concentration has arithmetic mean 3.4 ppt, uncertainty CV 0.44.

Mean values are appropriate for exposure point concentrations, since fishers will eat many fish.

For carp fillets, only 4 data points for TEQ. Apply the same methodology to get predicted 2007 concentration of 25 ppt, uncertainty CV 0.26.

These have to be weighted by relative intake of sport and bottom fish, approx. 0.965:0.035 (see Section 7.7.3). That gives an approximate mean of 4.1 ppt, or 4.1×10^{-6} mg/kg, with uncertainty CV 0.35. There is no variability assumed here — the fish should be pretty homogeneous along the river, because they are not confined to any particular stretches. Any observed variability along the river can be later accounted for in the HHRA.

7.7.2. Cooking and trimming contamination loss for sport-caught fish CLf

The nominal value is 0.5, which is that used for the Kalamazoo river PCBs.

Cooking and trimming losses were evaluated specifically for the Kalamazoo PCBs (Crouch *et al.*, 2001). That evaluation estimated (using Kalamazoo-specific information) an 11% probability for use of cooking methods with no PCB loss, and 89% probability for some PCB loss. The loss was estimated from the cooking method (variability), with 75% frying, 15% baking, 10% broiling. The uncertainty distributions for CLf for each of these methods is approximately uniform on (0.25,1) for fry, (0.425,1) for bake, (0.6,1) for broil.

Combining these gives a mean estimate of 0.69, with variability CV of 0.17 and uncertainty CV of 0.27, which was applied here.

7.7.3. Ingestion rate of sport-caught fish IRf

Use MCDH survey, looking at eaters only on the Tittabawassee River. The survey got months of year during which the person fished, fish meals in last 7 days, fish meals in last 30 days, was the last 30 days typical, if not what was typical monthly meals, and maximum in any month during last 5 years. For this analysis the 30 values are used. Some of the "typical" monthly values are inconsistent with the stated maximum in any month values, suggesting confusion. These were interpreted as follows:
(a) If "typical" was given as 0, use as average (2/5)*(maximum in any month*(months/yr) fished/12). [Assumption; consumption average about twice the minimum possible, based on available data].
(b) If the stated typical value exceeded the maximum possible based on the stated maximum in any month [*i.e.* (maximum in any month * (months/yr) fished/12)], then use as average the smaller of (typical*(months/yr)/12) and (maximum in any month*(months/yr) fished/12) [Assumption: some respondents interpreted "typical" as "during months they fished"].
(c) Otherwise use the stated typical.

That gives 122 values (from 129 respondents claiming to eat fish from TR; some gave 0 typical and 0 maximum in 5 yrs, others did not respond; both such results are ignored).

The distribution appears lognormal (Figure 5). Arithmetic mean 8.65 meals/yr, CV 2.32.

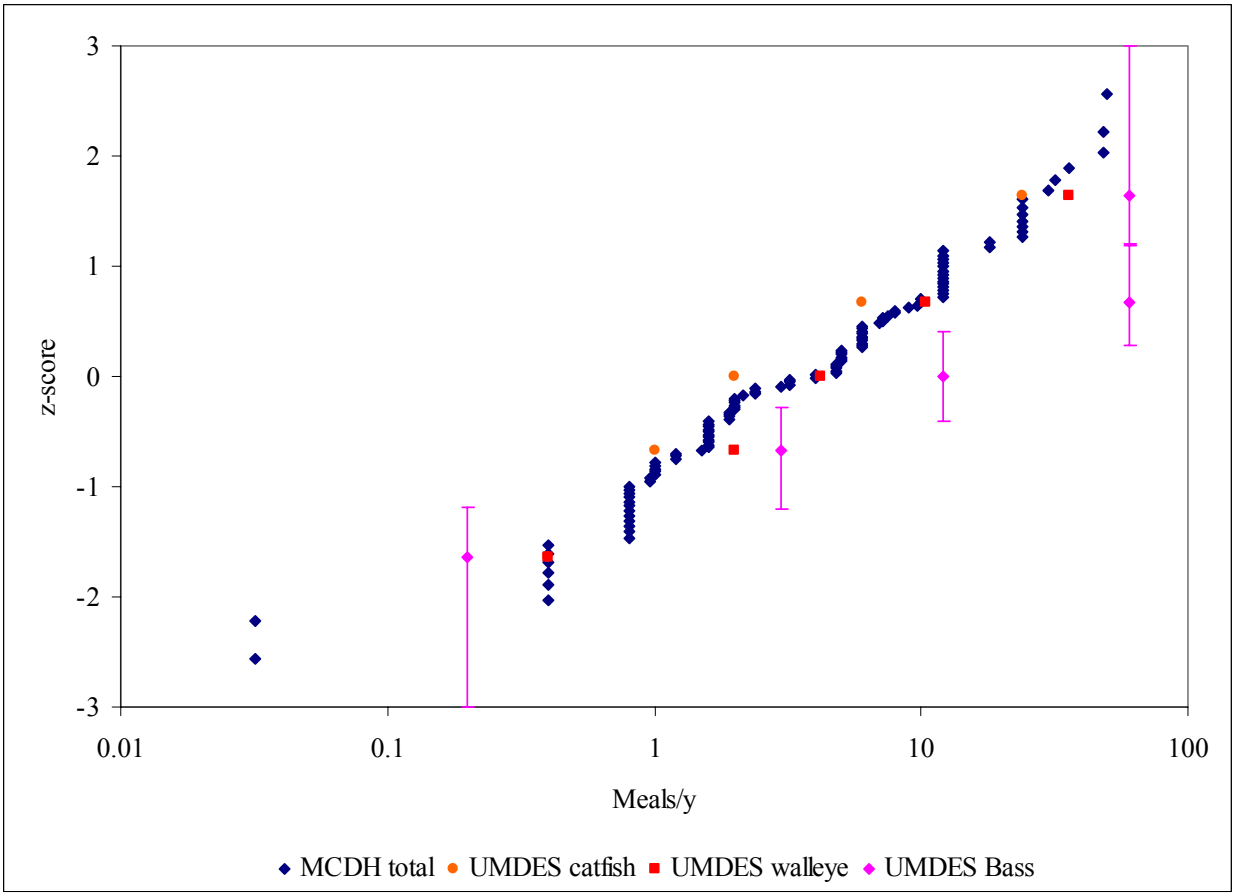

Figure 5 Meals/year distribution for fish-eaters on the Tittabawassee River, from the MDCH survey.

Note: the maximum claimed meals/30 d was 10, for a respondent who also claimed a maximum of 10 meals/month in any month in the last 5 years; but that respondent only fished 4 months/yr so I interpreted this as an average and maximum of 10 meals/month for 4 months/yr (average 40 meals/year).

This distribution is reasonably in line with the distributions seen by UMDES, given the small sample sizes in UMDES (note that the Bass "distribution" is based on 10 respondents; the error bars in Figure 5 are very approximate 1 SD).

For the MDCH survey, the meals/yr weighted fraction of fish that were "sport" versus "bottom feeders" is 0.965:0.035.

7.7.4. Meal size for sport-caught fish MSf

The Atkin survey (Table 6-8 in the Tittabawassee River Work Plan) gives a mean meal size of 0.25 kg, with variability CV of 0.31.

Also examine serving size in WWEIA (2003–2004). Select particular fish codes to try and match the characteristics of sport fish roughly. Include only: fish NS as to type, carp, catfish, cod, croaker, haddock, perch, pike, trout. Omit all others, including oily fish like mackerel, flat

fish like flounder, eels, sardines, mullet, etc. See Section 5.6.4 for the weighting methodology used. With these selections, the meal size estimate is 0.15 kg, with variability CV 0.76.

For adults eating self-caught fish in WWEIA (31 records; caught by respondent or someone known by the respondent), the mean is 0.25 kg, with CV 0.48.

The Adkin survey value is preferred, since meal sizes for self-caught fish could well be larger than the average values obtained in WWEIA. The "self-caught" category of the WWEIA confirms this value (the larger CV for WWEIA is expected, because it incorporates both person-to-person variability and also variability between eating occasions).

7.7.5. Exposure duration ED

Identical to the exposure duration for fishing, see Section 7.1.3.

7.7.6. Body weight BW

Same as for adult resident, see Section 2.1.6.

7.7.7. Averaging time AT

Nominal value, see Section 2.1.7.

8. Fish-eating child of anglers

8.1. Consumption of sport-caught fish

8.1.1. Concentration in sport-caught fish Cf

The concentration of contamination in sport-caught fish for the children of adult anglers is taken to be equal to that in the fish caught and eaten by the adults. See Section 7.7.1.

8.1.2. Cooking and trimming contamination loss for sport-caught fish CLf

The cooking and trimming contamination loss for sport-caught fish eaten by children is taken to be equal to the loss for sport-caught fish eaten by adults. See Section 7.7.2.

8.1.3. Ingestion rate of sport-caught fish IRf

The ingestion rate for children will be taken equal to that of adults, on the assumption that children eat the meals at the same time as the adult anglers. See Section 7.7.3.

8.1.4. Meal size for sport-caught fish MSf

There is no specific information on meal sizes for children eating sport-caught fish. Examining the age range 1–6 inclusive in WWEIA (2003–2004) gives a mean fish meal of 74 g, with variability CV 0.81. This is 0.48 times the adult meal size (see Section 7.7.4) in this same survey, with essentially the same CV. Based on this, use 0.48 the Atkin (adult) survey value, with the same CV as for adults (see Section 7.7.4). This gives a meal size of 0.12 kg, CV 0.31. [Note: there are insufficient records in WWEIA for "self-caught" fish for children to get anything useful; the analysis for adult self-caught fish shown in Section 7.7.4 helps support the use of a simple ratio.]

8.1.5. Exposure duration ED

Set equal to the exposure duration for resident children, see Section 3.1.3, since it is assumed that the adult in the family that gets the fish will fish for longer than the child's exposure duration.

8.1.6. Body weight BW

Same as for child resident, see Section 3.1.6.

8.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

9. Recreational (non-fishing, non-hunting) visitor — adult

9.1. Soil ingestion

9.1.1. Soil concentration Cs

Use the soil concentrations measured in Freeland Festival Park, Imerman Park, and Tittabawassee Township Park in the 2004 Ecological Risk Assessment Support Sampling (CH2MHill, 2004) and the 2006 update (Zwiernik, 2006). Take the mean values as representative of exposure point concentrations for individuals, and the variance between those means as representative of the variability in recreational exposure point concentrations. This gives a mean of 1,500 ng/kg TEQ = 1.5×10^{-3} mg/kg TEQ with variability CV of 0.38.

9.1.2. Soil ingestion rate IRs

Assumed to be identical to the soil ingestion rate for resident adults, see Section 2.1.2. This may result in double counting.

9.1.3. Exposure duration ED

UMDES E14 measured exposure duration in years, and the total number of days recreational activity. The total number of days, and possibly the number of years appears higher for the M/S FP area, so that area will be used. Use a double-exponential survival function, maximum time 85 y with 1 y granularity, with the methodology of Section 19.2 and the fitting procedure of Section 18.3. In this case, the observations were of a continuing activity, so we make that assumption in interpreting the results (it actually makes little difference in this case). The mean exposure duration is then 15.5 y, with CV 1.1 (making the assumption that the observations were of lifetime exposures gives mean 16.0 with CV 1.0).

9.1.4. Exposure frequency for soil ingestion EFs

This is the exposure frequency for recreational events since all other parameters are normalized (where necessary) to recreational event occurrences. UMDES E14 measured total exposure days up to the time of the observation. As for exposure duration (Section 9.1.3), this is a continuing exposure — the respondents almost certainly were still continuing this activity. Here the difference between assumptions about the observations is critical. Assuming the observations are of lifetime exposures gives a mean total exposure of 448 d with CV 1.5, whereas an assumption that the observations are of a continuing activity gives a mean 68.3 d, CV 3.5. Dividing this by the exposure duration (Section 9.1.3), using the methodology of Section 20,

gives a mean exposure frequency (assuming observations are lifetime exposure) of 28 d/yr with CV 0.77, or (assuming observations of a continuing activity) a mean of 4.7 d/y with CV 2.3. The latter is used here, since it corresponds better to the observations.

9.1.5. Ingestion absorption efficiency AEi

Same as for adult resident, see Section 2.1.5.

9.1.6. Body weight BW

Same as for adult resident, see Section 2.1.6.

9.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

9.2. Dermal contact with soil (regular)

9.2.1. Soil concentration Cs

Necessarily equal to the soil concentration for soil ingestion, Section 9.1.1.

9.2.2. Soil contact surface area SAd

Nominal value 3300 cm^2.

The nominal value has been chosen as the MDEQ default for a worker. For adult non-hunter, non-fisher recreational activity, the best surrogates in Kissel's data are probably again the groundskeepers (as for hunters, Section 5.2.2), since normal recreational users probably do not generally perform operations with soil or come particularly into contact with it (this may be incorrect if a large part of recreational use is for soccer, rugby, baseball, or other sports that may involve falling around on the ground). EPA (2004a) combined measurements on face, forearms, hands, and lower legs for this dataset, but exposure on the legs was extremely limited (the groundskeepers wore long pants); so for this initial assessment we evaluate faces, forearms, and hands, using the surface areas given in EPA (2004a) (average males and females). This gives a surface area of 2479 cm^2 (see Sections 4.2.2 and 4.2.4; but since we are evaluating different sets of data, the surface areas are not considered equivalent), and as discussed in Section 2.2.2 we estimate a CV of 0.15.

9.2.3. Exposure frequency for soil contact EFd

The exposure frequency for soil contact events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 9.1.4.

9.2.4. Adherence factor for soil contact AFd

As for surface area (Section 9.2.2) use the groundskeepers as surrogate. The groundskeeper data of Kissel *et al.* (as summarized in EPA, 2004a) give weighted estimates for adherence factors that are consistent with a lognormal distribution. The estimated mean and SD are 0.033 mg/cm^2 and 0.03 mg/cm^2 respectively, for a CV of 0.95 (see also Section 5.2.4).

9.2.5. Exposure duration ED

Necessarily the same as for soil ingestion, Section 9.1.3.

9.2.6. Dermal absorption efficiency AEd

Assumed identical as for the residential adult, Section 2.2.6.

9.2.7. Body weight BW

Assumed identical as for the residential adult, Section 2.1.6

9.2.8. Averaging time AT

Nominal value, see Section 2.1.7.

9.3. Dermal contact with soil (muddy hands)

9.3.1. Soil concentration Cs

The frequency of this type of contact may be sufficiently low that the averaging argument applied to soil ingestion and regular soil contact may not be appropriate, leading to a larger variability in soil concentration than for soil ingestion. To estimate this, take the individual measurements discussed in Section 9.1.1 as representative of the variability expected. That gives a mean of 1,500 ng/kg TEQ = 1.5×10^{-3} mg/kg TEQ with variability CV of 0.70.

9.3.2. Soil contact surface area SAd

Assume the same as for muddy hand soil contact by hunters, see Section 5.3.2.

9.3.3. Exposure frequency for soil contact EFd

The exposure frequency for muddy hands events is entirely nominal, at 1 event/yr.

9.3.4. Adherence factor for soil contact AFd

Use the reed gatherers as appropriate surrogates, as for anglers (see Section 7.3.4). Recreational adults are unlikely to have the extreme contact implied for hunters (Section 5.3.4), since recreational users are less likely to be out in or immediately after rain, and perhaps are more likely to get muddy hands in or near water (like anglers). Using the reed gatherer surrogates gives a mean adherence factor of 0.79 mg/cm^2 with CV of 0.68.

9.3.5. Exposure duration ED

Necessarily the same as for soil ingestion, Section 9.1.3.

9.3.6. Dermal absorption efficiency AEd

Assumed identical to the residential adult, Section 2.2.6.

9.3.7. Body weight BW

Assumed identical to the residential adult, Section 2.1.6

9.3.8. Averaging time AT

Nominal value, see Section 2.1.7.

9.4. Surface water ingestion

9.4.1. Surface water concentration Cw

The surface water concentration for recreational visitors is taken to be the same as that for hunters and fishers, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1.

9.4.2. Ingestion rate of surface water IRw

Nominal value 0.01 L/d.
Leave at the nominal value for this initial evaluation, since this pathway is assumed irrelevant for Dioxins and Furans.

9.4.3. Exposure frequency for surface water ingestion EFw

The exposure frequency for surface water ingestion events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 9.1.4.

9.4.4. Exposure duration ED

Necessarily the same as for soil ingestion, Section 9.1.3.

9.4.5. Body weight BW

Assumed identical to the residential adult, Section 2.1.6

9.4.6. Averaging time AT

Nominal value, see Section 2.1.7.

9.5. Dermal contact with surface water

9.5.1. Surface water concentration Cw

Necessarily the same as for surface water ingestion, Section 9.4.1.

9.5.2. Water contact surface area SAsw

Proposed nominal value 4500 cm^2.
Leave at the nominal value, since for dioxins and furans this pathway is deemed irrelevant anyway. Incorporate the 0.15 CV (see Section 2.2.2).

9.5.3. Length per event of surface water contact TD

Nominal value of 1 h/d. Left at the nominal values since this pathway is deemed irrelevant for dioxins and furans.

9.5.4. Exposure frequency for surface water contact EFsw

The exposure frequency for surface water contact events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 9.1.4.

9.5.5. Exposure duration ED

Necessarily the same as for soil ingestion, Section 9.1.3.

9.5.6. Permeability coefficient PC

No nominal value, chemical specific. Potentially body-part specific also.

Not evaluated for now. Not relevant for dioxins/furans.

9.5.7. Body weight BW

Assumed identical to the residential adult, Section 2.1.6

9.5.8. Averaging time AT

Nominal value, see Section 2.1.7.

10. Recreational (non-fishing, non-hunting) visitor — teen

10.1. Soil ingestion

10.1.1. Soil concentration Cw

For the teen recreational visitor, the soil concentration of contaminants is taken to be identical to the soil concentration for adult recreational visitors, since both are assumed to visit the same areas for recreation. See Section 9.1.1.

10.1.2. Soil ingestion rate IRs

Proposed nominal value 100 mg/d, equal to the nominal value for adults.

Set this equal to the adult intake rate, see Section 2.1.2.

10.1.3. Exposure duration ED

The teen period is supposed here to be the age range of nominally 8 to 17 inclusive, or 10 years. This is treated as a nominal figure in this initial evaluation.

10.1.4. Exposure frequency for soil ingestion EFs

The exposure frequency is that for recreational events, nominally 54 d/y (nominally 3 visits/wk for 3 summer months, 1 visit/wk during two spring and two fall months). This is treated as a nominal value for this initial evaluation.

10.1.5. Ingestion absorption efficiency AEi

Same as for adult resident, see Section 2.1.5.

10.1.6. Body weight BW

The average body weight for the age range 7 to 17 inclusive is 50 kg, with a CV of about 0.22 (assuming that each child follows a weight trajectory at a constant percentile of weight for age). See the discussion at Section 2.1.6.

10.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

10.2. Dermal contact with soil (regular)

10.2.1. Soil concentration Cs

Necessarily the same as the soil concentration for soil ingestion, Section 10.2.1.

10.2.2. Soil contact surface area SAd

The appropriate surrogate among Kissel's datasets is "Soccer players No. 1" (EPA, 2004a), since the participants are in the right age range (the other soccer players were adults) and this activity would correspond roughly to typical vigorous recreational activities. The appropriate surface area corresponds to that measured (face, forearms, hands, lower legs), since other most surfaces would likely usually be covered. This gives a total of 3515 cm^2, with a CV (see Section 2.2.2) of 0.15.

10.2.3. Exposure frequency for soil contact EFd

The exposure frequency for soil contact events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 10.1.4.

10.2.4. Adherence factor for soil contact AFd

See Section 10.2.2; the appropriate surrogate are the teen soccer players in Kissel's data. Treating these as lognormal, the estimated arithmetic mean is 0.06 mg/cm^2, with CV (treated as variability) of 0.80.

10.2.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 10.1.3.

10.2.6. Dermal absorption fraction AEd

Assumed the same as for adult resident dermal absorption, see Section 2.2.6.

10.2.7. Body weight BW

Same as for soil ingestion, Section 10.1.6.

10.2.8. Averaging time AT

Nominal values, see Section 2.1.7.

10.3. Dermal contact with soil (muddy hands)

10.3.1. Soil concentration Cs

Set equal to that for adult recreational muddy hand soil contact, see Section 9.3.1.

10.3.2. Soil contact area for muddy hand events SAm

Total body surface area, and the fraction that is hands, is estimated for the age range <7 to <18 in EPA (2004a), and we use the "hands" fraction. That gives 695 cm^2, and a variability of 0.15 is assumed (see Section 2.2.2).

10.3.3. Exposure frequency for muddy hand events EFm

Nominal value 1 d/y.
This receptor is afforded a nominal evaluation, so the nominal value is applied.

10.3.4. Adherence factor for muddy hand events AFm

Use "kids-in-mud" as a surrogate, using just the hands since the "muddy hands" event supposes just hand exposure ("kids-in-mud" was artificial, with bare feet, bare lower legs, and bare lower arms). These children were aged 9–14, so in the correct age range. The measurements are replicates on the same children, so average measurements on each child to get an estimate of a variability distribution. Treating the distribution as lognormal gives estimates of a mean of 66 mg/cm^2 with CV 0.98.

10.3.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 10.1.3.

10.3.6. Dermal absorption fraction AEd

Assumed the same as for adult resident dermal absorption, see Section 2.2.6.

10.3.7. Body weight BW

Same as for soil ingestion, Section 10.1.6.

10.3.8. Averaging time AT

Nominal values, see Section 2.1.7.

10.4. Surface water ingestion

10.4.1. Surface water concentration Cw

The surface water concentration for recreational visitors is taken to be the same as that for hunters and fishers, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1.

10.4.2. Ingestion rate of surface water IRw

Nominal value 0.01 L/d.
Left at its nominal values, since this route of exposure is not important for dioxins and furans.

10.4.3. Exposure frequency for surface water ingestion EFw

The exposure frequency for surface water ingestion events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 10.1.4.

10.4.4. Exposure duration ED

Same as for soil ingestion, see Section 10.1.3.

10.4.5. Body weight BW

Same as for soil ingestion, Section 10.1.6.

10.4.6. Averaging time AT

Nominal values, see Section 2.1.7.

10.5. Dermal contact with surface water

10.5.1. Water concentration Cw

The surface water concentration for recreational visitors is taken to be the same as that for hunters and fishers, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1.

10.5.2. Water contact surface area SAsw

Nominal value 3278 cm^2.
Left at its nominal value since this route is not important for dioxins and furans.

10.5.3. Length per event of surface water contact TD

Nominal value 1 h/d.
Left at its nominal value since this route is not important for dioxins and furans.

10.5.4. Exposure frequency for surface water contact EFsw

The exposure frequency for surface water contact events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 10.1.4.

10.5.5. Exposure duration ED

Necessarily the same as for soil ingestion, see Section 10.1.3.

10.5.6. Permeability coefficient PC

Chemical specific. Possibly body part specific.
Not evaluated here.

10.5.7. Body weight BW

Same as for soil ingestion, Section 10.1.6.

10.5.8. Averaging time AT

Nominal values, see Section 2.1.7.

11. Recreational (non-fishing, non-hunting) visitor — child

11.1. Soil ingestion

11.1.1. Soil concentration Cw

For the child recreational visitor, the soil concentration of contaminants is taken to be identical to the soil concentration for adult recreational visitors, since both are assumed to visit the same areas for recreation. See Section 9.1.1.

11.1.2. Soil ingestion rate IRs

Assumed to be identical to the residential child ingestion rate, Section 3.1.2. This may double count ingestion of soil, since it implies that the child gets all soil ingestion during any recreational visit. However, the soil concentrations are distinct (in principle).

11.1.3. Exposure duration ED

Since adult exposure duration for the recreational scenario can exceed the duration of childhood, we here use the duration of childhood (it is assumed that children will be accompanied by an adult). See Section 3.1.3.

11.1.4. Exposure frequency for soil ingestion EFs

The exposure frequency for soil ingestion is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. Since children are assumed to accompany adults, we use the exposure frequency assumptions for adults here; see Section 9.1.4.

11.1.5. Ingestion absorption efficiency AEi

Same as for adult resident, see Section 2.1.5.

11.1.6. Body weight BW

Same as for child resident, Section 3.1.6.

11.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

11.2. Dermal contact with soil (regular)

11.2.1. Soil concentration Cs

Same as for soil ingestion, Section 11.1.1

11.2.2. Soil contact surface area SAd

The surrogates used here are children playing in dry soil, and daycare children (children playing in wet soil omitted, because such play in recreational areas is unlikely for young children in wet conditions). The surface area involved is hands, forearms, lower legs, faces, and feet, totaling 2184 cm^2, with a CV of 0.15 (see Section 2.2.2).

11.2.3. Exposure frequency for soil contact EFd

The exposure frequency for surface water contact events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 11.1.4.

11.2.4. Adherence factor for soil contact AFd

The surrogates used here are children playing in dry soil, and daycare children (see Section 11.2.2). That gives a mean of 0.08 mg/cm^2, CV 1.24.

11.2.5. Exposure duration ED

Same as for soil ingestion, Section 11.1.3.

11.2.6. Absorption efficiency AEd

Same as for residential adult soil contact, Section 2.2.6.

11.2.7. Body weight BW

Same as residential child, See Section 3.1.6.

11.2.8. Averaging time AT

Nominal value, see Section 2.1.7.

11.3. Dermal contact with soil (muddy hands events)

11.3.1. Soil concentration Cs

Same as the soil concentration for muddy hands events for adults, see Section 9.3.1

11.3.2. Soil contact area for muddy hand events SAm

From EPA (2004a, Exhibit C-1) we get the surface area for children's hands for the age range <1 to <6 as 361 cm^2 (using both sexes combined for total surface area). The CV assumed is 0.15 (see Section 2.2.2).

11.3.3. Exposure frequency for muddy hand events EFm

No nominal value. Adopt a nominal value 1 d/y, and apply this.

11.3.4. Adherence factor for muddy hand events AFm

Use the same "kids-in-mud" value as for teens, see Section 10.3.4.

11.3.5. Exposure duration ED

Same as for soil ingestion, Section 11.1.3.

11.3.6. Absorption efficiency AEd

Same as for residential adult soil contact, Section 2.2.6.

11.3.7. Body weight BW

Same as residential child, See Section 3.1.6.

11.3.8. Averaging time AT

Nominal value, see Section 2.1.7.

11.4. Surface water ingestion

11.4.1. Surface water concentration Cw

The surface water concentration for recreational visitors is taken to be the same as that for hunters and fishers, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1.

11.4.2. Ingestion rate of surface water IRw

Adopt a nominal value of 0.01 L/day. Not evaluated since this route is irrelevant for dioxins/furans.

11.4.3. Exposure frequency for surface water ingestion EFw

The exposure frequency for surface water ingestion events is taken to be identical to the exposure frequency for recreational events since all other parameters are normalized (where necessary) to those recreational event occurrences. See Section 11.1.4.

11.4.4. Exposure duration ED

Same as soil ingestion, see Section 11.1.3.

11.4.5. Body weight BW

Same as residential child, See Section 3.1.6.

11.4.6. Averaging time AT

Nominal value, see Section 2.1.7.

11.5. Dermal contact with surface water

11.5.1. Surface water concentration Cw

The surface water concentration for recreational visitors is taken to be the same as that for hunters and fishers, since the water bodies involved (primarily the Tittabawassee River) are assumed to be common. See Section 5.4.1.

11.5.2. Water contact surface area SAsw

For teens and adults, 25% of the body surface area was assumed during such activities as fishing and wading. Young children visiting recreational areas are likely to contact water less frequently than their peers, but when they do they might get more of their body surface wet. So we assume 50% body surface area. Using EPA (2004a, Exhibit C-1), this gives 3280 cm^2 with CV 0.15 (see Section 2.2.2).

11.5.3. Length per event of surface water contact TD

We shall adopt a nominal value of 1 h/day for this initial evaluation.

11.5.4. Exposure frequency for surface water contact EFsw

Contact with surface water is not likely to occur on every recreational visit. We assume for this initial estimate that it occurs on 25% of such occasions, giving an exposure frequency of about 1 day/y on average (see Section 11.1.4). This will be assumed for a nominal value.

11.5.5. Exposure duration ED

Same as soil ingestion, see Section 11.1.3.

11.5.6. Permeation constant PC

Not evaluated in this initial evaluation, since this route is irrelevant for dioxins/furans.

11.5.7. Body weight BW

Same as residential child, See Section 3.1.6.

11.5.8. Averaging time AT

Nominal value, see Section 2.1.7.

12. Adult eating farm-produced meat

12.1. Consumption of farm-produced meat

12.1.1. Concentration in farm-produced meat Cm

We can expect the concentration in meat to be proportional to the concentration in the soil used by the farm animal. The soil concentration observed in UMDES in residences in the FP is estimated in Section 2.1.1 as a mean of 65.9 ng/kg with CV 6.15. The soil concentration to which wild animals are exposed is estimated in Section 5.1.1 as a mean of 1800 ng/kg with CV of 0.56. The concentrations in wild animal meat is estimated in Section 5.6.1 as a mean of 10.5 ng/kg (turkey), 0.18 ng/kg (deer), 0.46 ng/kg (squirrel), with CV 0.58.

If we assume that "farm-produced" meat animals are on soil concentrations similar to those seen in the UMDES residences, then we estimate (using proportionality) the mean farm-produced meat concentration as approximately 0.007 ng/kg for beef/pork/lamb/veal (using the relation between soil concentration and deer meat), and 0.39 ng/kg for chicken/turkey/duck/goose (using the relation between soil concentration and turkey), both with CV 6.15 (corresponding to the soil CV). Obviously the upper end of this will exceed the wild animal concentrations (because of the large CV), but that happens at the 99.2 %ile so should have minimal effect in our initial calculations.

As for the wild animals (see Section 5.6.1), the chicken/turkey/goose/duck group is likely the major contributor to doses, so we use a meat concentration of 0.39 ng/kg = 3.9×10^{-7} mg/kg with CV 6.15.

12.1.2. Cooking and trimming losses for farm-produced meat CLm

For this initial evaluation, use the value given for hunters (Section 5.6.2).

12.1.3. Ingestion rate of farm-produced meat IRm

UMDES G3d can be used to estimate a mean consumption rate of 32 meals/y of chicken, turkey, duck, or goose home-raised on the FP, with CV of 1.4, among the few consumers. UMDES G4d suggests roughly 50 meals/y of beef, pork, lamb, or veal home raised on the FP, with CV about 1.2. And UMDES G51a indicates about 68 meals/y, CV 1.7, for egg meals. For this evaluation, use the chicken/turkey/duck/goose estimates, since the concentration is likely sufficiently larger that this is the dominant exposure.

12.1.4. Meal size for farm-produced meat MSm

The concentrations evaluated are for chicken/turkey/goose/duck, and the total intake is likely dominated by this group. So evaluate the meal size for chicken, turkey, goose, & duck from WWEIA (2003–2004). Use the same weights as in WWEIA, so that the mix is assumed the same (we have no better data at the moment about relative production from the FP). [Use all the main chicken/turkey/goose/duck entries; omit Cornish game hen.] [In this case, we have to sum all the entries corresponding to the same person ID #, day, and to the same eating occasion (DRx_030Z), to get the total for a meal; since this mixes 2 days, use the average weight for that person; again this is wrong, but should be close enough for now]. [Censor below 10 g per meal to exclude those that are not "meals"[14]]. For ages 7+, the censored distribution is pretty well lognormal. Mean 113 g, SD 76 g, CV 0.675. [Note: I have not censored out self-caught meat]

12.1.5. Exposure duration ED

Same as residential duration, see Section 2.1.3

12.1.6. Body weight BW

Same as adult resident, see Section 2.1.6.

12.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

13. Child eating farm-produced meat

13.1. Consumption of farm-produced meat

13.1.1. Concentration in farm-produced meat Cm

The contaminant concentration in farm-produced meat eaten by children is taken to be identical to that in farm-produced meat eaten by adults. See Section 12.1.1.

13.1.2. Ingestion rate of farm-produced meat IRm

The ingestion rate for the child eating farm-produced meat is taken to be the same as for the adult, using the assumption that the whole family involved will eat meat from the same source at the same time. See Section 12.1.3.

[14] Very low values of meat consumption per meal probably correspond to meat ingredients in other dishes, likely commercially prepared so of no interest for FP exposures. The cutoff was selected where the distribution has a distinct change in shape. Better selection of the WWEIA records included in the analysis might provide a preferable approach.

13.1.3. Meal size for farm-produced meat MSm

See the discussion for adults, Section 12.1.4. For children, the meal size (censored below 10 g[15]) is lognormal, mean 68 g, SD 45 g, CV 0.66.

13.1.4. Cooking and trimming losses for farm-produced meat CLm

Cooking and trimming losses for farm-produced meats eaten by children are taken to be identical to cooking and trimming losses for farm-produced meats eaten by adults. See Section 12.1.2.

13.1.5. Exposure duration ED

The same as for the resident child, see Section 3.1.3.

13.1.6. Body weight BW

The same as for the resident child, see Section 3.1.6.

13.1.7. Averaging time AT

Nominal value, see Section 2.1.7.

14. Adult eating farm-produced eggs

14.1. Consumption of farm-produced eggs

14.1.1. Concentration in farm-produced eggs Ce

The concentration in chickens and their eggs will probably be proportional to soil concentration. Nouwen *et al.* (2004) measured 33 ng/kg fat in egg yolks at a mean concentration of 24.3 ng/kg dry in soil for free range chickens. This is within the range observed by Harnley *et al*. (2000) at that soil concentration. Re-analyzing Harnley *et al.* (2000) data on free-ranging chickens (including the data point on white leghorn, cited as from Petreas *et al.*, 1996) using a sensible physical and statistical model[16] gives a ratio of egg concentration (total egg) to soil concentration of 0.46 with GSD 1.365 or CV 0.32.

The soil concentration expected in "farms" is estimated here to be the same as residences in the FP (see Section 12.1.1), with mean 65.9 ng/kg and CV 6.15 (variability). Multiplying by the ratio of egg to soil concentration gives an egg concentration of 30 ng/kg, or 3×10^{-5} mg/kg, with variability CV of 6.15 and uncertainty CV of 0.32.

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[15] See Footnote 14.

[16] Harnly *et al*. (2000) fit a straight line on a log-log plot (which I have reproduced with my digitized results from their plot), hence assume a power law dependence between egg concentration and soil concentration with lognormally distributed experimental deviations (experimental errors + variations between chickens). I assume direct proportionality between soil and egg concentration, again with lognormally distributed deviations. The Harnly *et al*. (2000) best fit results in roughly a square-root dependence (0.48 power), which is physically implausible at best; and indeed the major non-linearity in their fit is at concentrations lower than they measured. Harnly *et al*. (2000) then claim that 0.38 ppt in soil gives 1 ppt in eggs for unconfined chickens, based on this square-root fit, but that is an unreasonable extrapolation below their data. For the range of concentrations of interest to us, the Harnly *et al*. (2000) fit would give lower estimates of egg concentrations than the linear proportionality that I use here.

14.1.2. Ingestion rate of farm-produced eggs IRe

UMDES Q51a asked about egg meals in the last 5 years from the TR floodplain. There were 14 responses from the FP, and 28 overall. The values for overall responses in UMDES are dominated (because of the weighting) by the few measurements (<4) in the MS OFP area, which are not reported. So use the 14 responses from the FP. Using a double exponential (theory, Section 19.2.2; fitting method, Section 18.3) gives an estimated mean of 61 egg meals/y with CV 1.7. Using WWEIA (2003–2004), the average meal size for ages 6+ is 110 g (CV 0.58) using a cutoff of 20 g/meal,[17] so 61 egg meals/y corresponds approximately to 120 eggs/y (CV 1.7) using an egg mass of 56 g/egg, or 2 oz/egg.

14.1.3. Mass of farm-produced eggs Megg

Nominal value of 56 g/egg (see Section 14.1.2), corresponding to 2 oz/egg (US standard Large egg, USDA 2000).

14.1.4. Exposure duration ED

Same as residential duration, see Section 2.1.3

14.1.5. Body weight BW

Same as adult resident, see Section 2.1.6.

14.1.6. Averaging time AT

Nominal value, see Section 2.1.7.

15. Child eating farm-produced eggs

15.1. Consumption of farm-produced eggs

15.1.1. Concentration in farm-produced eggs Ce

The contaminant concentration in farm-produced egss eaten by children is taken to be identical to that in farm-produced eggs eaten by adults. See Section 14.1.1.

15.1.2. Ingestion rate of farm-produced eggs IRe

See the discussion for adults, Section 14.1.2. The child (ages 1–6) meal size distribution for eggs in WWEIA (2003–2004), cutting off at 20 g/meal,[18] is 87 g/meal (CV 0.90). Using the egg mass of 56 g/egg (see Sections 14.1.2 and 14.1.3), and the same meal frequency as for adults (see Section 14.1.2, assuming adults and children eat eggs at the same meals, with eggs from the same source) gives an egg consumption rate of 95 eggs/y with variability CV 1.7.

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[17] A cutoff in introduced to account for the measurements of egg consumption in WWEIA that would not be considered "egg meals" in UMDES; that is, in the small egg component of other meals, many of which would have been commercially preparations in WWEIA. Since such meals would not have been prepared with TR FP eggs, even for TR FP residents, they are omitted here. The 20 g is chosen by examination of the distribution of values; there is a fairly well-defined break in the shape of the distribution at around 20 g. A better job may be possible by better selection of the WWEIA records to include in the analysis.

[18] See Footnote 17.

15.1.3. Mass of farm-produced eggs Megg

The mass of farm-produced eggs eaten by children is taken to be identical to the mass of farm-produced eggs eaten by adults. See Section 14.1.3.

15.1.4. Exposure duration ED

The same as for the resident child, see Section 3.1.3.

15.1.5. Body weight BW

The same as for the resident child, see Section 3.1.6.

15.1.6. Averaging time AT

Nominal value, see Section 2.1.7.

16. Adult eating farm-produced dairy products

16.1. Consumption of dairy products

16.1.1. Concentration of contaminant in farm-produced diary products Ca

We can attempt to estimate expected milk fat concentrations based on soil concentrations. All diary products are here assumed to correspond (on a fat basis) to milk fat. Hendriks *et al*. (1996) gives a milk fat/dry soil ratio of 0.03 to 0.1 without accounting for any background and using highly averaged values for both soil and milk at soil concentrations ranging from 20–70 ng/kg. Coutinho *et al*. (2002) gives 0.45 for the ratio using averaged values at soil concentrations of 1.8 to 16.9 ng/kg with no background correction and very few measurements. Schulz *et al*. (2004, 2005) measured 3 individual cows on soil with a concentration of 570 ng/kg (but # of soil samples not given) and we obtain an average ratio of 0.01. Lake et al. (2005) suggests a value of about 0.1 on soil concentrations of 4 to 50 ng/kg (but only medians are available for soil concentration, the statistic for the milk concentration is not specified, and there is clearly some background effect that is not taken into account).

The best estimate for our situation is probably about 0.01 from Schulz *et al*. (2004, 2005), followed by the range given by Hendriks *et al*. (1996). We will here use a median estimate of 0.03 with an uncertainty range of about a factor of 3 (i.e. an uncertainty CV of 1.5), hence a mean of 0.055.

The soil concentration expected in "farms" is estimated here to be the same as residences in the FP (see Section 12.1.1), with mean 65.9 ng/kg and CV 6.15 (variability). Applying the ratio gives a mean concentration in milk of 3.6 ng/kg fat = 3.6×10^{-6} mg/kg fat, with variability CV 6.15 and uncertainty CV 1.5.

16.1.2. Ingestion rate of farm-produced dairy products IRa

UMDES G52a (milk) indicates that only one person indicated obtaining milk from cows raised in the TR FP, and nobody obtained milk from home-raised cows in the Saginaw River/Bay floodplain (G52b). There are only 36 people who indicated using milk from home-raised cows elsewhere (G52c), and the distribution (particularly the upper end) is not substantially different

from the distribution for store-bought milk (G52d). So use the last to estimate ingestion rates, assuming that for those with access to home-raised milk, the limitation is not the supply but the demand.

Examining the distribution for store-bought milk (UMDES G52d), it is clear that an appreciable fraction of the responses were of the nature of 3 milk meals/day, suggesting milk with every meal. And there appears to be a minimum of order 1 meal/month (60 in 5 years). Putting in a combination of a fraction at some minimum value, a fraction at a maximum value of 5460 meals/5 yrs (3 meals/day), and a truncated normal in between, gives a mean estimate of 1645 meals/5 yrs, or 329 meals/yr, with CV 0.88.

16.1.3. Meal size of farm-produced dairy products MSa

WWEIA (2003–2004) was used. Codes associated with fluid milk, milk shakes, malted milk, milk beverages, eggnog, to match the UMDES questionnaire about milk. This will miss cheese and other dairy products, but it is unlikely that there is much, if any, cheese or other dairy production on the TR FP. Censor results at 80 g/meal, to account for the many entries that would not be counted as "meals" (doing it properly would require taking account of the eating occasion). That gives a mean of 313 g fluid/meal for those over aged 6, with CV 0.70. We assume consumption of unprocessed milk, so it corresponds to full-fat of around 3.5%, giving approximately 11 g fat/meal, with CV of 0.70.

16.1.4. Exposure duration ED

Same as residential duration, see Section 2.1.3

16.1.5. Body weight BW

Same as adult resident, see Section 2.1.6.

16.1.6. Averaging time AT

Nominal value, see Section 2.1.7.

17. Child eating farm-produced dairy products

17.1. Consumption of dairy products

17.1.1. Concentration of contaminant in farm-produced diary products Ca

The concentration of contaminant in farm-produced dairy products eaten by children is taken to be identical to the concentration in farm-produced dairy products eaten by adults. See Section 16.1.1.

17.1.2. Ingestion rate of farm-produced dairy products IRa

The same as for adults, assuming consumption at the same meals. See Section 16.1.2.

17.1.3. Meal size of farm-produced dairy products MSa

See the discussion for adults at Section 16.1.3. Applying the same methodology, censoring again at 80 g/meal, gives 252 g fluid/meal with CV 0.70. Again assuming 3.5% fat gives 8.8 g fat/meal with CV 0.70.

17.1.4. Exposure duration ED

The same as for the resident child, see Section 3.1.3.

17.1.5. Body weight BW

The same as for the resident child, see Section 3.1.6.

17.1.6. Averaging time AT

Nominal value, see Section 2.1.7.

18. Estimation of some distributions

For many data in the UMDES, we have available sample statistics consisting of the number of observations, mean, SE of mean, and various percentile points of the data (generally the median, 75th percentile, and 95th percentile; in some cases also the 5th and 25th percentiles). We wish to obtain estimates of mean and CV for these data, or to fit the data to functional forms in order to obtain more complex estimators.

18.1. Certain lognormal or other highly skewed continuous distributions

A simple approach to obtaining the mean and coefficient of variation (CV) of the distribution of which the data are a sample would be to calculate the SD of the observations from the SE of the mean multiplied by $\sqrt{N}$, and use the ratio of SD to observed mean as the CV. However, empirical exploration indicates that for lognormal distributions with large σ (*e.g.* >1) this simple approach substantially underestimates the CV most of the time. Moreover, for the UMDES data, since weighted estimates are given, the number of observations does not necessarily coincide with the effective N to use to relate the SD and SE. The same problems can be expected for other highly skewed distributions.

To attempt to get a better estimate of the CV, particularly for distributions that are likely to be lognormal or similarly skewed, an alternative approach was used. The data (mean and percentiles) were suitably transformed (*e.g.* log-transformed), and estimates obtained of the sampling uncertainties (standard deviations, SD) in each of the transformed values. For example, for a log transformation, the observed CV for the mean (the given S.E. divided by the mean) is transformed to an estimated measurement sampling SD of the logarithm using

$$\mathrm{SD} = \sqrt{\ln\left(1+\mathrm{CV}^2\right)}$$

(an exact relation for lognormal distribution parameters). For the percentiles, the sampling SD of the log-transformed values is estimated as

$$\mathrm{SD} = \sigma\sqrt{\frac{p(1-p)}{N}}\Bigg/\left(Z\left(\Phi^{-1}(p)\right)\right)$$

where p is the percentile (as a probability), N the number of observations, Z the standard normal variate function, Φ^{-1} the inverse of the cumulative standard normal, and σ the standard deviation of the normal distribution being estimated. This is an approximation based on the assumption of a lognormal distribution. For each observation (mean, and the various percentiles) construct a

normalized deviation (ratio of the difference of the observation from the value predicted by the fitted distribution to the sampling SD), sum their squares, and minimize that sum with respect to the parameters of the fitted distribution. Then use the estimated parameters on the transformed scale to estimate the mean and CV (on an arithmetic scale), using the appropriate inverse transforms. A few empirical experiments indicated that this approach, using a lognormal transformation, gave a much better estimate for the CV for lognormal distributions.

18.2. Continuous survival distributions

For continuous survival distributions (*e.g.* distributions of exposure times), the same analysis as in Section 18.1 is used, except with no logarithmic transformation. The estimated SD for an empirical percentile 100*p* is given by

$$\sigma_p = \sqrt{\frac{p(1-p)}{N}}$$

if there were *N* total observations, and the squared deviation from predicted percentage points (using the selected survival function) normalized by this SD is summed over the available percentage points, together with a similar squared normalized deviation for the mean (using the reported SE for that mean as its normalizer). The sum of squares is minimized with respect to the parameters of the selected survival function to obtain the estimates. [Note that these are all approximations, particularly because the *N* values may well be substantially incorrect because of the weighting scheme used in UMDES results reported so far.]

18.3. Certain discrete survival distributions

Several exposure time distributions in the UMDES data are obtained as discrete multiples of a unit (*e.g.* 1 year), with a minimum measure of 1 unit (otherwise the event never occurred for that observed person, so that person is not counted in the data — *e.g.* hunters must have hunted for at least one hunting season to be counted as hunters). For small times (as measured in the time unit), the distribution is highly discrete, and the percentiles given may fall within the range where the distribution takes large steps from one unit to the next. In such cases, we again estimate an expected standard deviation of the empirical percentile 100*p* as

$$\sigma_p = \sqrt{\frac{p(1-p)}{N}}$$

if there were *N* total observations. However, where the distribution is discrete, this standard deviation is applied to the deviation from the edge of the range only if the empirical percentile point falls outside the predicted range for the percentile. Thus for each fractile *p*, of the empirical survival distribution with empirical exposure time t_p (an integer multiple of the unit), the following is computed:

if	$S(t_p) < p$	then	$\left(\frac{S(t_p)-p}{\sigma_p}\right)^2$
else if	$S(t_p+1) > p$	then	$\left(\frac{S(t_p+1)-p}{\sigma_p}\right)^2$
else			0

where $S(t)$ is the fitted (discrete) survival distribution (see Section 19.2), and used as the contribution to the sum that is minimized to estimate the parameters of $S(t)$ [as in Section 18.2, this sum is carried over the available percentiles together with the mean value].

19. Evaluation of total exposure time from surveys of current exposure

This section describes the mathematics required for interpretation of surveys that collect information on exposure times up to the time of the survey (current exposure time), under the "ergodic" (steady state) hypothesis.

19.1. The continuous time case

19.1.1. Israeli and Nelson (1992) analysis

Let $S(t)$ be the probability to observe (*e.g.* in a survey) a current exposure time longer than t. Assuming a steady state[19] (Israeli and Nelson, 1992, call this the "ergodic hypothesis"), the approach of Israeli and Nelson (1992) can be used to derive from this the distribution of total exposure times. Let $P(t) = 1 - S(t)$ be the (cumulative) probability for current exposure time being less than t, with density $p(t)$; and let $M(t)$ be the probability for total exposure time being less than t, with density $m(t)$. Then

$$p(t) = \frac{dP}{dt} = -\frac{dS}{dt}$$

and the mean and variance of the current (observed) distribution $p(t)$ of exposure times[20] are

$$t_O = \int_0^\infty t p(t)\, dt = \int_0^\infty S(t)\, dt$$

$$\sigma_O^2 = \int_0^\infty (t - t_0)^2\, p(t)\, dt = 2\int_0^\infty t S(t)\, dt - t_O^2$$

(subscript O for "observed").

The steady-state hypothesis leads to

$$M(t) = 1 - \frac{p(t)}{p(0)}$$

so that[21]

$$m(t) = \frac{dM}{dt} = -\frac{1}{p(0)}\frac{dp}{dt}$$

The average exposure time is then

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[19] For application to surveys, it usually is required to postulate both constancy in calendar time of the probabilities involved and also constancy in the rate of entry into the exposed population.

[20] It is necessary (but not sufficient) that $tS(t) \to 0$ as $t \to \infty$ for the mean current exposure time to be finite; and similarly for finite mean of total exposure time requires $t(1–M(t)) \to 0$ as $t \to \infty$. All empirical functions for $S(t)$ should be designed to meet these requirements, since both these means obviously must be finite. Indeed the requirements are slightly stricter — the integrals of these expressions must exist and be finite. Throughout, we assume that all required integrals exist and are finite.

[21] $p(0)$ is proportional to the rate of entry into the employed population, which is necessarily finite; functional forms for $S(t)$ must satisfy this constraint.

$$t_m = \int_0^\infty t m(t)\, dt = \frac{1}{p(0)} \int_0^\infty p(t)\, dt = \frac{1}{p(0)} \int_0^\infty -\frac{dS}{dt}\, dt = \frac{1}{p(0)}$$

and the variance in exposure time is given (using a similar sequence of substitutions and integrations by parts) by

$$\sigma_m^2 = \int_0^\infty (t - t_m)^2\, m(t)\, dt = t_m (2t_O - t_m)$$

19.1.2. Alternative approach

The footnotes detail some of the constraints on allowable functional forms. Another approach can be enlightening. In the general case, consider an "exposed" population in which exposure may begin and subsequently permanently terminate, and any period between the start of exposure and permanent cessation of exposure is considered to be part of the exposed period. The population examined is that currently exposed — *i.e.* between the start of exposure and the permanent cessation of it. This population will be characterized by the duration of exposure t, and the calendar time T, and we assume a population density $n(t,T)$ such that at calendar time T the current number in the population exposed for durations in $(t, t + dt)$ is $n(t,T)dt$ in the limit $dt \to 0$. We also suppose that the probability per unit time to permanently cease exposure after exposure duration t and at calendar time T is $z(t,T)$, and that the number starting exposure at calendar time T is $q(T)$. Note that z is necessarily non-negative, but can be infinite.

Consideration in the limiting case of the fate of a subset of the population exposed for between t and $t + \Delta t$ after a calendar time ΔT leads to

$$\frac{\partial n}{\partial t} + \frac{\partial n}{\partial T} = -zn$$

while consideration in the limiting case of what happens at $t = 0$ during a small interval of calendar time ΔT leads to

$$n(0,T) = q(T)$$

Now suppose that the probability $z(t,T)$ is independent of calendar time T, so we may write $z(t,T) \equiv z(t)$. It is then straightforward to show that the solution for n is

$$n(t,T) = q(T - t) \exp\left(-\int_0^t z(s)\, ds\right)$$

and if also the entry rate q is a constant then

$$n(t,T) \equiv n(t) = n_0 \exp\left(-\int_0^t z(s)\, ds\right) \qquad \text{where} \qquad n_0 = n(0)$$

Comparison with Section 19.1.1 shows that we then have the identity

$$\frac{p(t)}{p(0)} = \exp\left(-\int_0^t z(s)\, ds\right)$$

which shows that p is constrained to be a decreasing function that may have finite step discontinuities (if z contains delta functions), but cannot have more extreme discontinuities (like delta functions). It follows that P (respectively S) of Section 19.1.1 must be an increasing (decreasing) function with no discontinuities.

19.1.3. A specific example — sum of exponentials

A simple functional form that meets the requirements of Sections 19.1.1 and 19.1.2 and has an upper cut-off T on the exposure time is a sum of exponentials in the form

$$S(t) = \sum_i \gamma_i \frac{\exp(-t/t_i) - \exp(-T/t_i)}{1 - \exp(-T/t_i)} \quad \text{with} \quad \sum_i \gamma_i = 1 \quad \text{for} \quad t \le T$$
$$= 0 \quad \text{for} \quad t > T$$

corresponding to

$$p(t) = \sum_i \frac{\gamma_i}{t_i} \frac{\exp(-t/t_i)}{1 - \exp(-T/t_i)} \quad \text{for} \quad t \le T$$
$$= 0 \quad \text{for} \quad t > T$$

Using this functional form, we get

$$\int_0^\infty S(t)\, dt = t_O = \sum_i \gamma_i t_i \frac{1 - (1 + T/t_i)\exp(-T/t_i)}{1 - \exp(-T/t_i)}$$

$$\int_0^\infty tS(t)\, dt = \left(t_O^2 + \sigma_O^2\right)/2 = \sum_i \gamma_i t_i^2 \frac{1 - \left(1 + T/t_i + \tfrac{1}{2}(T/t_i)^2\right)\exp(-T/t_i)}{1 - \exp(-T/t_i)}$$

and

$$t_m = \left(\sum_i \frac{\gamma_i}{t_i} \frac{1}{1 - \exp(-T/t_i)} \right)^{-1}$$

[Note: it is critical that these formulas be carefully coded to prevent substantial errors for large values of t_i.]

19.2. The discrete time case

19.2.1. Theory

For many surveys, the reported exposure times can only be integer multiples of a unit of time (*e.g.* years, months, days, seasons), with any exposure corresponding to at least one exposure time unit (*e.g.* a person classified as a hunter necessarily has hunted for one or more hunting seasons; otherwise that person is not so classifiable). The above analysis then requires a slight modification. Suppose $p(t)$ is the probability for an observed exposure time (in an instantaneous survey) of exactly t units, with t necessarily strictly positive (in particular, non-zero), with[22]

$$\sum_{t=1}^{\infty} p(t) = 1$$

We can define a cumulative function, the probability for an observed exposure time to equal or exceed t units, by

[22] As for the continuous case, it will be assumed that all the required sums exist and are finite; in reality there is a finite upper bound to exposure times for all individuals, so this requirement is always met; and all functional forms used for fitting data should be chosen with such conditions in mind.

$$S(t) = 1 - \sum_{i=1}^{t-1} p(i) \qquad S(1) = 1$$

$$p(t) = S(t) - S(t+1)$$

The mean and variance of the current (observed) distribution $p(t)$ of exposure distribution are

$$t_O = \sum_{t=1}^{\infty} tp(t) = \sum_{t=1}^{\infty} S(t)$$

$$\sigma_O^2 = \sum_{t=1}^{\infty} (t - t_O)^2 \, p(t) = 2\sum_{t=1}^{\infty} tS(t) - t_O - t_O^2$$

(subscript O for "observed").

Under the steady state hypothesis, the probability that exposure time reaches t units is just

$$\frac{p(t)}{p(1)}$$

so this is just the probability for total exposure period to equal or exceed t units. Thus defining $m(t)$ to be the probability for total exposure time to be exactly t units, we have

$$m(t) = \frac{p(t) - p(t+1)}{p(1)}$$

Then we obtain using straightforward substitution of these relations

$$\sum_{t=1}^{\infty} m(t) = 1 \qquad \text{as expected}$$

$$t_m = \sum_{t=1}^{\infty} tm(t) = 1/p(1)$$

$$\sigma_m^2 = \sum_{t=1}^{\infty} (t - t_m)^2 \, m(t) = t_m (2t_O - t_m - 1)$$

which are discrete analogs of the continuous case (Section 19.1).

19.2.2. A specific example — sum of exponentials

The analog of the continuous time case (Section 19.1.3) has

$$S(t) = \sum_i \gamma_i \frac{\exp\left(-(t-1)/t_i\right) - \exp\left(-T/t_i\right)}{1 - \exp\left(-T/t_i\right)} \quad \text{with} \quad \sum_i \gamma_i = 1 \quad \text{for} \quad t = 1, 2, \ldots, T$$

$$= 0 \quad \text{for} \quad t > T$$

(*i.e.* an identical functional form for $S(t)$ in discrete and continuous cases, except that the time is shifted by 1 unit). If we define

$$\theta_i = \left(1 - \exp\left(-1/t_i\right)\right)^{-1}$$

then the other expressions involved can be put in a form very similar to the continuous case:

$$p(t) = \sum_i \gamma_i \frac{1 - \exp\left(-1/t_i\right)}{1 - \exp\left(-T/t_i\right)} \exp\left(-(t-1)/t_i\right) \quad \text{for} \quad t = 1, 2, \ldots, T$$

$$= 0 \quad \text{for} \quad t > T$$

For the averages we get

$$\sum_{t=1}^{\infty} S(t) = t_O = \sum_i \gamma_i \theta_i \left(\frac{1 - (1 + T/\theta_i)\exp(-T/t_i)}{1 - \exp(-T/t_i)} \right)$$

$$\sum_{t=1}^{\infty} tS(t) = \left(\sigma_O^2 + t_O + t_O^2\right)/2$$

$$= \sum_i \gamma_i \theta_i^2 \left(\frac{1 - \left(1 + T/\theta_i + \tfrac{1}{2}T(T+1)/\theta_i^2\right)\exp(-T/t_i)}{1 - \exp(-T/t_i)} \right)$$

and

$$t_m = \left(\sum_i \frac{\gamma_i}{\theta_i} \frac{1}{1 - \exp(-T/t_i)} \right)^{-1}$$

[Note: as for the continuous case, it is critical that these formulas be very carefully coded to prevent substantial errors for large values of t_i.]

20. Calculations for products of independent variables

20.1. Exact calculation for a product

Let X_i, i = 1, 2, ..., n be independent variables (with any distributions such that the means and variances exist and are finite), with E(X_i) = μ_i and var(X_i) = σ_i^2. Write

$$Z = \prod_{i=1}^{n} X_i; \quad \mathrm{E}(Z) = \mu; \quad \mathrm{var}(Z) = \sigma^2$$

then it is straightforward to verify that

$$\mu = \prod_{i=1}^{n} \mu_i \qquad \text{and} \qquad \sigma^2 = \prod_{i=1}^{n} \left(\mu_i^2 + \sigma_i^2\right) - \prod_{i=1}^{n} \mu_i^2$$

Writing CV for the coefficients of variation (with obvious subscripting), the last relation can be re-written

$$CV^2 = \prod_{i=1}^{n} \left(1 + CV_i^2\right) - 1$$

These results hold exactly for any sets of independent variables X_i, no matter what their distributions, provided all the means and variances exist.

20.2. Exact or approximate calculation for an inverse

Section 20.1 evaluates a product of terms. In this application, one or more terms (always two terms, the averaging time and the body weight) are inverses, where we estimate the distribution of the inverse of the term required in the product. To apply Section 20.1 requires evaluating or estimating the parameters for the inverse of the known terms. In this case, averaging time will always be a nominal value, so known with no uncertainty or variability. Body weight is known to be accurately represented by lognormal variability distributions (*e.g.* Burmaster and Crouch, 1997). The inverse of a lognormal distribution with log parameters μ, σ is also lognormal, with parameters $-\mu$, σ, so the mean of the inverse of a lognormal may be obtained as the inverse of the mean multiplied by exp(σ^2), and the CV is the same as for the inverse. This approximation

is used here for both the body weight and the averaging time term (although, as stated, there should be no uncertainty or variability associated with the latter).

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Oral Bioavailability Values for Midland Soils and Tittabawassee River Floodplain Soils

Technical Memorandum: Oral Bioavailability Values for Midland Soils and Tittabawasee River Floodplain Soils

Site-specific data obtained from oral bioavailability studies (Exponent 2005; Exponent and Summit 2006) along with review of site-specific soil characteristics data provide the best scientific information for deriving bioavailability estimate(s) to be used in the human health risk assessments (HHRAs) for Midland Soils and the Tittabawassee River floodplain soils. Multiple lines of evidence support the use of a 25 percent relative oral bioavailability factor, which represents the midpoint of the factors derived from data for Midland and data for the Tittabawassee River. Primary among these is the site-specific peer reviewed bioavailability study in which rats and swine were fed Midland soil and Tittabawassee River floodplain soil. The bioavailability estimates from these site-specific studies were consistent with other published results for bioavailability of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and for other similar compounds. The bioavailability study data are supported by bioaccessibility results derived from *in vitro* studies on Midland soils, by the data on Midland soil characteristics, which suggest little variability, and finally by extensive site-specific biomonitoring data collected in the University of Michigan Dioxin Exposure Study (UMDES). The data for swine are thought to be the most representative of human exposure based on similarities to human gastric physiology. The bioavailability data described here can also be applied probabilistically in the event that probabilistic approaches are applied in the HHRAs for Midland or the Tittabawassee River floodplain.

The following scientific information supports the use of a 25 percent bioavailability factor:

1. **Bioavailability:** A site-specific pilot bioavailability study (Exponent 2005) and follow-up study (Exponent and Summit 2006) evaluated the bioavailability of PCDD/Fs from Midland and Tittabawassee River floodplain soils fed to rats and swine. These studies resulted in site-specific toxicity equivalent (TEQ)-weighted estimates of absolute oral bioavailability of 20 percent for local soils with corresponding relative bioavailability estimate of 25 percent based on data for swine (where undetected chemicals are assumed present at one-half the detection limit). The pilot and follow-up bioavailability studies can be found in Appendix E-3 of the Midland RI WP and Appendix C-6 of the Tittabawassee River Floodplain RIWP.

   – The gastrointestinal tract of swine is physiologically closer to humans than that of rats. As a result, swine have been identified by the U.S. Environmental Protection Agency (U.S. EPA) as the preferred model for assessment of oral bioavailability of metals from soils (U.S. EPA 2006) and were suggested for use in this site-specific bioavailability by the Michigan Department of Environmental Quality (MDEQ). Other researchers have also identified swine as a preferred model for evaluating human nutrition (Miller and Ullrey 1987; Book and Bustad 1974). For these reasons, reliance on data from swine will provide

the most physiologically relevant estimate of likely bioavailability in the human gastrointestinal tract for use in the HHRA.

- The published literature from studies on other types of soils impacted by PCDD/Fs shows results consistent with those obtained in data from these site-specific studies.

2. **Bioaccessibility:** The bioaccessibility results from Midland soils, published in a peer-reviewed scientific journal, show a relatively small desorption range of PCDDs/Fs from Midland soils (Ruby *et al*. 2002). These *in vitro* bioaccessibility results are consistent with the swine oral bioavailability data and this coherence of *in vivo* and *in vitro* evidence supports the recommendation of a 25 percent site-specific, oral bioavailability estimate.

   - The Toxicology Excellence for Risk Assessment (TERA) panel of September 21, 2006, recognized the value of bioaccessibility data in guiding the selection of bioavailability estimates (TERA comments attached as Appendix E of this memorandum).

   - The bioaccessibility data can also be used to construct distributions of potential PCDD/F bioavailability estimates to be used for area soils should probabilistic approaches be employed in the derivation of area soil criteria.

3. **Applicability of the Site-Specific Bioavailability and Bioaccessibility to the Broader Site Areas:** Although the source of PCDD/Fs in Midland (i.e., fly ash) differs from that in the floodplain (*i.e.*, PCDD/Fs adhered to a graphite or sludge matrix), the nature of the sources and the site-specific data on soil characteristics suggest that the available site-specific oral bioavailability data are adequate to represent site conditions in the HHRAs for both areas. Soil characteristics have little apparent influence on oral bioavailability. However, the variability in area soils is low and, as such, any influence would thus be negligible for the following reasons:

   - **Midland:** More than 300 Midland soils sampled and analyzed demonstrate a relatively narrow range of total organic carbon (TOC) and black carbon. An important fact is that the Midland sample assessed in the swine bioavailability study fall within the middle of the range of soil characteristics (see the information provided below which shows that these parameters [*i.e.*, total organic content and black carbon] actually have very little to no impact on *in vivo* oral bioavailability).

   - **Floodplain:** PCDD/Fs in the floodplain have a different congener profile than those in Midland soils, with higher furan content, and are thought to result from chloralkali practices from 100 years ago. PCDD/Fs were likely transported through river sediments to floodplain soils incorporated into the graphite and/or sludge matrix. As such, the PCDD/Fs likely represent a matrix independent of

naturally occurring soil organic carbon. Therefore, a single soil sample from the floodplain adequately reflects the true extent of oral bioavailability because it will be a function of either the sludge or graphite-particles in or upon which the furans reside, and not of the soils overall organic carbon content.

- Thirteen floodplain soils showed good correlations between TEQ and TOC, and had a range of organic carbon content from less than one to up to 13 percent whereas the Floodplain sample evaluated in the bioavailability study had an organic content of 2.73 percent. This suggests that to the extent that organic content has any role in bioavailability, the site-specific data should be predictive of the larger area soils. However, as discussed further below, floodplain soil characteristics are likely to be immaterial because the matrix effects controlling oral bioavailability are likely to be a function of the graphite electrode support material and not naturally occurring soil organic material composition.

- **Relative Importance of Soil Organic Carbon in Oral Bioavailability:** Soil characteristics such as organic carbon content are more significant with respect to the desorption of persistent compounds in environmental settings than they are to *in vivo* oral bioavailability with respect to either source of PCDD/Fs under consideration here. While changes in organic carbon may alter the rate of chemical desorption from the soil matrix into an aqueous environment (i.e., pore water), the difference in organic carbon does not lead to differences in oral bioavailability. Desorption of a chemical from a soil matrix into pore water, for example, is governed by the log K_{ow} (partitioning coefficient), TOC and, most significantly, organic carbon. The TOC in a soil particle can influence the partitioning between the soil particle and pore water. *In vivo* oral bioavailability, on the other hand, is influenced by a different set of factors including the lipid, protein, and carbohydrate constituents in the gastrointestinal tract along with elevated temperature, gastric motility, and a very large surface area in the small intestine designed to facilitate both the desorption of materials from their matrix as well as absorption of material once desorbed. Soil characteristics and the parameters influencing the equilibrium between the soil particles and pore water, are insignificant when viewed against the fat-absorptive efficiencies of the human gastrointestinal tract.

4. **Concordance with Biomonitoring:** The measured site-specific blood concentrations observed during the UMDES suggest that the generic exposure assumptions, including those regarding bioavailability included under MDEQ's 201 regulations, overestimate exposure and risk. Use of the generic MDEQ exposure assumptions (including bioavailability) would predict dramatic increases in blood TEQ for residents on soils at 1,000 ppt

TEQ; however, the UMDES study did not find such increases in blood TEQ compared to reference populations. This fact supports the conclusions that exposure parameters used as algorithm inputs, including the assumption of 50 percent oral bioavailability, differ significantly from site-specific realities.

The multiple lines of evidence provide a weight-of-the-evidence basis for applying a relative oral bioavailability factor of 25 percent in the HHRAs. These data are described more fully in Appendix A of this memorandum.

Appendix A: Weight of Evidence for 25 Percent Relative Oral Bioavailability

Introduction

Bioavailability tests are conducted to evaluate the extent to which PCDD/Fs in soils are absorbed in the gut following ingestion. Adjustments for bioavailability are necessary because risk assessment should be performed on the absorbed dose and not the intake estimate assumed to be ingested by a child or an adult. The amount of the chemical that is not absorbed from the gut is not toxicologically active. Particular terms used in the following document include:

- **Absolute bioavailability**: Measure of the amount of a chemical absorbed when compared to the same dose that is given intravenously. The intravenous route is selected because 100 percent of the dose gets into laboratory animals. Absolute bioavailability is estimated from the ratio of the amount of the chemical detected in the body after oral administration to the amount of the chemical detected in the body following intravenous administration.

- **Relative bioavailability**: Estimated as the ratio of the chemical found in the body after oral administration to the amount of the chemical detected in the body following a route of exposure other than the intravenous route. In this discussion, relative bioavailability is the ratio of oral absorption of PCDD/F from soil relative to oral absorption from corn oil as used in the PCDD/F toxicity studies (*i.e.*, relative bioavailability = oral absorption from soil/oral absorption from corn oil). A relative bioavailability adjustment (RBA) is often applied to account for differences in relative bioavailability.

It is generally believed that about 80 percent of a TCDD dose administered in corn oil is absorbed although the data and analyses supporting this assumption show some variability (Diliberto *et al*. 2001; Rose *et al*. 1976). The 80 percent estimate has been used here.

Reduced bioavailability from soil is thought to be a result of binding with soil; in floodplain soils, reduced bioavailability may also be related to binding with the carbon source. Because of this, bioavailability can also be evaluated through consideration of *in vitro* studies set up to simulate the degree of solubility of chemicals under the chemical conditions of the human stomach. These studies estimate bioaccessibility, which is defined as the soluble fraction of PCDD/Fs or other chemical of interest.

Both bioavailability and bioaccessibility data are available for Midland site soils and these data sets both support a 25 percent oral bioavailability recommendation (Budinsky *et al.* in press; Ruby *et al*. 2002). Specifically, Dow sponsored a pilot bioavailability study (Exponent 2005) and follow-up study (Exponent and Summit 2006) that evaluated the bioavailability of PCDD/Fs from Tittabawassee River floodplain soils (Appendix E-3 Midland RIWP; Appendix

C-6 Tittabawassee River Floodplain RIWP). These studies followed a bioaccessibility study conducted on Midland soils (Ruby *et al.* 2002). The following sections discuss these findings. Subsequent sections discuss the applicability of bioavailability and bioaccessibility data for use in the HHRAs. The following multiple lines of evidence support the use of a 25 percent relative bioavailability estimate:

- The results of the site-specific bioavailability and bioaccessibility studies for Midland and the Tittabawassee River floodplain soils
- The scientific literature on bioavailability of PCDD/Fs at other similar sites
- Data from swine are considered more representative of human bioavailability by U.S. EPA for metals and in other applications, and are proposed for use here
- Local soil characteristics studies suggest that site-specific bioavailability data are adequate for characterization of the area bioavailability
- Comparison of estimates derived assuming default bioavailability and other default exposure assumptions greatly overestimate serum TEQ as measured in the UMDES study.

Results of Bioavailability and Bioaccessibility Studies for Midland and Tittabawassee River Soils

Data concerning the two soils evaluated in the bioavailability studies are shown in Table 1 (the pilot and follow-up studies have been previously furnished, but can be provided). The Midland soil sample was selected because of its relatively high concentration of congeners and its prior evaluation in the Ruby *et al*. (2002) bioaccessibility study. The Imerman Park floodplain soil sample was selected because it contained the highest TEQ concentration that was under the U.S. EPA and Agency for Toxic Substances and Disease Registry (ATSDR) residential soil guidelines, resulting in minimal additional handling restrictions for the University of Missouri investigators (< 1,000 ppt).

Table 1. Soil characteristics in the < 250 μm fraction

Parameters	Midland Soil Dow Corporate Center CC-S-27	Tittabawassee River Imerman Park THT02769
Soil Characteristics (mean value)		
percent Solids	99.2	98.9
pH	5.77	7.69
Carbon, total organic	3.14	2.73
Coarse Sand (250 μm–2 mm)	31.1	42.1
Fine Sand (160–250 μm)	44.9	26.8
Very Fine Sand (75–160 μm)	11.4	8.78
Percent Silt (4–75 μm)	12.1	21.4
Percent Clay (< 4 μm)	0.5	0.86
Congener Concentration pg/g TEQ (mean value)		
	131 (TCDD)	215 (TCDF)
	66.9 (1- PeCDD)	53.8 (1-PeCDF)
	7.35 (1,6-HxCDD)	441 (4-PeCDF)
	11.7 (1,4,6-HpCDD)	71.9 (1,4-HxCDF)
	18.0 (4-PeCDF)	16.4 1,6-HxCDF)
	269 (TEQ)[a]	847 (TEQ)[a]

[a] TEQ estimates reflect the World Health Organization toxicity equivalence factor values (Van den Berg et al. 1998).

The relative oral bioavailability estimates for the various congeners (Tables 2 and 3, and Figure 1), and on a TEQ-weighted basis (Table 4) and absolute oral bioavailability results on a TEQ basis (Table 4), are shown in the following figure and tables. A value of 25 percent relative oral bioavailability was selected from Table 4 as the midpoint of the values from Midland and Tittabawassee River data, based on undetected values set at one-half the detection limit (DL=1/2).

Table 2. Congener-specific mean relative bioavailability estimates for Midland Soil–Pilot Study

Congener	Rat Mean percent RBA (SD)	Swine Mean percent RBA (SD)	
		½ DL[a]	DL[a]
TCDD	35 (4.2)	18 (7.7)	22 (4.4)
1-PeCDD	40 (3.2)	24 (9.8)	34 (6.8)
1,6-HxCDD	47 (3.3)	38 (20.9)	45 (14.4)
1,4,6-HpCDD	34 (2.7)	55 (17.6)	55 (17.6)
4-PeCDF	40 (2.4)	32 (9.9)	41 (7.8)

[a] Non-detectable tissue concentrations replaced with one-half detection limit (DL) or detection limit.

Table 3. Congener-specific mean relative bioavailability estimates for the Floodplain Soil–Pilot Study

Congener	Rat Mean percent RBA (SD)		Swine Mean percent RBA (SD)	
	Pilot	Follow-up	½ DL[a]	DL[a]
TCDF	89 (12.6)	62 (8.1)	22 (5.7)	23 (5.8)
1-PeCDF	58 (6.4)	57 (6.3)	30 (13.8)	34 (9.9)
4-PeCDF	52 (3.6)	56 (4.5)	27 (3.5)	27 (3.5)
1,4-HxCDF	57 (3.4)	56 (4.7)	35 (4.2)	35 (4.2)
1,6-HxCDF	56 (5.0)	61 (6.1)	37 (3.3)	37 (3.3)

[a] Non-detectable tissue concentrations replaced with one-half detection limit (DL) or detection limit.

The pilot study relative bioavailability results are displayed in Figure 1. A discussion of detection limits achieved in these experiments is found in Appendix B; however, a complete discussion of the detection limits for the bioavailability studies can be found in Appendix D (Tables D-5 through D-12) submitted to MDEQ as part of the first bioavailability report and can be found in Appendix E-3 of the Midland RIWP and Appendix C-6 of the Tittabawassee River Floodplain RIWP.

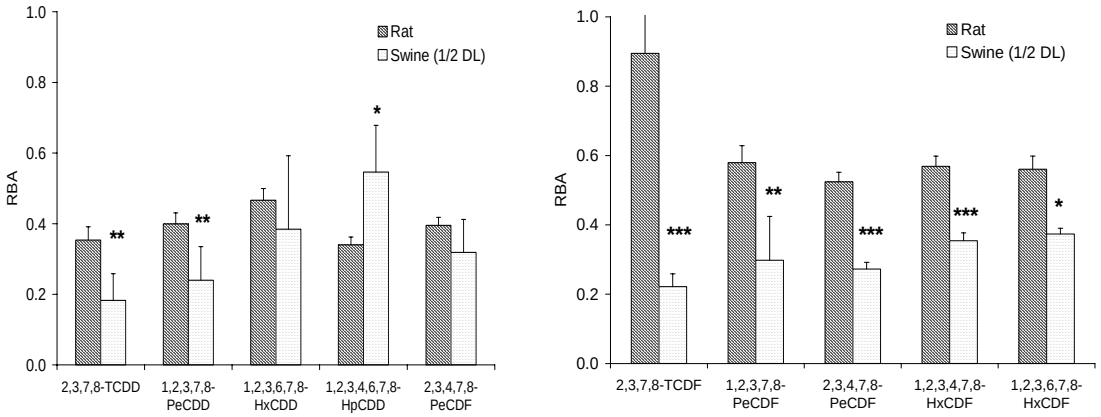

Figure 1. Congener-specific relative bioavailability observed in the Pilot Study (Midland [left] and Tittabawassee River [right]); * = p<0.05, ** = p<0.01, *** = p<0.001.

Table 4. TEQ-weighted overall RBA and absolute bioavailability estimates

	Midland Soil		Tittabawassee River Flood Plain Soil	
	RBA	Absolute Bioavailability[a]	RBA	Absolute Bioavailability[a]
Rat – Pilot	0.37	0.30	0.63	0.51
Rat - Follow-up	NR	NR	*0.58–0.60*	*0.46–0.48*
Swine (ND=1/2 DL)	0.23	0.19	0.27	0.22
Swine (ND=DL)	0.29	0.23	0.27	0.22
In vitro bioaccessibility estimate:	0.17		Not measured	

Note: DL - detection limit
ND - not detected
NR - not repeated in the follow-up study

[a] Absolute bioavailability estimated assuming 80 percent bioavailability from corn oil vehicle as follows: absolute bioavailability = relative bioavailability ×0.8 bioavailability in corn oil vehicle.

Selection of Representative Bioavailability Estimate for Site-Specific Human Health Risk Assessments

A site-specific TEQ-weighted estimate of absolute oral bioavailability of 20 percent for local soils is to be used in the risk assessment algorithms for both Midland and Tittabawassee River, with corresponding relative bioavailability estimate of 25 percent based on data for swine (where undetected chemicals are assumed present at one-half the detection limit). This position is supported by the following: data from bioavailability analyses in other settings; data indicating that swine are the most representative animal model for evaluating human exposure potential; and site-specific data on soil characteristics. More fundamentally, the findings of the UMDES comprehensive site-specific exposure and biomonitoring evaluation versus blood levels predicted using MDEQ algorithm assumptions also support a lower bioavailability estimate than the assumed 50 percent estimate applied in the MDEQ default 201 soil criteria.

Published Literature on Bioavailability of Dioxins and Furans from Soils Supports Site-Specific Study Estimate

Published bioavailability studies that can be used to provide perspective concerning oral bioavailability from soil is shown in Table 5. Liver concentration data, when available, were used to estimate relative bioavailability of the soil-TCDD matrix to a solvent-TCDD solution (usually corn oil). Some of the studies provide insufficient data for quantifying bioavailability. Absolute bioavailability was estimated by assuming some fractional oral bioavailability for the corn oil solutions (usually 80 percent [Diliberto *et al*. 2001; Rose *et al*. 1976]). It is recognized that many of these studies involve rodents, which are not considered to be as representative as swine as a result of limitations in extrapolation to humans imposed by physiological differences in intestinal tract anatomy and physiology compared to humans (U.S. EPA 2006; Casteel *et al*. 2006).

Table 5. Literature values for oral bioavailability of dioxin- and furan-contaminated soils

Study	Test Species	Site	Particle Size (microns)	TCDD Concentration in Soil (μg/kg)	Relative Bioavailability	Absolute Bioavailability
Lucier *et al.* (1986)	Female Sprague Dawley rats	Minker Stout	< 250	880	21–45	17–36
McConnell *et al*. (1984)	Guinea pigs	Times Beach and Minker Stout	< 250	770–880	14–19	11–15
Wendling *et al*. (1989)	Guinea pigs	Times Beach and Newark, NJ	NA	510–1,400	1.6–30	1.3–24
Bonaccorsi *et al*. (1984)	Albino rabbits	Seveso	37–74	81	33–40	27–33
Shu *et al*. (1988)	Sprague Dawley rats	Times Beach	< 420	723	53–70 percent	37–49[a] (mean of 43)
Umbreit *et al*. (1986)	Guinea pigs	Times Beach and New Jersey Salvage Yard	NA	2,280	0.5–21.3[b]	
Wittsieppe *et al.* (2007)	Minipigs	Hamburg	100–200	27–51	2–39.8[c] 22.8–42.2[d]	1.6–31.8[c] 18.3–33.8[d]

Note: NA - information on sieve or mesh size not provided

[a] Shu *et al*. (1988) assumed 70 percent absolute bioavailability for corn oil.

[b] Umbreit *et al*. (1986) provides these bioavailability estimates in text. No corn oil liver data were provided.

[c] Range for dioxin congeners (*i.e*., TCDDs relative bioavailability was 2 percent).

[d] Range for furan congeners (*i.e*., 4-PeCDFs relative bioavailability was 34.4 percent).

Overall, the data demonstrate:

1. Less than 50 percent relative oral bioavailability for TCDD from a variety of soil matrices.

2. The greatest relative oral bioavailability was observed with Times Beach soils where the waste oil spraying may have resulted in the most bioavailable matrix and where the authors observed a 70 percent absorption from corn oil, which resulted in a higher relative bioavailability estimate (i.e., relative bioavailability = bioavailability from soil/bioavailability from corn oil). In contrast, reduced bioavailability has been observed in other settings where TCDD was present from other sources, including incinerator wastes consisting predominantly of black carbon.

3. The estimate of 25 percent relative bioavailability derived here is well within the range observed in other settings.

Wittsiepe *et al.* (2007) is the most relevant study for evaluating literature support for using the swine bioavailability data in the HHRA(s). These authors conducted a 28-day feeding study where four minipigs consumed PCDD/F-contaminated soil mixed in with food pellets. Another group of fouranimals consumed a solvent extract of the soil added to the food. Feeding lasted

28 days. The soil used in this study had two characteristics in common with floodplain soil: a greater percentage of furans contributing to the TEQ and the source of PCDD/Fs was sediments—in this case the soil obtained from Hamburg, Germany, that had received dredge materials from the nearby harbor. The average relative bioavailability for dioxin and furan compounds in soil compared to corn oil in this study was 28.4 percent (standard deviation: 9.9 percent), similar to the estimate of 25 percent proposed for the Midland and Tittabawassee River floodplain HHRAs. A copy of the Wittesiepe *et al.* (2007) paper is included as Appendix D of this memorandum.

Swine Represent Human Gastric Absorption Better Than Rats

The use of the swine bioavailability estimates will introduce less uncertainty in calculating theoretical exposures than would the use of oral bioavailability results from the rat studies. This is because of the close similarity between human and swine gastrointestinal physiology. First, allometric scaling between swine and humans is not needed because of similarities in size (compared to children), anatomy, and physiological function of the gastrointestinal tract. Humans and swine have comparable liver weights, hepatic blood flow, and clearance rates in relationship to body weight, and according to Boxenbaum (1982), this eliminates the need for allometric scaling. In contrast, allometric scaling must be considered when extrapolating from rats to humans, thereby adding uncertainty in extrapolating results from rats to humans.

For these reasons, pigs have become the preferred animal model for bioavailability assessment of soils contaminated by metals (U.S. EPA 2006; Casteel *et al.* 2006). In addition, pigs, along with monkeys and dogs, are preferred pharmacokinetic models for evaluating pharmaceuticals and environmental chemicals such as lead and cadmium (Krishnan *et al*. 1994; Eklund *et al.* 2004; Weis and Lavelle 1991). Moreover, pigs are a preferred species for modeling human nutrition (Miller and Ullrey 1987; Book and Bustad 1974). Miller and Ullrey (1987) concluded:

> It is apparent that there are important similarities and differences between pigs and people. Fortunately, for those intent on studying digestive function, the morphology and physiology of the gastrointestinal systems are much alike. …it is apparent that the omnivorous pig is one of the best models for study of nutrition issues in the omnivorous human. (page 376)

The similarity in the gastric tract function between humans and swine is partly a result of comparable intestinal enzyme development and motility, especially with regard to human infants (Redel *et al*. 1997; Shulman *et al*. 1988; Morgan *et al*. 1987; Groner *et al*. 1990).

In contrast to observed similarities with pig gastric function, the human and rat intestinal tracts differ in critical anatomical and physiological parameters that may influence the elements of liberation and absorption of materials contained within or on a solid matrix. Rats possess a forestomach, lack a gallbladder, and typically eat continuously during their active hours. The influence of the continuous feeding behavior of rats, and fundamental anatomical and physiological differences between rats and humans add to the uncertainty in the use of rat data for predicting a human response. For these reasons, U.S. EPA has demonstrated a preference for data from swine over data from rats for understanding the relative oral bioavailability of

metals in soil, as swine are expected to be a better surrogate than rats for estimating oral bioavailability in humans.

For comparison, the following dietary information was obtained on-line at the Purina (PMI Nutrition International Rodent Lab Diet) and Ziegler Brothers internet sites (Ziegler Brothers Swine Diet). These diets were used in the rat and swine studies, respectively.

Guaranteed Analyses

Diet Components	**PMI Rodent Lab Diet**	**Ziegler Bros. Swine Diet**
Crude Protein, not less than	23%	14%
Crude Fat, not less than	4.5%	4.0%
Crude Fiber, not more than	6.0%	5.0%
Ash, no more than	8.0%	8.0%

The 'dough balls' used to feed the swine (control dosage or soil dosage) consisted of the regular swine diet that was wetted to allow burial of the soil into the feed (no vehicle). The soil itself (Midland and the floodplain) was directly added to the dough ball (one gram) and then fed to the pigs.

Feed was mixed with soil in a ball in order to ensure that the animals received the entire dose and did not loose any of the soil to their enclosure while eating. As described on page 11 of the Pilot Study work plan, one gram of soil was mixed with 20 grams of moistened feed. The animals were fasted for two hours prior to dosing in order to increase the acceptance of the feed/soil combination.

The control dosage used in the swine study consisted of the five predominant congeners (TCDD, 1-PeCDD, 1,6-HxCDD, 1,4,6-HpCDD and 4-PeCDF for Midland; TCDF, 4-PCDF, 1-PCDF, 1,4-HxCDF and 1,6-HxCDF for the floodplain) dissolved in corn oil. The corn oil was then placed into a gelatin capsule. The gelatin capsule was then inserted into the wetted swine diet (the "dough ball"). A comparison of the congener profile used in these experiments to that of the Midland or Floodplain soils can be found in Appendix C of this memorandum.

Local Soil Characteristics Indicate Bioavailability Estimates Are Representative

The results of the soil characteristics studies of Midland and Tittabawassee River floodplain soils show little variability, and thus do not require multiple samples to assess bioavailability.

The scientific basis for this conclusion will be discussed separately for Midland and Floodplain soils.

Midland

Soil samples from Midland (n=352, Table 2-1 of CH2M Hill 2007) were submitted for dioxin and furan analyses that also included TOC and black carbon for 337 of these samples. The results for TOC and black carbon for Midland soils are shown in Figures 2 and 3, respectively.

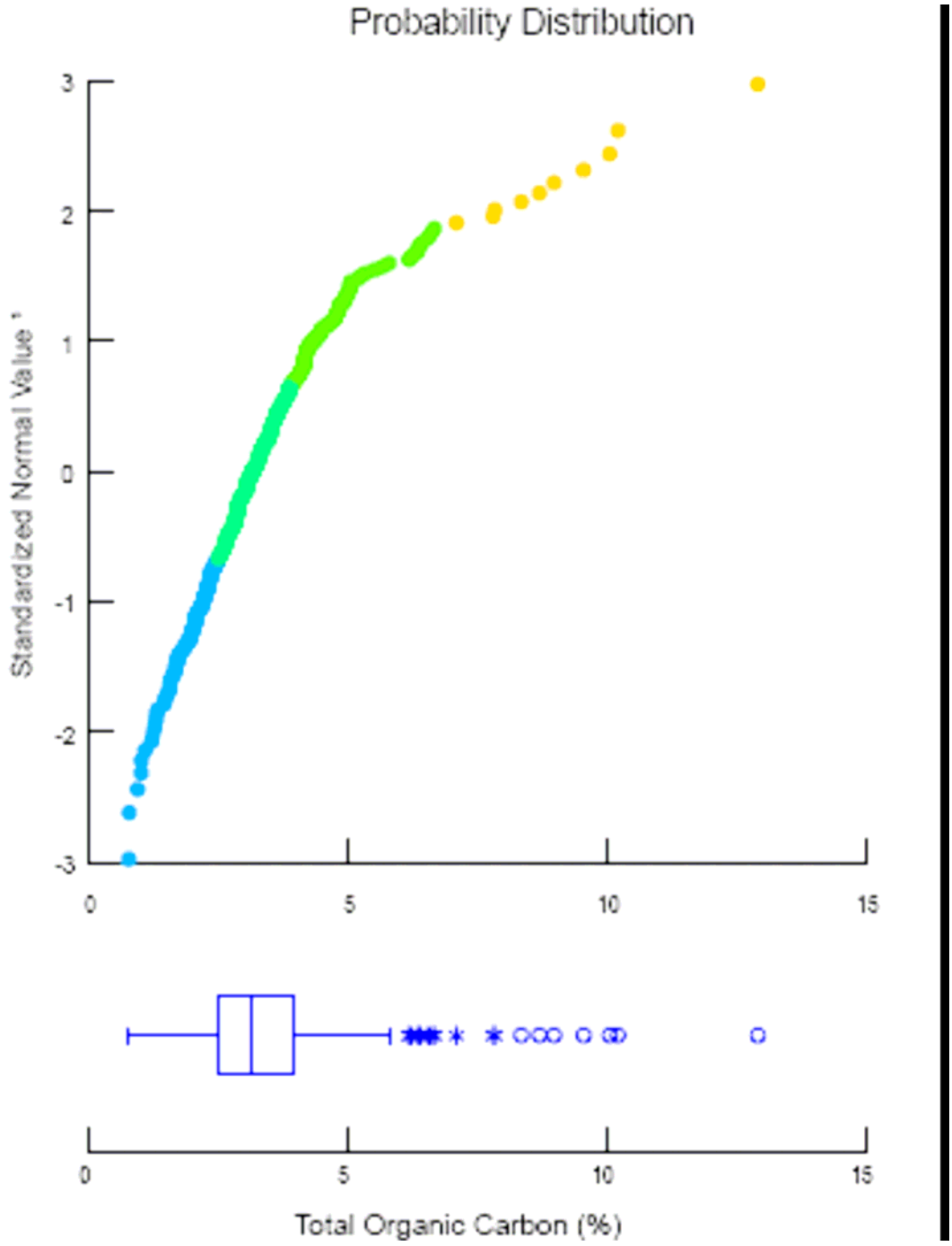

Figure 2. Distribution of TOC content of Midland soil samples (CH2MHill 2007)

The mean and standard deviation for TOC were 3.16 and 1.50, respectively (Figure 2). Ninety five percent of TOC falls between 0.16 and 6.16 percent. The Midland soil sample TOC tested in swine was 3.14 percent, which is almost identical to the average TOC concentration in Midland soil. The relatively small range of TOC should have little impact on the range of potential oral bioavailability, to the extent that TOC has any influence.

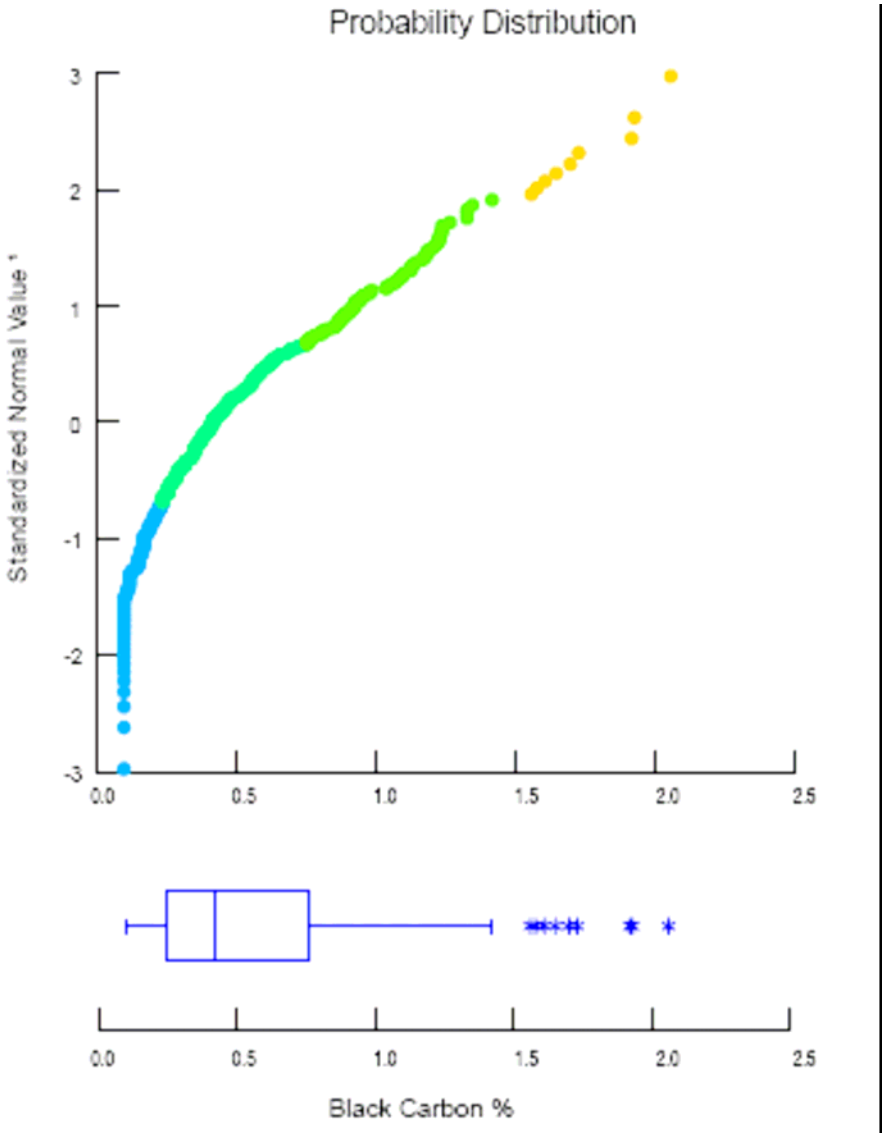

Figure 3. Distribution of black carbon content of Midland soil samples (CH2MHill 2007)

The mean black carbon percentage was 0.42 percent with 95 percent of the samples ranging from 0 to 1.18 percent (Figure 3). As with the TOC, the small range of black carbon should have little impact on oral bioavailability if related at all.

Data from the initial bioaccessibility study of Ruby *et al*. (2002; Figure 4) suggest that for the Midland soils evaluated in their study, the TEQ was correlated with TOC, whereas bioaccessibility (a measure of desorption) was not highly correlated with or was independent of either TOC or TEQ.

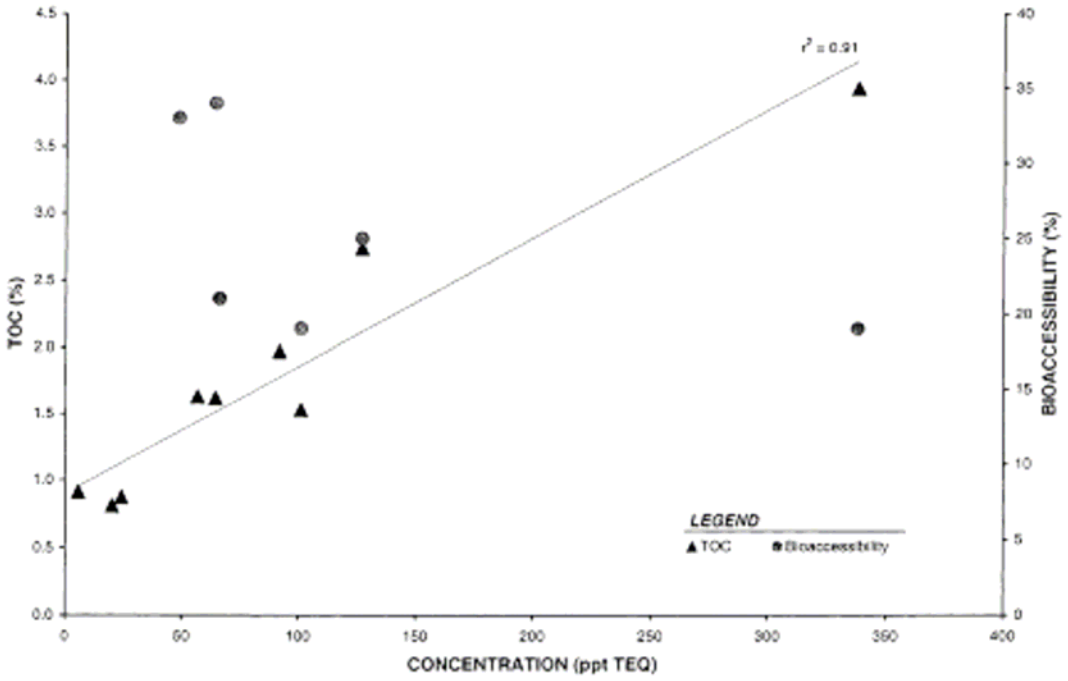

Figure 4. Figure 2 from Ruby *et al.* (2002).

While TOC was highly correlated with TEQ, bioaccessibility was not highly correlated with either TOC or TEQ in the tested samples.

Floodplain

Thirteen floodplain soil samples from four locations were analyzed (Levee, High Terrace, Low Terrace, and Wetland) for soil samples taken at various depths, and the organic content in these soils was well correlated with the TEQ measurements. The organic content in the soils ranged from less than 1 percent to 13 percent. Thus, to the extent that organic content is predictive of oral bioavailability, the soil sample evaluated in the bioavailability study, which had an organic content of 2.73 percent, would provide a conservative basis for the HHRA.

The Graphite Electrode Matrix Is Independent of Soil Characteristics

It is believed that the floodplain soil TEQ, with its unique furan profile, resulted from the use of graphite support materials and graphite-related sludge that occurred with historic chloralkali production around the late 1800s.

> …The formation of high levels of PCDF and other chlorinated organic compounds is tied to the use of coal or graphite electrodes (sludge from electrolysis cells resulting mainly from reaction of chlorine with the pitch binder of graphic anodes). These electrodes have been used since the beginning of industrial chlorine production via chloroalkali electrolysis in 1890. … (Otto *et al.* 2006).

Sludge formed from the degradation of graphite electrodes, enriched in furan profiles identical to the river floodplain soils and sediment, has been described by other investigators in other locations (Rappe *et al*. 1990; Svensson *et al*. 1993, Ying *et al*. 2000). PCDFs incorporated into the graphite and/or sludge matrix represents a matrix independent of naturally occurring soil organic carbon. Therefore, a single soil sample from the floodplain adequately reflects the true extent of oral bioavailability because it will be a function of either the sludge or graphite particles in or upon which the furans reside, rather than the soil's overall organic carbon content.

Environmental Desorption and *In Vivo* Oral Bioavailability: Role of Organic Carbon

Desorption from the soil matrix (environmental release and transport) of persistent compounds differs from oral bioavailability. Oral bioavailability is the absorption of persistent compounds from the intestinal tract. Desorption typically describes the process whereby a persistent compound is released from its solid matrix (soil), and is highly influenced by organic carbon including black carbon (Koelmans *et al.* 2006).

Oral bioavailability of persistent compounds from the lumen of the intestinal tract across the surface of the gut wall is governed by the process known as liberation (from the acronym LADME or Liberation, Absorption, Distribution, Metabolism and Elimination [Ritschel 1980]). Liberation is partially controlled by the matrix (soil) but is more dependent upon intestinal factors including bile acids, proteins, carbohydrates, gastric motility, surface area, first pass effect, biliary-hepatic recycling, and unique species' differences in these parameters. In studies of *in vitro* gastrointestinal models the presence of bile acids has been found to be an important factor.

In environmental settings, bile acids are obviously not present and desorption from the soil matrix and subsequent absorption are more controlled by soil related factors, including organic carbon (Oomen *et al.* 2004). For example, Pu *et al.* (2005) showed that increasing organic soil content by six-fold reduced desorption (environmental bioavailability) of PCB 118 and PCB 52 by about 30 percent or less, whereas *in vivo* oral bioavailability of the same soils in rats was not reduced by increasing organic carbon content. In another study, organic carbon content of soils was found to have no influence on the oral bioavailability of pentachlorophenol (Pu *et al*. 2003). Fries and Marrow (1992) found no difference in relative oral bioavailability estimates for two hexachlorobiphenyl compounds in soils containing 0.65, 1.6, and 14 percent organic material. The absence of organic carbon's influence on oral bioavailability persisted even after the soils had been aged six months. In some instances, even environmental bioavailability may be independent of organic content in soil. For example, two studies looking at soil impacted by paper mills and a chlorophenol plant found that organic content was not associated with bioavailability in *Lumbriculus variegates*, which is an aquatic version of the earth worm (Lyytikainen *et al*. 2003a,b).

In summary, soil characteristics such as organic carbon content may influence desorption, but would be insignificant in the intestinal tract, where other variables, such as bile acid, are much more important. Overall, organic carbon was not a significant factor influencing oral bioavailability in the studies available to date. Both soils tested in the bioavailability study were in the middle of the range of characteristics observed in the local Midland and floodplain soils for organic carbon and black carbon.

The UMDES Data: Observed versus Predicted Blood Data for Total TEQ Using MDEQ Exposure Assumptions

The University of Michigan (UMDES 2006) data for TEQ can be used to examine the validity of the various bioavailability parameters as well as the overall risk assessment exposure model. Using a simple one-compartment model, a 7.5-year half-life for PCDD/Fs, the MDEQ Part 201 regulation assumptions for adult exposure (including frequency and soil ingestion rates), and a 50 percent bioavailability rate, the increase in blood TEQ associated with different durations of residence on soils contaminated at 1,000 ppt TEQ can be predicted. These predicted estimates can be compared to the results obtained for blood TEQ by the University of Michigan, for Floodplain and Near Floodplain residents.

Figure 9 presents the predicted increment in blood TEQ resulting from use of the MDEQ Part 201 assumptions regarding oral and dermal exposure (frequency, ingestion rate, dermal

contact surface area and adherence rate, and bioavailability) for adults following 17 years of residence on soil contaminated at 1,000 ppt, and assuming a composite 7.5 year half-life for elimination of these compounds. Figure 9 also presents the finding of the UMDES study of a less than 1 ppt increment in blood TEQ associated with an average of 17 years of residence on properties with soil at 1,000 ppt. The theoretical assumptions incorporated into the MDEQ algorithms overpredict the observed result by a factor of approximately 20.

This demonstrates that the exposure assumptions used by MDEQ, including the estimate of bioavailability, are overly conservative. These exposure assumptions represent upper bound estimates on all parameters over the lifetime of an individual. However, in reality, for each of the parameters, an individual is highly unlikely to experience upper bound conditions continuously, including continuous contact only with soils at the high end of the distribution on their property and other locations where they go. The disparity between the theoretical estimates and the observed small difference related to soil on blood concentrations supports the use of more realistic, data-based assumptions (as well as probabilistic approaches), including the site-specific bioavailability data, in the risk assessment.

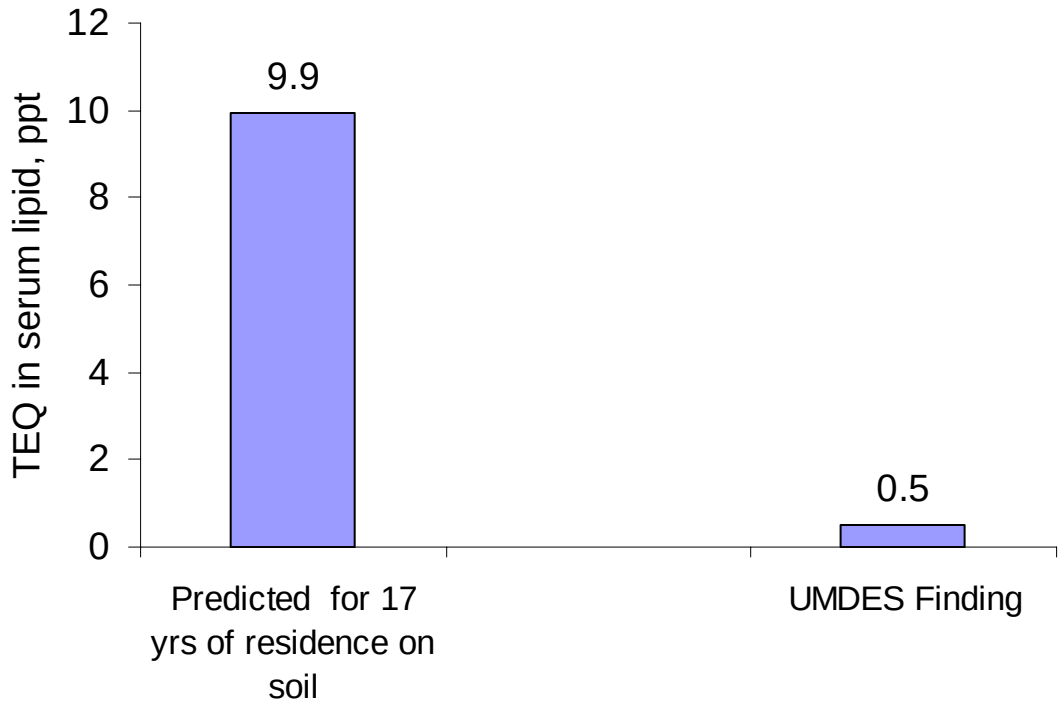

Figure 9. Theoretical increase in blood concentrations in an adult based on MDEQ Part 201 exposure assumptions (updated dermal exposure assumptions, 0.5 relative bioavailability of soil) for an adult residing on soil contaminated at 1,000 ppt TEQ for 17 years compared to the findings from the UMDES study.

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Appendix B:
Detection Limits Associated with the Bioavailability Pilot and Follow-up Studies

The following tables present data from the Swine liver and adipose for the Midland soil group as an example of the detection limits achieved in the experimental design. The designation "J" indicates detected but below the level of quantitation. "U" indicates not-detected. "Um" designates a non-detected congener estimated as the highest possible concentration based on the detection limits of the assay.

Complete information on rat and swine liver and adipose concentrations and their respective detection limits can be found in "Appendix D", Tables D-5 through D-12t of the first pilot study report on bioavailability. This report can be found in Appendix E-3 of the Midland RIWP and Appendix C-6 of the Tittabawassee River Floodplain RIWP.

Swine Liver Tissue Concentration – Midland Soil (Group 3)

Analyte	Pig #1 (pg/g)	Pig #2 (pg/g)	Pig #3 (pg/g)	Pig #4 (pg/g)	Pig#5 (pg/g)
TCDD	0.200 J	0.224 J	0.174 U	0.284 J	0.248 J
1-PCDD	0.195 U	0.232 J	0.120 U	0.189 U	0.208 Um
1,6-HxCDD	0.401 U	0.408 J	0.225 Um	0.268 Um	0.402 Um
1,4,6-HpCDD	5.17	12.0	6.81	8.46	11.9
4-PCDF	0.425 J	0.856 J	0.558 J	0.600 J	0.816 J

J: Detected but below the limit of quantitation
U: Nondetect; value represents detection limit
Um: Nondetect; value represents estimated maximum possible concentration

Swine Adipose Tissue Concentration – Midland Soil (Group 3)

Analyte	Pig #1 (pg/g)	Pig #2 (pg/g)	Pig #3 (pg/g)	Pig #4 (pg/g)	Pig#5 (pg/g)
TCDD	0.508 Um	0.638 Um	0.773 J	0.805 J	0.814 J
1-PCDD	0.443 Um	0.611 Um	0.552 J	0.750 J	0.677 Um
1,6-HxCDD	0.500 U	0.956 J	0.833 Um	1.39 J	1.25 J
1,4,6-HpCDD	5.62	7.67	8.15	11.4	9.81
4-PCDF	0.390 U	0.308 Um	0.303 Um	0.504 J	0.436 Um

J: Detected but below the limit of quantitation
U: Nondetect; value represents detection limit
Um: Nondetect; value represents estimated maximum possible concentration

Appendix C:
Congener Breakdown of Soils used in Bioavailability Studies Compared to Area Soils

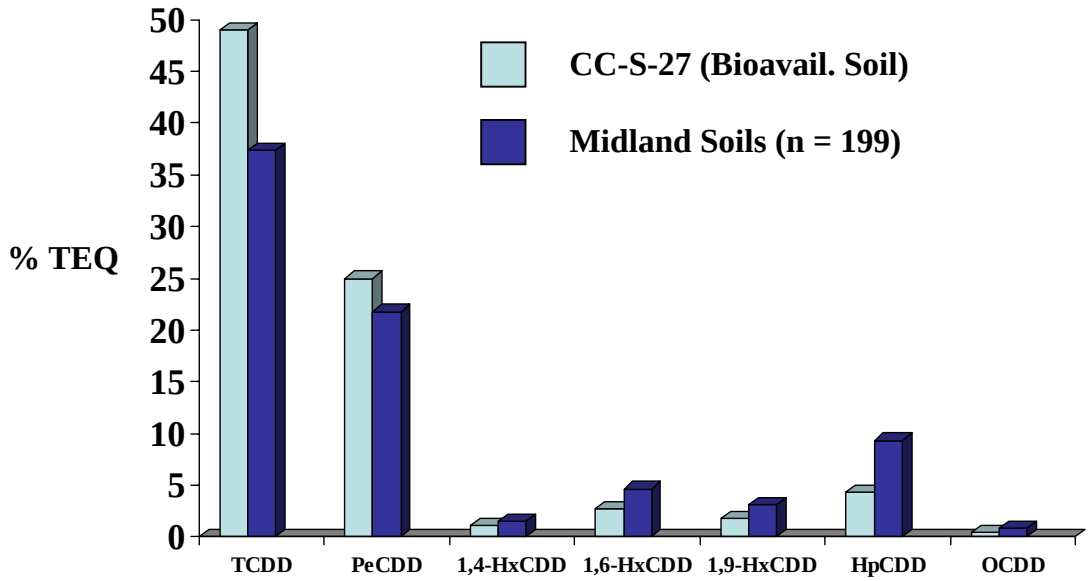
The following graph depicts the congeners contribution to the overall TEQ for the soil groups compared to congener-TEQ-contribution measured in Tittabawassee River floodplain soils and Midland Soils.

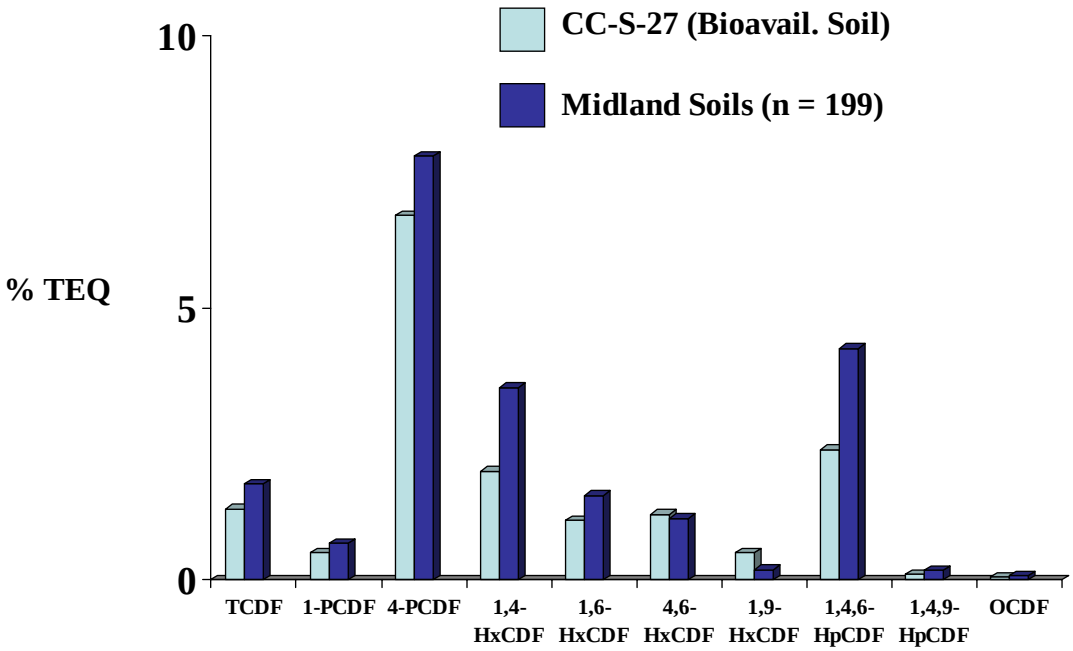
The first two graphs depict the dioxin and furan congener pattern for the Bioavailability Study Soil (CC-S-27) versus the Median value of 199 Midland soil samples.

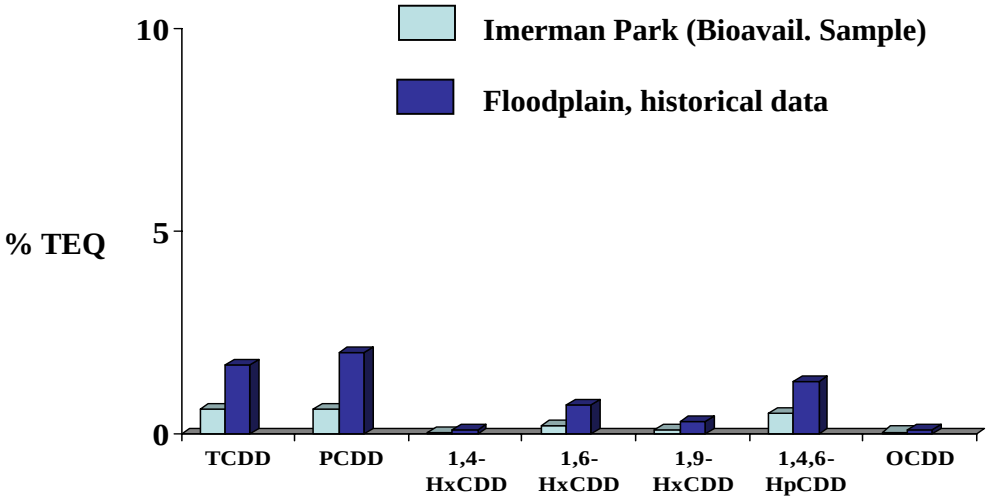
The second two graphs depict the dioxin and furan TEQ contribution for the Tittabawassee River Floodplain soil (Imerman Park 2) compared to historical data on floodplain soils.

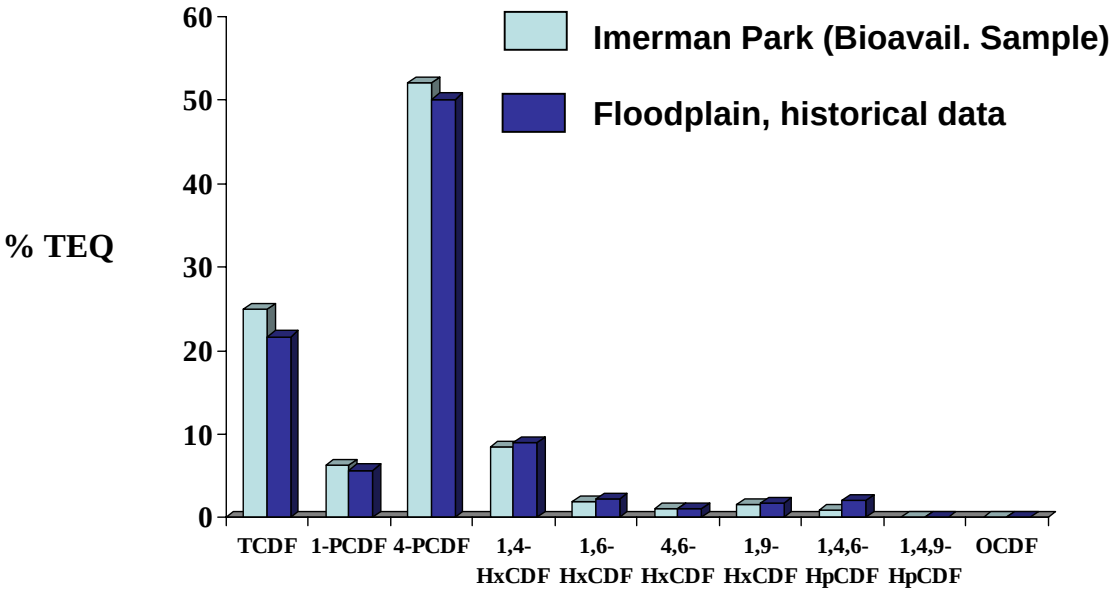
All of the comparisons are based on the 1998 WHO TEFs (van den Berg et al, 1998). This was done because the original Pilot study, prior to the follow-up study, was done before the 2005 WHO TEFs came out. Adjusting with the 2005 WHO TEFS would simply result in a proportional adjustment of the % TEQ with about a 60% reduction in the contribution of 4-PeCDF to the over TEQ.

Overall, these data show that the soils used in the bioavailability study and those analyzed in Midland and the floodplain have comparable congener contributions to the TEQ. In the River, >94% of the TEQ is due to the furans, whereas in Midland dioxins are a more important contributor to the TEQ than furans.




CC-S-27 (Bioavail. Soil)
Midland Soils (n = 199)
% TEQ
10
5
0
TCDF
1-PCDF
4-PCDF
1,4-HxCDF
1,6-HxCDF
4,6-HxCDF
1,9-HxCDF
1,4,6-HpCDF
1,4,9-HpCDF
OCDF


Imerman Park (Bioavail. Sample)
Floodplain, historical data
% TEQ
10
5
0
TCDD
PCDD
1,4-HxCDD
1,6-HxCDD
1,9-HxCDD
1,4,6-HpCDD
OCDD


% TEQ
60
50
40
30
20
10
0
Imerman Park (Bioavail. Sample)
Floodplain, historical data
TCDF
1-PCDF
4-PCDF
1,4-HxCDF
1,6-HxCDF
4,6-HxCDF
1,9-HxCDF
1,4,6-HpCDF
1,4,9-HpCDF
OCDF

Appendix D:

Wittespie *et al.* 2007. Bioavailability of PCDD/F from contaminated soil in young Goettingen minipigs. ChemoSphere. S355-S364

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Bioavailability of PCDD/F from contaminated soil in young Goettingen minipigs

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Abstract

For the general population the intake of food of animal origin is the main route of human exposure to polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/F). Besides this the ingestion of contaminated soil might be an important exposure path for small children. For risk assessment the knowledge of the bioavailable fraction of soil bound contaminants is important.

In a balance study with young Goettingen minipigs the oral bioavailability of PCDD/F from contaminated soil was estimated by determination of the retention of PCDD/F from soil in different organs and tissues. Relative bioavailability was estimated by comparing the retention from soil to the retention of PCDD/F in organs and tissues after oral administration of a PCDD/F mixture extracted from the same soil by solvent. The soil had a PCDD/F-contamination of 5.3 μg I-TEq/kg and originated from a former arable land that had been treated with sludge from the port of Hamburg some years ago. Two groups of each four animals were exposed daily for 28 days via their diet either to 0.5 g soil per kg body weight and day (2.63 ng I-TEq/(kg_{bw} · d)) or to a daily dose of 1.58 ng I-TEq/(kg_{bw} · d) given to the diet by solvent. Five unexposed animals were used as a control group.

Liver, adipose tissue, muscle, brain and blood were analyzed for their PCDD/F content. Accumulation of PCDD/F from soil or solvent in comparison to control animals was only observed for congeners with 2378-chlorosubstitution and predominantly took place in the liver. Bioavailability of 2378-chlorosubstituted congeners was in the range of 0.64%–21.9% (mean: 10.1%) from soil and 2.8%–59.8% (mean: 31.5%) when administered by solvent. The soil matrix reduced the bioavailability by about 70%. Expressed as I-TEq only 13.8% of the PCDD/F contamination were bioavailable from soil. The relative bioavailability of 2378-chlorosubstituted congeners from soil in relation to administration by solvent was in the range of 2%–42.2% (mean: 28.4%).

When not considering the bioavailability, the risk by oral uptake of PCDD/F contaminated soil might be overestimated.

Keywords: Polychlorinated dibenzo-*p*-dioxins; Polychlorinated dibenzofurans; Bioavailability; Soil; Accumulation; Minipigs; Swine

1. Introduction

Generally humans are exposed to polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) mainly via intake of food of animal origin. In contrast to the oral pathway inhalation or dermal uptake of PCDD/F is of minor relevance. For young children however, the oral ingestion of contaminated soil can be a major route of PCDD/F exposure. Soil ingestion estimates for children in the range of 50–200 mg per day have been discussed by several authors (Binder et al., 1986; Clausing et al., 1987; Calabrese et al., 1989; Calabrese et al., 1990; Calabrese et al., 1991). Children showing pica-behaviour can ingest up to several gram soil per day.

Since PCDD/F are able to bind to certain soil constituents they become progressively less available over time for uptake by organisms and exerting toxic effects. These factors are currently not reflected by most methods for determination of risk from contaminated soil and it is assumed that the risk is overestimated in most cases (Alexander, 2000).

In several animal studies the uptake of orally administered PCDD/F from different exposure media was

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investigated. When PCDD/F are administered to rats, guinea pigs, mice or monkeys by using a readily available dosing vehicle like oil or solvent a decreasing bioavailability with the grade of chlorination was observed. The values dropped from 70% to 90% for 2378-TetraCDD to 2–15% for OctaCDD (Birnbaum and Couture, 1988; van den Berg et al., 1994; Diliberto et al., 1996). Liver and adipose tissue were the major storage compartments for PCDD/F and in particular 2378-substituted congeners are accumulated (Abraham et al., 1989; van den Berg et al., 1994; Diliberto et al., 1996; Körner et al., 2002).

In relation to PCDD/F given by solvent or oil the absorption of PCDD/F administered by soil is lower. For rats, rabbits and guinea pigs bioavailability of 2378-TetraCDD from naturally contaminated soil is between 16% and 50% (Bonaccorsi et al., 1984; McConnell et al., 1984; Lucier et al., 1986; Umbreit et al., 1986; Shu et al., 1988; Umbreit et al., 1988). Poiger and Schlatter (1980) found bioavailability values of 16–24% for 2378-TetraCDD in rats when the substance was artifically added to the soil for feeding purposes in the laboratory.

The relative bioavailability of 2378-TCDD in soil, calculated as the ratio of the oral absorption of 2378-TetraCDD from soil to the absorption of 2378-TetraCDD from a readily available dosing vehicle – each based on 2378-TetraCDD-concentrations in liver of test animals –, could vary by 2 orders of magnitude (from 0.5 to 60%) and was generally in the range of 20 to 60% (Ruby et al., 2002).

Only a few studies investigated the bioavailability of PCDD/F from soil naturally contaminated with complex mixtures of PCDD/F. These studies concentrated on foraging animals and the risk for humans resulting from the intake of animal products like meat, eggs or milk.

Stephens et al. (1995) examined the uptake and accumulation in chicken which were exposed to naturally contaminated soil, caused by aerial deposition in the vicinity of a pentachlorophenol facility, at doses of 0.3–2.5 ng I-TEq/(kg_{bw}·d) through their diet. A decrease of the bioavailability with the grade of chlorination from 80% for TetraCDD to <10% for OctaCDD and a tissue-specific distribution was observed. Considering all 17 congeners with 2378-chlorosubstitution pattern 5%–30% of the intake was transferred into the eggs, 7%–54% was accumulated in the adipose tissue and less than 1% in the liver.

The in vivo studies on bioavailability of PCDD/F from soil summarized above were limited to 2378-TetraCDD and were performed in rodents, lagomorphs or birds in most cases. The fact that these animals have significant anatomic and physiologic differences from humans limits their applicability for human risk assessment. Moreover the distribution in chicken is quite different from that in mammals, especially because of egg-laying as a unique mechanism for excreting fat.

Besides, studies on cows fed with grass silage from a field, which had a history of repeated sewage sludge applications, showed in general similar results regarding the congener-specific bioavailability (McLachlan et al., 1990; Richter and McLachlan, 2001). For nonlactating cows the authors observed, that the PCDD/F after dietary absorption are first sequestered primarily in the liver and then redistributed into other tissues in dependence of the perfusion rates of the different tissues and the molecule size. Redistribution is more rapid for lower chlorinated congeners, higher chlorinated congeners retained in the liver for longer periods of time.

One of the most important factors influencing the bioavailability of a chemical from soil is its mobilization from the matrix. Studies of Umbreit et al. (1986) on 2378-TetraCDD contaminated soil indicate a correlation between the extractability by organic solvents and the bioavailability. In recent time approaches for human risk assessment have been made to use physiologically based extraction tests (PBETs) to measure the fraction of PCDD/F that would be soluble in the human gastrointestinal tract and might be bioaccessible (Rotard et al., 1992; Rotard et al., 1995; Wittsiepe et al., 2001; Ruby et al., 2002). Our working group (Wittsiepe et al., 2001) compared different artificial digestive tract models to estimate the bioaccessibility of PCDD/F from the technogene slag material 'Kieselrot'. Within all tested digestive juices the rate of mobilization increased more or less with the grade of chlorination and this was observed for PCDD as well as for PCDF. The degree of mobilization depends considerably on the composition of the digestive juices, especially on bile and supplementary food material added to the test system. The great influence of bile has also been observed for other contaminants (Oomen et al., 2004). Development work for PBETs is still ongoing (Ruby, 2004).

The objective of the present study was to examine the oral uptake and accumulation of PCDD/F from a naturally contaminated soil particularly with regards to absolute and relative bioavailability with the final aim to extrapolate bioavailability data to human risk assessment.

Minipigs are supposed to be an adequate animal model because of wide physiological and biochemical similarities to humans regarding the gastrointestinal tract (Swindle and Smith, 1998). We used young pigs at the age of about 1–3 months to simulate childrens physiological age and body weight. The animals were orally exposed to known amounts of PCDD/F either soil-bound or as an extract of the same soil to determine the influence of the soil matrix on bioavailability.

2. Methods and materials

2.1. Soil preparation

The soil (30.6% sand, 36.5% silt, 32.9% clay, 6.83% organic carbon) originated from the upper layer of a former arable land which is located near the city of Hamburg in Northern Germany. The soil had been treated with sludge from the port of Hamburg some years ago. For experimental use and analysis the material was air-dried at 20 °C, only larger aggregates were carefully crushed by

hand. Soil particles >1 mm were removed by sieving. For the exposure experiments soil of the particle size fraction <1 mm was used.

PCDD/F contamination of the soil is 5.3 μg I-TEq/$kg_{dry\,weight}$, which is far above the limit values for PCDD/F in contaminated soil with respect to direct uptake given by German regulations (BMU, 1998; BMU, 1999) which is 100 ng I-TEq/$kg_{dry\,weight}$ for playgrounds and 1000 ng I-TEq/$kg_{dry\,weight}$ for residential areas. The congener pattern shows increasing concentrations with the grade of chlorination and is dominated by PCDF (see Table 1 and Fig. 1), which is rather unusual in comparison to patterns found in industrial or residential areas (Rotard et al., 1994).

2.2. Preparation of PCDD/F exposure solution

The PCDD/F mixture for the solvent exposure experiment was gained by extraction of the soil with hexane/acetone (50 + 50 v%, 3 times for each 2 h, then 12 h). The combined extracts were evaporated under vacuum and a clean up of the extract was performed by extraction with concentrated sulphuric acid and 10% sodium sulphate solution, followed by column chromatography on alumina oxide. The PCDD/F-concentrations of the exposure solution are shown in Table 1.

2.3. Animal treatment

Young Goettingen minipigs (Ellegaard Goettingen Minipigs ApS, Dalmose Denmark) aged 56–78 days at the beginning of the experiment were divided into two exposure groups (“soil” and “solvent” with each 4 animals) and one control group (5 animals). Detailed data on the exposure groups are given in Table 2. The animals were housed separately in metabolic cages and were fed with a SDS standard diet (SDS Special Diet Services, Witham, Essex, England) adjusted to 3% of their body weight (bw) per day, according to the recommendations of the breeder. The feeding took place twice a day, half of the ration at 08.00 a.m. and the other half at 3.30 p.m. The animals had unlimited access to water.

On 28 consecutive days soil was administered at a dose of 0.5 g/kg_{bw} per day at 13.30 p.m. resulting in a daily uptake of 2.63 ng I-TEq/($kg_{bw} \cdot d$). For the solvent experiment PCDD/F were applied at a daily dose of 1.58 ng I-TEq/($kg_{bw} \cdot d$) at 11.00 a.m. Soil or solvent were incorporated into pellets consisting of small amounts of feed, milk powder and water to make it palatable. These pellets were fed by hand to the minipigs to ensure the complete intake. Soil and solvent doses were adjusted to the individual pig’s body weight every three days.

On day 29, between 19.5 and 28.5 hours after the last administration of soil or solvent, the animals were sacrificed. Organs with assumed accumulation and contribution to the bioavailability of PCDD/F or toxicological relevance, as liver, adipose tissue, muscle, brain and blood, were taken and stored at −18 °C until analysis.

The experiments were conducted according to the German Animal Protection Law (permission 23.8720 No. 20.35, district authority Arnsberg, Germany).

Table 1
PCDD/F-concentrations of the exposure media and lipid-adjusted concentrations in liver and adipose tissue of both exposure groups

	Exposure media		Mean concentrations (±standard deviation) in tissues of minipigs			
			Soil exposure ($N = 4$)		Solvent exposure ($N = 4$)	
	Soil (μg/$kg_{d.w.}$)	Solvent (μg/l)	Liver (pg/g fat)	Adipose tissue (pg/g fat)	Liver (pg/g fat)	Adipose tissue (pg/g fat)
2378-TetraCDD	0.051	0.079	3.7 ± 1.9	n.d. ± –	15[a] ± 5.2	0.76[b] ± 0.32
12378-PentaCDD	0.22	0.62	50 ± 31	1.6 ± 0.45	116 ± 39	3.2 ± 1.4
123478-HexaCDD	0.31	0.87	213 ± 81	3.7 ± 0.79	443 ± 82	11 ± 0.75
123678-HexaCDD	0.64	1.7	180 ± 73	5.2 ± 0.78	338 ± 82	15 ± 2.3
123789-HexaCDD	0.54	1.5	89 ± 45	1.4[b] ± 0.21	208 ± 65	3.4 ± 0.66
1234678-HeptaCDD	3.6	9.9	2023 ± 1008	14 ± 2.9	4375 ± 1396	39 ± 4.9
OctaCDD	4.3	12	4875 ± 1916	17 ± 6.5	7075 ± 1981	26s ± 2.0
2378-TetraCDF	2.0	4.0	60[a] ± 27	2.2 ± 0.95	115 ± 71	3.2 ± 1.6
12378-PentaCDF	5.1	14	73 ± 45	4.2 ± 1.3	162 ± 66	12 ± 1.6
23478-PentaCDF	2.5	6.5	2725 ± 2604	9.5 ± 3.2	3150 ± 465	30 ± 6.6
123478-HexaCDF	12	43	20000 ± 14445	109 ± 23	30000 ± 4397	293 ± 5.7
123678-HexaCDF	9.1	30	11975 ± 3688	60 ± 17	25500 ± 6720	160 ± 17
234678-HexaCDF	1.8	5.5	2175 ± 768	6.2 ± 1.2	3425 ± 512	13 ± 1.5
123789-HexaCDF	1.8	5.1	266 ± 171	2.8[a] ± 0.79	508 ± 232	4.8 ± 1.5
1234678-HeptaCDF	44	130	44250 ± 11266	136 ± 48	88750 ± 14032	477 ± 72
1234789-HeptaCDF	17	49	16500 ± 4796	36 ± 10	34750 ± 6291	127 ± 5.8
OctaCDF	120	430	54750 ± 17134	108 ± 45	89250 ± 24540	387 ± 90

n.d. = not detectable.
[a] $n = 3$, one value below detection limit or in the range of blank sample.
[b] $n = 2$, two values below detection limit or in the range of blank sample.

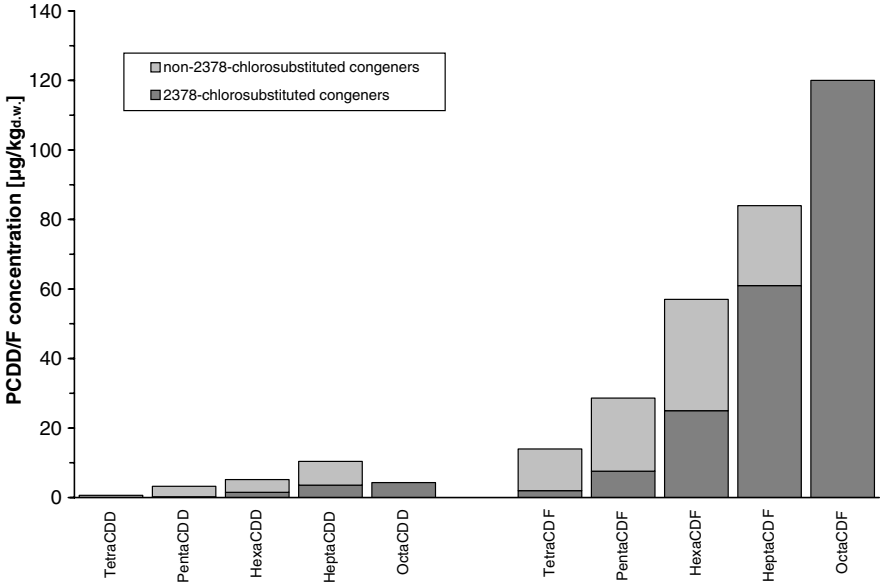

Fig. 1. Concentrations of PCDD/F in the administered soil (particle size fraction <1 mm).

Table 2
Exposure groups and basic data of the minipigs

Exposure group	Sex	At beginning of exposure		At time of death						
		Age days)	Animal weight (g)	Age (days)	Animal weight (g)	Adipose tissue (g)[a]	Blood (g)[b]	Liver (g)[c]	Brain (g)[c]	Muscle tissue (g)[d]
Soil	*f*	76	5500	104	6900	690	269	174	43.4	n.d.
	f	75	4850	103	6500	650	254	173	42.7	n.d.
	m	78	5550	106	7050	705	550	171	41.9	n.d.
	m	75	5650	103	7450	745	581	178	42.1	n.d.
	Mean	76	5388	104	6975	698	414	174	42.5	–
Solvent	*f*	69	4650	97	5950	595	226	193	37.0	2677
	f	64	4950	92	6450	645	245	163	37.3	n.d.
	m	74	5050	102	6300	630	491	193	33.6	n.d.
	m	63	4900	91	6700	670	523	171	35.4	3015
	Mean	67.5	4888	95.5	6350	635	371	180	35.8	2846
Control	*f*	–	–	84	5400	540	211	137	n.d.	2430
	f	–	–	87	5450	545	213	143	n.d.	n.d.
	m	–	–	84	5350	535	417	166	n.d.	2407
	m	–	–	87	5650	565	441	111	n.d.	n.d.
	m	–	–	103	6150	615	480	136	n.d.	2767
	Mean	–	–	89	5600	560	352	139	–	2535

n.d. = not determined.
[a] 10% of body weight based on literature data for minipigs (Holtz and Kallweit, 1981).
[b] 7.8% of body weight for male and 3.9% of body weight for female animals, based on literature data for minipigs (Holtz and Kallweit, 1981).
[c] weight after removal.
[d] 45% of body weight, value was determined by subtracting the weight of organs, blood and excreta from the total body weight of 4 minipigs.

2.4. PCDD/F analysis

2.4.1. Extraction

- *Soil:* 30 g of soil were spiked with 17 $^{13}C_{12}$-labelled PCDD/F-congeners (2.5 or 5.0 ng) and Soxhlet extracted with toluene/2-methoxyethanol (90 + 10 v%) for 24 h.
- *Tissue samples*: Representative aliquots of the tissues were cut into small pieces and in most cases freeze-dried before further preparation. The material was weighed and mixed with sea sand/sodium sulphate (1:1) until a dry and homogeneous mixture resulted. An internal standard solution containing 17 $^{13}C_{12}$-labelled PCDD/F-congeners (25 or 50 pg) was added and the samples were extracted with hexane/acetone (50 + 50 v%) for 24 h using a Soxhlet apparatus. The extract was dried with anhydrous sodium sulphate and the solvent evaporated at 40 °C under vacuum to constant weight. The residue, which represented the fat content,

was weighed and redissolved in hexane for sample clean up.

- *Blood:* The extractions of whole blood samples were performed as described by us previously (Wittsiepe et al., 2000).

2.4.2. Clean up

The clean up was performed by standard methods using modified silicagels, alumina and activated charcoal. After adding 2 µl of dodecane as a keeper the final sample extract was evaporated in a nitrogen stream to the keeper volume and reconstituted by adding 10 µl of toluene, containing $^{13}C_{12}$-1234-TCDD as an external standard.

2.4.3. GC/MS-analysis

The analytical instrument system was a VG AutoSpec high-resolution mass spectrometer and a Hewlett Packard 5890 series II gas chromatograph equipped with a Gerstel KAS 2 vaporization system [GC-parameters: column: J&W Scientific, DB-5, 60 m, 0.1 µm film thickness; temperature program: 200 °C (3 min), 5 °C/min, 220 °C (16 min), 5 °C/min, 235 °C (7 min), 5 °C/min, 330 °C (9 min); injector program: 70 °C (60 s), 12 °C/s, 330 °C (10 min), split off (1 min); split on (2 min); injection volume: 2 µl; MS-parameters: single ion recording mode; resolution 8000–10 000 at 10%; electron impact ionization at 40 eV; perfluorokerosene lock mass check; observation of two ions each for native and labelled isomers; setting of five time windows]. The detection limit in tissue and blood samples was about 1 pg/g fat. Soil samples were additionally analyzed on a polar GC-column.

2.5. Mass balance calculations

For mass balance calculations the total masses of the congeners in the various tissues were calculated from the concentrations of the congeners and the total masses of the respective tissues. For liver and brain the fresh weight of the whole organ was determined after removal from the fresh dead body. The total weight of blood and adipose tissue was calculated using literature data that determined their percentage in total body weight of minipigs (Holtz and Kallweit, 1981). This practice is acceptable if a homogeneous distribution of the PCDD/F in all kinds of body fats is assumed. Literature data indicate, that an uniform PCDD/F distribution among different adipose tissues related to their lipid content is found when the animals were close to a contaminant steady state (Feil et al., 2000; Richter and McLachlan, 2001). The share of muscle tissue was determined by subtracting the weight of organs, skin, bones, blood and excreta from the total body weight of the minipigs.

2.6. Bioavailability

Estimation of bioavailability in selected tissues was calculated as the ratio of the mass of a PCDD/F-congener in the tissue to the administered mass of the same congener from soil or solvent multiplied by 100%:

$$b_{i,j} = \frac{m_{i,j}}{M_i} * 100\%$$

$b_{i,j}$ bioavailability of congener i in the tissue j (%)
$m_{i,j}$ mass of congener i in tissue j (pg)
M_i mass of congener i administered to the pig by soil or solvent (pg)

To estimate the total bioavailability in the animal we added the masses found in relevant tissues:

$$B_i = \frac{\sum_j m_{i,j}}{M_i} * 100\%$$

B_i total bioavailability of congener i in the pig (%)
$m_{i,j}$ mass of congener i in tissue j (pg)
M_i mass of congener i administered to the pig by soil or solvent (pg)

To compare the bioavailability from the two exposure media (soil and solvent), the relative bioavailability in a selected tissue or in the total animal was calculated as the ratio of the bioavailability in soil to the bioavailability in solvent multiplied by 100%:

$$b_{i,j,\mathrm{rel}} = \frac{b_{i,j,\mathrm{soil}}}{b_{i,j,\mathrm{solvent}}} * 100\% \quad \text{or} \quad B_{i,\mathrm{rel}} = \frac{B_{i,\mathrm{soil}}}{B_{i,\mathrm{solvent}}} * 100\%$$

$b_{i,j,\mathrm{rel}}$ relative bioavailability of the congener i in the tissue j (%)
$b_{i,j,\mathrm{soil}}$ bioavailability of the congener i in the tissue j administered by soil (%)
$b_{i,j,\mathrm{solvent}}$ bioavailability of the congener i in the tissue j administered by solvent (%)
$B_{i,\mathrm{rel}}$ relative total bioavailability of the congener i in the pig (%)
$B_{i,\mathrm{soil}}$ total bioavailability of congener i in the pig administered by soil (%)
$B_{i,\mathrm{solvent}}$ total bioavailability of congener i in the pig administered by solvent (%)

3. Results and discussion

In the tissue samples of the animals of the control group most PCDD/F congeners were not detectable and only a few higher chlorinated congeners were found in trace amounts. These findings ensure, that PCDD/F in the tissues of the exposed minipigs originated exclusively from the administered soil or solvent. Low levels of PCDD/F in juvenile swine have also been reported by Ruby et al. (2004).

3.1. Concentrations and accumulation of PCDD/F in tissues

PCDD/F concentrations in liver, blood, brain, muscle and different adipose tissues were calculated on fat and on

fresh weight basis. As expected, in samples of the exposed animals only congeners with 2378-chlorosubstitution pattern were found in the various tissues in different concentrations, both on fat and on fresh weight basis. Liver and adipose tissue contained the highest concentrations of PCDD/F of all tested tissues. These data are shown in Table 1. Concentrations in blood and brain are significantly smaller (<1% of the lipid-adjusted concentrations in liver) and the muscle tissue samples from the solvent exposed animal group, which were analyzed exemplary, also show significantly smaller concentrations in comparison with liver and adipose tissue. When considering the same tissues, significantly higher concentrations were found in the solvent exposed animals. The same tissues show similar homologue patterns in the two exposure groups. As in the exposure media concentrations of PCDF are higher than those of PCDD. Within the PCDD homologue group an increase in concentrations from TetraCDD to OctaCDD for both exposure groups can be observed. Within the PCDF the concentrations increase with the grade of chlorination up to the hepta-chlorinated congeners. 1234678-HeptaCDF shows the highest concentrations all in all.

The liver-to-adipose concentration ratio indicates an about 10 fold higher affinity of higher chlorinated congeners to the liver. In other studies similar results were observed in chicken, rats, marmoset monkeys, calves and humans (Abraham et al., 1989, 1990; Thoma et al., 1989; Thoma et al., 1990; Feil et al., 2000; Richter and McLachlan, 2001; Körner et al., 2002). Richter and McLachlan (2001) also observed a higher accumulation in liver for higher chlorinated congeners (50–75% of administered dose of HeptaCDF and OctaCDD) while penta- and hexachlorinated congeners were mainly found in adipose tissue. The authors suggested a primary sequestration of all congeners in the liver followed by a redistribution which is more rapid for lower chlorinated congeners. Finally a steady state is reached in which the PCDD/F are homogeneously distributed in all body lipids. Since in the present study the condi-

Table 3
Means and standard deviations of bioavailability of PCDD/F from soil or solvent in liver, adipose tissue and the sum of all examined tissues and means of relative bioavailability of PCDD/F from soil in Goettingen minipigs

$N = 4$ minipigs exposed in each group	Bioavailability from soil (%)			Bioavailability from solvent (%)			Relative bioavailability from soil (%)		
	Liver	Adipose tissue	Total	Liver	Adipose tissue	Total	Liver	Adipose tissue	Total
2378-TetraCDD	0.75	n.d.	0.75 ± 0.34	9.3[a]	31.2	38.2 ± 9.4	8.1	–	2.0
12378-PentaCDD	2.3	4.3	6.6 ± 2.1	9.3	11.5	20.8 ± 3.8	24.5	37.5	31.7
123478-HexaCDD	7.2	6.9	14.1 ± 2.2	24.9	34.9	59.8 ± 6.5	28.8	19.9	23.6
123678-HexaCDD	3.0	4.8	7.8 ± 1.6	10.0	27.0	37.0 ± 4.5	29.6	17.9	21.1
123789-HexaCDD	1.7	1.7[b]	2.5 ± 1.4	6.8	6.0	12.8 ± 3.0	24.8	28.1	19.7
1234678-HeptaCDD	5.9	2.2	8.1 ± 1.8	21.5	11.8	33.4 ± 8.4	27.6	18.2	24.3
OctaCDD	11.9	2.9[a]	14.0 ± 3.0	28.4	6.8	35.3 ± 7.9	41.8	42.0	39.8
2378-TetraCDF	0.30	0.64	0.86 ± 0.44	1.5	2.1	3.6 ± 1.4	20.5	30.1	24.1
12378-PentaCDF	0.14	0.49	0.64 ± 0.26	0.56	2.2	2.8 ± 0.66	25.8	22.1	22.8
23478-PentaCDF	10.4	2.3	12.8 ± 6.7	23.6	13.5	37.1 ± 2.6	44.2	17.3	34.4
123478-HexaCDF	16.5	5.4	21.9 ± 6.5	33.6	20.0	53.6 ± 5.9	49.1	27.1	40.9
123678-HexaCDF	13.8	4.0	17.9 ± 4.2	41.4	15.3	56.8 ± 10.5	33.4	26.2	31.5
234678-HexaCDF	12.6	2.0	14.6 ± 2.9	30.5	6.5	36.9 ± 4.0	41.2	31.1	39.4
123789-HexaCDF	1.5	0.92[a]	2.2 ± 1.4	4.9	2.8	7.7 ± 3.1	31.0	32.6	28.6
1234678-HeptaCDF	10.7	1.9	12.7 ± 1.7	33.0	11.3	44.4 ± 5.7	32.5	17.0	28.5
1234789-HeptaCDF	10.5	1.3	11.8 ± 2.0	34.4	7.7	42.1 ± 6.0	30.5	17.0	28.0
OctaCDF	4.9	0.54	5.4 ± 1.6	9.9	3.0	12.9 ± 2.9	49.2	18.4	42.2
Minimum P(4–8)CDD	0.75	1.7	0.75	6.8	6.0	12.8	8.1	17.9	2.0
Maximum P(4–8)CDD	11.9	6.9	14.1	28.4	34.9	59.8	41.8	42.0	39.8
Mean P(4–8)CDD	4.7	3.8	7.7	15.7	18.5	33.9	26.4	27.3	23.2
Standard deviation	3.9	2.0	5.1	8.9	12.2	14.8	10.0	10.4	11.7
Minimum P(4–8)CDF	0.14	0.49	0.64	0.56	2.1	2.8	20.5	17.0	22.8
Maximum P(4–8)CDF	16.5	5.4	21.9	41.4	20.0	56.8	49.2	32.6	42.2
Mean P(4–8)CDF	8.1	2.0	10.1	21.3	8.4	29.8	35.7	23.9	32.0
Standard deviation	6.0	1.6	7.4	15.6	6.3	21.0	9.8	6.3	6.9
Minimum P(4–8)CDD/F	0.14	0.49	0.64	0.56	2.1	2.8	8.1	17.0	2.0
Maximum P(4–8)CDD/F	16.5	6.9	21.9	41.4	34.9	59.8	49.2	42.0	42.2
Mean P(4–8)CDD/F	6.7	2.7	9.1	19.0	12.6	31.5	31.9	25.2	28.4
Standard deviation	5.4	1.9	6.5	13.2	10.2	18.3	10.6	7.9	9.9

n.d. = not detectable.
[a] $n = 3$, one value below detection limit or in the range of blank sample.
[b] $n = 2$, two values below detection limit or in the range of blank sample.

tions of exposure were quite similar in both exposure groups and the liver-to-adipose concentration ratio is higher for the soil-exposure group it can be assumed that the absorption from soil occurs slower than absorption from solvent.

Considering the tissue weights and the PCDD/F-concentrations found in these compartments of the exposed animals, the main burden of PCDD/F is found in liver and adipose tissue. Liver shows the highest accumulation. Total masses of PCDD/F found in muscle tissue, blood and brain are negligible, as observed in previous studies on animals (Lakshmanan et al., 1986; Shu et al., 1988; van den Berg et al., 1994; Stephens et al., 1995; Diliberto et al., 1996; Richter and McLachlan, 2001; Körner et al., 2002).

As part of this study different adipose tissue samples of the solvent exposed animals were examined (skin, back of the neck, back fat, shoulder, abdomen and kidney). The lipid-normalized concentrations were similar in skin, kidney and shoulder while concentrations in abdominal fat were significantly higher and the fat from the back or from the nape of the neck showed lower concentrations. This might be due to the fact that the animals were not in a steady state at the end of the experiment and shows that

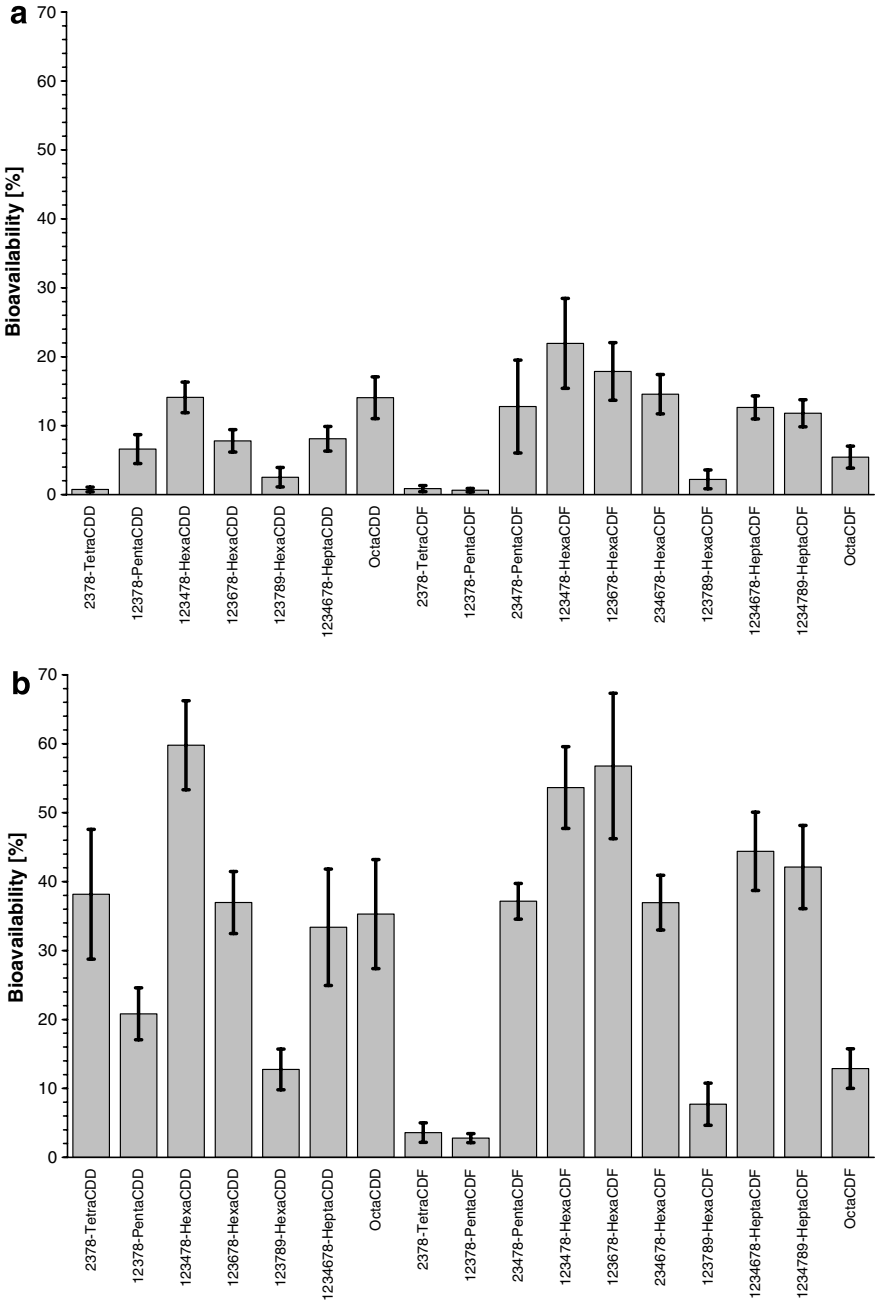

Fig. 2. Bioavailability of PCDD/F in Goettingen minipigs ($n = 4$) based on accumulation in liver, adipose tissue, brain and blood (arithmetic means and standard deviations): (a) from orally administered soil and (b) from orally administered solvent.

the estimation of the PCDD/F content in adipose tissue should be viewed critically.

3.2. Bioavailability

In view of the fact, that predominantly 2378-chlorosubstituted congeners accumulated, only these congeners are discussed below. The data presented are mean values for each PCDD/F-congener calculated from all animals of the specific exposure group. The concentrations of some PCDD/F-congeners, especially 2378-TetraCDD, in the soil were extremely low (see Table 1). As a consequence the amount accumulated in the tissues was in some cases below the limit of detection. Values which were either below the detection limit or in the range of blank samples were not considered with respect to the calculations for the mean values.

3.2.1. Bioavailability from soil

A congener- and tissue-specific distribution of the bioavailability of PCDD/F from soil was found. The accumulation occurs mainly in liver and adipose tissue whereas in blood and brain it is considerably lower (<0.5% with respect to total bioavailability). The calculated values for

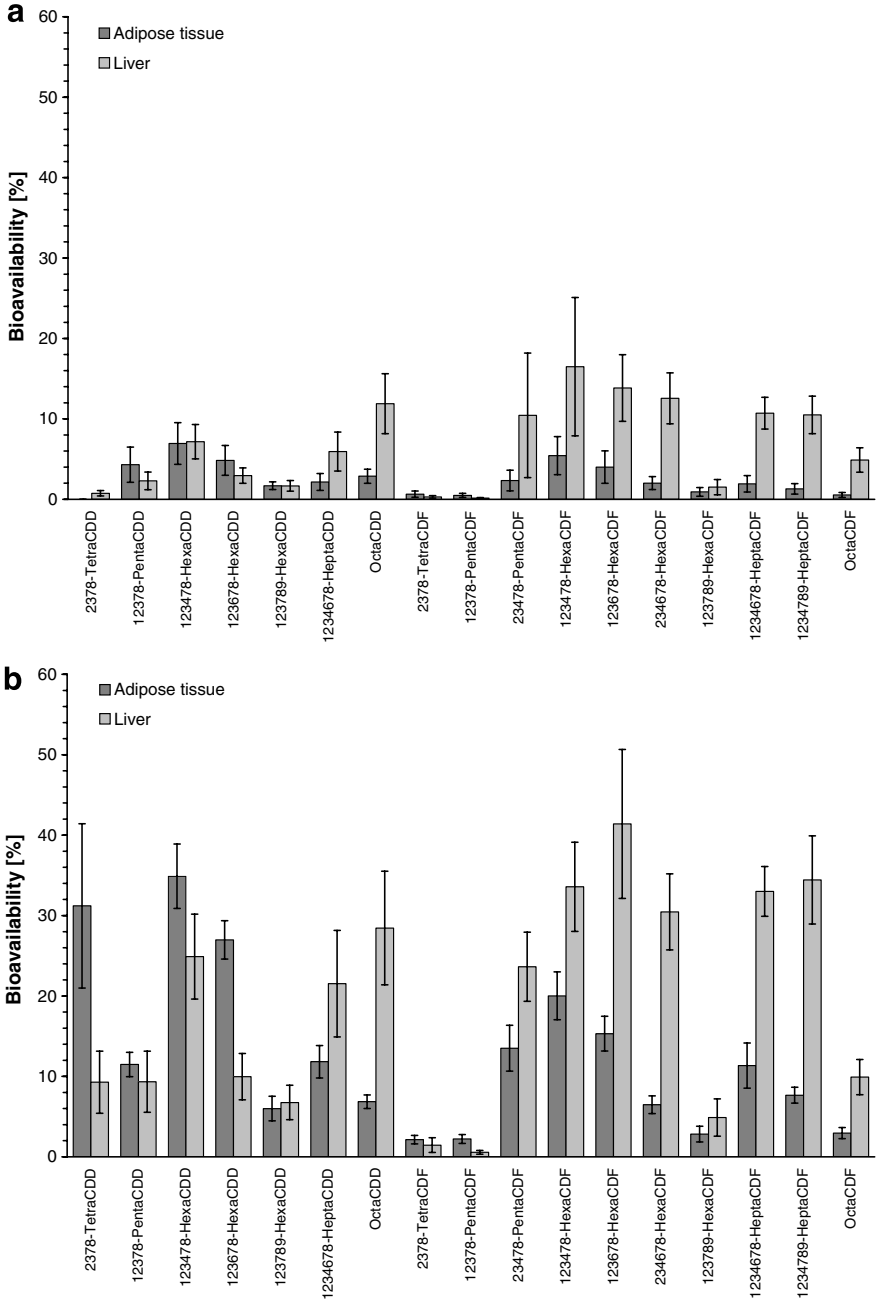

Fig. 3. Comparison of arithmetic means and standard deviations of bioavailability of PCDD/F in liver and adipose tissue of Goettingen minipigs ($n = 4$): (a) from orally administered soil ($n = 3$ for 2378-TetraCDF, OctaCDD and 123789-HexaCDF; $n = 2$ for 123789-HexaCDD) and (b) from orally administered solvent ($n = 3$ for 2378-TetraCDD).

liver and adipose tissue are shown in Table 3. Looking at the total bioavailability $B_{i,soil}$, 123478-HexaCDD and OctaCDD are the best bioavailable PCDD congeners (14.1% and 14.0%). The bioavailability of most PCDF congeners is slightly higher than those of the corresponding PCDD congeners. 123478-HexaCDF, the best bioavailable PCDF congener, is bioavailable at rates of 5.4% and 16.5% in adipose tissue and liver and to 21.9% totally (Table 3, Figs. 2a and 3a).

Averaged across all 17 2378-chlorosubstituted PCDD/F congeners the mean bioavailability from soil is 9.2% (range: 0.6% (12378-PentaCDF) to 21.9% (123478-HexaCDF)). The standard deviation varies between 0.3% and 6.7%. With respect to I-TEq values bioavailability from soil can be calculated to 13.8%. It should be mentioned, that other soils might result to other values.

3.2.2. Bioavailability from solvent

Bioavailability of PCDD/F in the solvent exposed group showed a similar congener- and tissue-specific pattern, but higher levels compared to the soil exposure group (see Fig. 2b). The highest total bioavailability was found for 123478-HexaCDD (59.8%), followed by 123678- (56.8%) and 123478-HexaCDF (53.6%).

For the higher chlorinated congeners the bioavailability is generally higher in liver than in adipose tissue (Fig. 3). A possible explanation are the parameters influencing the redistribution. After absorption from the gastro-intestinal tract and sequestration in the liver, the redistribution of the congener to outer compartments – like adipose tissues – is influenced by the perfusion rates of the tissues and by physico-chemical parameters like lipophilicity and molecule size.

3.2.3. Relative bioavailability from soil

The relative bioavailability expresses the influence of the soil matrix on the bioavailability (Table 3). Except for 2378-TetraCDD (see note above) the congener-specific values for the total relative bioavailability were in the range of 19.7–42% and thus emphasize the great influence of the soil matrix.

4. Conclusion

- Accumulation of PCDD/F from soil or solvent is only observed for congeners with 2378-chlorosubstitution.
- Bioavailability of PCDD/F is congener- and tissue-specific. Accumulation takes place predominantly in liver, which is the primary compartment, and in adipose tissue as a secondary compartment. All other tissues examined are of minor importance for calculation of bioavailability.
- The soil matrix has a significant influence on oral bioavailability. Under the chosen experimental conditions and in relation to PCDD/F orally administered by solvent, soil reduces the bioavailability of about 70%.
- Expressed as I-TEq-values the bioavailability of PCDD/F from the examined soil is 13.8%. This indicates that neglecting the bioavailability might lead to an overestimation of the risk by oral uptake of PCDD/F contaminated soil.

Acknowledgements

Parts of the investigations were supported by the Umweltbundesamt, Germany (FKZ 29873227/01). The technical assistance of Michaela Fey, Heidemarie Joppich and Sonja Schaub is gratefully acknowledged.

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Appendix E:
TERA Peer Consultation on the Dow Pilot Bioavailability Study

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

December 1, 2006

Mr. Ben Baker
Senior Environmental Project Leader
Michigan Operations
The Dow Chemical Company
1790 Building, Washington Street
Midland, Michigan 48674

Dear Mr. Baker:

SUBJECT: Sampling and Analysis Plan in Support of Bioavailability Study, Midland Area Soils (Plan); The Dow Chemical Company, Michigan Operations (Dow); MID 000 724 724

The Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division (WHMD), has completed a review of the subject Plan submitted by Dow on November 22, 2006. The November 2006 revision of the Plan supersedes previously submitted versions. The MDEQ is approving this plan as noted below.

The September 21, 2006, report of the independent scientific peer consultation panel (Panel) is enclosed. The MDEQ will take the Panel's recommendations into consideration during the review of the results of the study and the future design of a bioavailability study, if necessary.

By copy of this letter, the MDEQ acknowledges that the law firm of Miller, Canfield, Paddock and Stone, P.L.C. (Miller Canfield), will serve as the Third Party for purposes of sample blinding. The blinding protocol is described in Miller Canfield's November 14, 2006, letter to the MDEQ and is agreeable to the MDEQ.

Should you have any questions regarding this approval, please contact Mr. Allan Taylor, Hazardous Waste Section, WHMD, at 517-335-4799 or by e-mail at taylorab@michigan.gov, or you may contact me.

Sincerely,

Jim Sygo
Deputy Director
517-241-7394

Enclosure

cc/enc: Mr. Greg Cochran, Dow
Mr. Gary Dyke, CH2M Hill
Mr. Thomas C. Phillips, Miller Canfield
Mr. Jim Lancaster, Miller Canfield
Mr. Noel Bush, City of Midland
Mr. James O. Branson, III, Esq., City of Midland
Mr. Kenneth Wiley, Fishbeck, Thompson, Carr & Huber, Inc.
Mr. Gregory Rudloff, U.S. Environmental Protection Agency, Region 5
Mr. George Bruchmann, MDEQ
Mr. Stephen Buda, MDEQ
Ms. Delores Montgomery, MDEQ
Mr. Terry Walkington/Ms. Trisha Peters, MDEQ
Ms. Virginia Himich, MDEQ
Ms. Cheryl Howe, MDEQ
Dr. Deborah MacKenzie-Taylor, MDEQ
Mr. Arthur Ostaszewski, MDEQ
Mr. Allan Taylor, MDEQ
Off-Site Corrective Action File, MDEQ

Report of the Peer Consultation Conference Call: Sampling and Analysis Plan In Support of Bioavailability Study, Midland Area Soils

Submission by
The Dow Chemical Company

Peer Consultation Organized by
Toxicology Excellence for Risk Assessment
(http://www.tera.org/peer)

September 21, 2006

Table of Contents

Executive Summary

This peer consultation meeting has been organized by Toxicology Excellence for Risk Assessment (*TERA*). *TERA* is an independent non-profit organization with a mission to protect public health through the best use of toxicity and exposure information in the development of human health risk assessments. *TERA* has organized and conducted peer review and peer consultation meetings for private and public sponsors since 1996.

This peer consultation conference call was part of an ongoing effort to develop site-specific bioavailability data that may be used to generate site-specific cleanup criteria for a Dow Chemical Company facility in Midland, Michigan. In an earlier phase of the process, the panel members provided written comments on the study design for the pilot study.

Of the soil parameters discussed in the sampling plan, the panel recommended that only soil organic carbon and particle size would provide relevant information. The analytical method for SOC should be one that uses pulverization, acidification, combustion, and quantification of released CO_2. The panel also recommended that Dow look for correlations between these parameters and concentrations of PCDD/PCDF TEQ. However, the panel also recommended that conducting in vitro chemical desorption assays will give a better understanding of how bioavailable PCDD/PCDFs will be on the different soils observed at the site. One panel member still cautioned that these data may not provide a clear basis for selecting soils, and recommended that a random sampling approach may be an alternative way to select soils. The panel recommended that considering clusters or hotspots is an appropriate approach to analyzing the data and agreed with the assumption of univariate distribution as discussed by the authors for this analysis. Finally, one panel member recommended that a cost/benefit analysis be conducted, given that the preliminary results suggest the site-specific bioavailability may not be significantly different from the 50% default value.

1. Participants

Michigan Department of Environmental Quality
Deborah MacKenzie-Taylor
Al Taylor

Dow Chemical Company
Ben Baker
Bob Budinsky
John Davis

C2HMHill confirm spelling of these names.
Gary Dykema
Alba Turner

Call Facilitator
Michael L. Dourson, Ph.D.
Toxicology Excellence for Risk Assessment (*TERA*)

Peer Consultation Panel Members*

Kelly Black
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Neptune and Company

Linda Lee, PhD.
Professor of Environmental Chemistry
Crop Soil and Environmental Sciences
Department of Agronomy
Purdue University

Joseph Pignatello, PhD.
Soil Chemist
Department of Soil and Water
Connecticut Agricultural Experiment Station

* Affiliations listed for identification purposes only.

2. Background and Process

This peer consultation meeting has been organized by Toxicology Excellence for Risk Assessment (*TERA*). *TERA* is an independent non-profit organization with a mission to protect public health through the best use of toxicity and exposure information in the development of

human health risk assessments. *TERA* has organized and conducted peer review and peer consultation meetings for private and public sponsors since 1996.

Elevated levels of PCDDs and PCDFs have been found in surficial soils surrounding the Dow Chemical Company facility in Midland, Michigan. These elevated levels are predominantly the result of air emissions from historical processing and combustion practices at Dow. Elevated levels of dioxins and furans have also been found in sediments and floodplain soils along the Tittabawassee River downstream of the Dow facility. These two areas have distinct and different patterns of PCDD and PCDF contamination, both in congener distribution and spatial distribution. A detailed investigation to determine the nature and extent of contamination in these two distinct areas has not yet been conducted. It is also not known if there are other contaminants of concern in these areas.

Under Michigan's cleanup program (Part 201, Environmental Remediation of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended), the Michigan Department of Environmental Quality (MDEQ) derives generic, land use-based cleanup criteria utilizing a risk-based approach that is consistent with the approach described in the U.S. EPA RAGS guidance. This approach includes an assumption for oral absorption efficiency when estimating risks from incidental ingestion of soils. The current generic assumption of oral absorption for PCDDs and PCDFs from soil used by MDEQ is 50%. A person conducting a cleanup also has the option to generate and utilize site-specific criteria, rather than using criteria based on generic assumptions.

This peer consultation conference call was part of an ongoing effort to develop site-specific bioavailability data that may be used to generate site-specific cleanup criteria. In an earlier phase of the process, a bioavailability pilot study was conducted to ensure that an adequate study could be designed that would give reliable estimates of relative bioavailability. The sampling and analysis plan that is the subject of this peer consultation will be used to guide selection of the soils to be tested in the full bioavailability study. Panel members were asked to provide written responses to the Charge questions (see Appendix X) ; these comments were provided to all parties prior to the conference call and are attached to this report in Appendix X.

At the start of the call, Dr. Dourson, the facilitator, described how the call would be run. He explained that discussions would be based on the written comments submitted by the panel members prior to the meeting and on the charge questions. He noted that all panelists would have the opportunity to state their own positions on the charge items and to ask one another clarifying questions and further discuss the issues.

TERA has prepared this meeting report. The report summarizes the sponsors' presentations and comments, as well as the panel discussions and recommendations. The meeting report is a summary, not a transcript. Individual opinions of the panel members are noted (although not identified by name), along with areas of agreement and disagreement. Panel members have reviewed and commented on the draft report. The sponsors also were given the opportunity to review the draft report to confirm the accuracy of the sponsor presentations and comments.

3. Sponsor Presentation and Clarifying Questions

Dow gave a short presentation about the purpose of the sampling plan. Dow indicated that the primary purpose for the sampling plan was to gather information on the soil properties that may influence bioavailability in order to identify soils that may be used for future bioavailability feeding studies. A secondary purpose is to better understand the distribution of dioxins and furans in Midland area soils, as well as to identify any other chemicals that may be present in the soils and attributable to Dow activities at the site. The sampling plan employs a transect type approach to sampling that was developed by MDEQ. Since the area is urban, it is not known what types of soil will be found.

Dow also indicated that their goal for the soil sampling was to understand how heterogeneous the soils in the area are and to classify the soils into groups. Particle size analysis was proposed, because it is a typical way of classifying soils (clays, silts, sands, etc.); however, they are not sure if this parameter will be relevant to bioavailability. Other parameters selected parameters were considered to possibly have some relevancy to classifying soils for bioavailability. However, Dow noted that the soil parameters were not selected with the intention of trying to predict bioavailability.

MDEQ noted that the City of Midland required that residential property owners be kept anonymous, which added additional complexity to the sampling plan. As a result, the samples will be blind. One panel member asked how property owners will be kept anonymous when a sampling box falls in a single property. Dow noted that in this case, the owners will not be anonymous; however, most of the properties in the sampling area are industrial or commercial, not residential.

Another panel member asked about how the contaminants were released into the site. Dow replied that air deposition following combustion and windblown particles was the primary method of release; chemicals were not released in the vapor phase.

4. Discussion

Discussion of Written Comments

The facilitator opened the discussion by asking the panel members to summarize their written comments. One panel member noted that the refe rences cited for the analytical methods that would be used to measure the soil parameters were incorrect, particularly for measuring soil organic carbon. This panel member concluded that soil organic matter (SOC), and particular black carbon, will be the most important factor for assessing bioavailability. However, the reference for the analytical method was incorrect. The authors probably mean to cite the companion volume by Sparks, Methods of Soil Analysis, Part 3 Chemical Methods (Chap 34 by Nelson and Sommers). The loss on ignition method could result in and overestimation of SOM because not all of the water would be removed. In addition, there is not a reliable method for differentiating black carbon from natural SOC in that reference. Another panel member agreed. This person noted that the sampling plan calls for evaluating both soil organic matter (SOM) and

SOC and suggested that SOC is a parameter that can be obtained more accurately than SOM. For SOC they need to carefully consider the alternative methods described in Nelson and Sommers to avoid including inorganic C present in soil minerals or lawn care chemicals. However, this reviewer also explained that the relationship between any specific soil properties and bioavailability is unclear, so that there will be no clear guidance on how to use the soil properties data to choose soils for the bioavailability study.

Dow asked if there were methods published in the literature for measuring black carbon. A panel member indicated that two such methods have been published, but that both are unreliable. The first method involves a low temperature combustion where the sample is heated to 375° C in a stream of air. The theory of this method is that ordinary organics are destroyed and the soot carbon is left behind. However the reviewer said that some soot carbon is actually lost too (Nguyen, et al., 2004), so the method is inaccurate. The second method involves acidic dichromate at 55° C. The theory of this method is that ordinary organics are oxidized, leaving the soot behind. However, the reviewer indicated that in this method, not all of the ordinary organic material is removed (Pignatello et al., 2006 and references therein), so the method is inaccurate.

This panel member suggested that the H/C/N ratio proposed in the sampling and analysis plan will not be useful for characterizing bioavailability. The elemental analysis should not be performed unless the SOM has been extracted from the soil, which is arduous and difficult, time-consuming, and often inaccurate in that some mineral components may also be extracted. Another panel agreed. The ratio of H/C/N within SOM may have some correlation to sorption, but not the H/C/N of the whole soil. Inorganic components contain significant amount so H,C and N as well, which are not relevant to sorption of the compounds of interest.There is no literature to support the idea that the H/C/N ratio of the organic matter is related to bioavailablity.

One panel member noted that particle size is a parameter that could influence bioavailability because organic material and clay tend to be enriched in the smaller particles. However another reviewer indicated that although contaminants may be associated with small particles, the small particles may be adhering to larger particles. If contaminants were associated only or predominantly with the small particles, this might tend to obscure any dependence on particle size. Also, reviewers noted that the rate of transfer out of particles may change increase with decreasing particle size, contrary to the assumption in the Sampling and Analysis Plan.

MDEQ then asked the panel whether particle size and PCDD/PCDF concentration would be useful data to collect. See discussion on particle size above. Panel members replied that concentration may not play a big role in the amount of chemical that is bioavailable. It will be sufficient to just evaluate soils with both low and high concentration without having to evaluate an entire range of concentrations. Obviously, it is important to include soils with a wide range in PCDD/PCDF concentration to establish a dose-response curve.

Charge Question #1. *In order of importance, which soil parameters are known to influence the bioavailability of dioxins and furans? Should additional soil parameters be included in the sampling and analysis plan? Are any of the parameters listed unnecessary or of little*

importance to bioavailability? If you recommended adding or deleting parameters, please explain why.

Two panel members agreed that the most relevant approach would be to conduct in vitro desorption experiments on the samples to indicate what could be removed from the different soils following a reference set of conditions and a timeframe. The conditions would mimic the pH and other conditions found in the intestinal tract and would include an infinite sink to gather the desorbed material. The timeframe of the desorption studies should represent the residence time a contaminant may have in the human digestive track. Desorption data could then be compared with the SOC data to see if there is a correlation. Tthe expected correlation, if any, would be that soil with higher SOC will limit transfer of a contamiant to the human, thus may reflect a lower bioavailablity.

MDEQ mentioned a previous desorption study conducted on the Midland area soils. This study was similar to what the panel had just described and suggested a PCDD/PCDF relative bioavailability of 16-26%. In contrast, the pilot in vivo bioavailability study in rats suggested that the relative bioavailability was 30-47%. Given the discrepancy between the in vitro and in vivo studies, MDEQ asked whether the panel members still recommended a desorption study. One panel member suggested that the discrepancy could be explained if the conditions under which desorption was carried out were not representative of the rat system. Even if they are not identical, it is likely that given a sufficient number of samples there would be a correlation between desorption-derived bioavailability and rat assay bioavailability.

Another panel member, replied that their work we did with PCBs (so related compounds to those in discussion) showed no correlation to in vivo rat assays and in vitro extraction assays (PBET) among the limited soils tested (Pu et al., 2006). However, this was a limited study with artificially treated soils rather than field soils. Some additional work with field soils for another chlorinated compound suggested that aging in the filed did not seem to change bioavailability as assessed with an in vivo rat assay. Therefore, this panel member questioned whether the in vitro study would prove to be very useful. More definitive work needs to be done in this area. Therefore, if there were funds to include both that would be great. However, the desorption in itself will likely not be helpful in assessing which soils to do more detailed bioavailability studies given the costs. **Note, panel members elaborated on their thoughts while providing comments on the draft. Since this info technically was not part of the conf call, I would be happy to put this info in an Appendix, rather than the body of the notes. Let me know what you think.**

Dow indicated that approximately 145 soil samples will be collected and that the cost of the desorption study would be approximately $25K-35K per sample. This reviewer believes his laboratory could do it for far less. Given the cost how many samples should be analyzed. One panel member replied that even evaluating 10% of the samples could provide useful information. However, panel members noted that it is a management decision on how to most effectively spend money on this issue. Given that the preliminary results of the bioavailability study suggest that site-specific bioavailability may not be significantly different than the 50% default, the panel members suggested that the costs associated with gathering additional site-specific data may not be worth it.

The facilitator then asked the panel to form conclusions on which parameters would be useful to include in the evaluation and which are unnecessary. The panel replied that SOC is the most relevant parameter, but that it is important to remove the inorganic carbon before measuring SOC. The panel also suggested that soil texture data (particle size and specific surface area) could provide useful information and are relatively easy to measure. The panel stated that soil organic matter and the H/C/N ratio are not necessary and can be removed from the list. Black carbon may be a desirable parameter if a reliable method were available, which is not the case. Dow asked if the C/N ratio would provide information that could help differentiate soils. One panel member replied that the first step required would be to separate organic from inorganic matter. It is possible to separate most of the organic matter from the inorganic matter by repetitive treatment with a solution of HF and HCl. Some investigators believe there are significant alterations of organic matter by this treatment, although its effect on C/N is unclear. Even then, this reviewer was not sure that the parameter would tell much about bioavailability.

Charge Question #2. *Will the source of contamination ((e.g., combustion processes, process emissions, fugitive dust transport – wind born and mechanical) significantly affect the soil parameters that should be considered for bioavailability? If so, how should this be taken into consideration?*

One panel member noted that if combustion is the primary source of PCDD/PCDFs in the area, then one would expect that the PCDD/PCDFs would be less bioavailable. However, this person also indicated that there is no way measure this effect since there is no reliable method for measuring the ash particles that originally bore PCDD/PCDFs, which may include black carbon. Another panel member agreed and added that contaminants will come off the transport particles and will then adhere to soil particles, but there is no way to identify and quantify this effect. Finally, another panel member noted that if the site is old (apx 100 years according to Dow), then the sampling design should address this by looking at deeper soils.

Charge Question #3. *Should an evaluation be performed to determine dioxin and furan concentrations within different size fractions, (e.g., greater and less than 250 μm)? Should there be more empirical evaluation (e.g., using separation methods, microscopic methods or other methods) of the association of dioxins and furans with different soil components to aid in the determination which soil components are likely to influence the bioavailability of the dioxins and furans in these soils?*

One panel member stated that if the sampling plan is changed to include this approach, then the current sample size may be inadequate. Other panel members indicated that chemicals will have entered the soil on very small particles, but that the small particles will be associated with larger particles. Although it may be useful to evaluate chemical concentration as a function of particle size, there is no approach for using this information to decide which soils should be used for the bioavailability study.

Charge Question #4. *Comment on the procedures proposed for evaluating the statistical and spatial distributions of bioavailability parameter results. Are there other approaches that are more appropriate?*

One panel member indicated that in general, the approaches used in the sampling plan were appropriate. This person suggested that the authors should consider more visual approaches for showing the results of the analyses. The sampling plan should discuss how non-detects will be handled in the analyses, and should also consider discussing chemical concentrations in terms of concentration above background, where background information is available. The panel member noted that particularly for metals, and for some organics, regional data on background concentrations are available. MDEQ confirmed that they have regional data on background levels of metals and PCDD/PCDFs.

A panel member suggested that the risk-based thresholds be better explained in the sampling plan, and asked, for example, how the 1000 ppt level for PCDD/PCDFs was developed. MDEQ explained that the risk-based thresholds was a generic way of saying "levels of concern". In particular, the 1000 ppt level for PCDD/PCDFs was derived from the ATSDR intermediate MRL and is being used until a site-specific criteria can be developed.

Charge Question #5. *Should the correlation between individual soil parameters and soil dioxin and furan concentrations be evaluated? If so, how?*

A panel member indicated that it is not clear how this would inform the choice of soils for the bioavailability study, but if this data would help, then it could be done. Another panel member said that this could be done if the sampling plan only identified one primary soil parameter and maybe 2 secondary parameters. For identifying a correlation between SOC and PCDD/PCDF concentration would be great. However, if this correlation were observed, that would not automatically mean that there would also be a correlation between SOC and bioavailability.

Charge Question #6. *Are the data evaluation procedures for dioxins and furans discussed in Section 3.3 consistent with accepted methods? Are these procedures adequate to allow authors to identify test soils representative of dioxin/furan concentrations throughout the area for the bioavailability study? Should clusters or hot spots be evaluated in addition to area-wide concentrations?*

One panel member indicated that the methods in the sampling plan were not consistent with accepted methods. Also, these assays do not appear to help authors select soils for the bioavailability studies. Perhaps, a better approach would be just to take a random sampling of soils.

The authors replied that they are assuming a univariate distribution and will look to see if there are relationships between the parameters. They will try to identify any clusters of parameters that appear similar among soils in order to select a group of soils for more detailed studies. The reviewer then indicated that just because soils may appear to be group by certain parameter clusters, it does not mean that the there is a correlation between these parameter clusters and bioavailability. Therefore, soils selected to represent the parameter clusters may not representative in terms of bioavailability of all the soils. Dow replied that they are trying to understand how many different soil categories are present at the site. Another panel member

suggested that, in addition to helping select soils for the bioavailability study, the data on soil parameters may also be used to determine which final bioavailability factors should be applied to different parts of the site. Therefore, it will be important to be sure that the results are representative of the different parts of the site.

Charge Question #7. *Do you have any comments on an aspect of the sampling plan that has not been addressed in the charge?*

One panel member was concerned that, given the assumption of homogeneity in the sampling boxes, it was not reasonable to justify an interim action for only the sampled property without verifying that the other properties do not share similar PCDD/PCDF concentrations. Dow explained that if they find a sample in one box that is greater than the action level, then additional samples would be analyzed in that box.

A panel member stated that the sampling is not random, but rather seems to be biased toward the higher concentration areas. This person urged that caution be used when using this data for a more full characterization of the site during the remedial investigation. A reviewer asked why the sampling was being conducted only outside the Dow plant. MDEQ explained this was due to the fact that earlier sampling on the Dow plant showed that the PCDD/PCDF congener profiles were different on-site than in the community.

Another reviewer asked how the plant material would be removed from the samples before analyzing. The authors explained that large pieces would be removed by hand, and then the soil would be put through a ¼ inch screen.

Finally, a panel member asked what mechanism would be used for deciding which soils to use in the bioavailability study. MDEQ replied that no mechanism has been selected yet. Based on the results from the first round of sampling, Dow will propose a procedure for selecting soils. MDEQ will review this proposal and then forward it to the panel for their suggestions.

5. Panel Recommendations

Of the soil parameters discussed in the sampling plan, the panel recommended that only soil organic carbon (SOC) and particle size distribution among the parameters proposed may provide relevant information. However, panel members noted that there is little guarantee of even this providing enough information to help select soils for bioavailability testing, which is why random sampling was suggested by one reviewer. The analytical method for SOC should be one that uses pulverization, acidification, combustion, and quantification of released CO_2. The panel also recommended that Dow look for correlations between these parameters and concentrations of PCDD/PCDF TEQ. The panel also suggested that conducting in vitro chemical desorption assays may give a better understanding of how bioavailable PCDD/PCDFs will be on the different soils observed at the site. While some type of desorption measurement may in fact be better than simply SOC and texture, the cost to do such, which is 2 orders of magnitude more, must clearly be justified. Panel members still cautioned that these data may not provide a clear basis for selecting soils, and recommended that a random sampling approach may be an

alternative way to select soils. The panel recommended that considering clusters or hotspots is an appropriate approach to analyzing the data and agreed with the plan to rely mainly on univariate analyses as discussed by the authors. Finally, one panel member recommended that a cost/benefit analysis be conducted, given that the preliminary results suggest the site-specific bioavailability may not be significantly different from the 50% default value.

6. References

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Founded in 1852
by Sidney Davy Miller

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November 14, 2006

Mr. Jim Sygo
Deputy Director
Michigan Department of Environmental Quality
Executive Division
P.O. Box 30473
Lansing, MI 48909-7973

Re: Dow Corrective Action – Blinding Protocol for the Upcoming Soil Sampling and Analysis

Dear Mr. Sygo:

We are writing to you to confirm our understanding of Miller Canfield's role as the Third Party for the sampling and analysis of the Midland Area Soils under the terms and conditions set forth in this letter agreement ("Agreement"). We are also writing to you to confirm that the October 2006 Blinding Protocol ("Blinding Protocol") prepared by Fishbeck, Thompson, Carr and Huber ("FTCH") and the October 27, 2006 memorandum attached to this Agreement entitled Operating Procedure ("OP") represent our mutual understanding of the blinding process that the Third Party is intended to implement.

Miller Canfield is agreeing to serve as the Third Party under the following terms and conditions:

1. Miller Canfield is representing the City of Midland with respect to this matter and is continuing its attorney-client relationship with the City of Midland. Any work performed or actions undertaken pursuant to this Agreement, the OP or the Blinding Protocol is done for the benefit of the City and for the purpose of providing legal advice to the City.

2. Miller Canfield agrees to serve as and undertake the duties of the "Third Party", which is referenced in the Sampling and Analysis Plan in Support of Bioavailability Study, Midland Area Soils ("SAP"); the OP attached to this Agreement; and the Blinding Protocol. Miller Canfield agrees to retain FTCH as the "Third Party Contractor" ("TPC") to perform the scientific and technical elements of the OP and the Blinding Protocol.

3. In its capacity as TPC, FTCH shall be a consultant to Miller Canfield for the purpose of providing legal advice to the City; therefore, communications between the City, Miller Canfield, and FTCH shall be confidential, subject to attorney-client privilege, and not subject to disclosure to Dow or MDEQ absent the permission of the City.

4. Dow and MDEQ agree that sampling and analysis of the Midland Area Soils, the Blinding Protocol, the SAP, and the Quality Assurance Project Plan ("QAPP") shall be carried out in strict accordance with the OP attached to this Agreement.

5. Dow and MDEQ agree that the Blinding Protocol shall be attached to and incorporated by reference into the SAP. Dow and MDEQ also agree that the terms of the Blinding Protocol and the OP shall take precedence over any conflicting terms of the SAP or QAPP.

6. Pursuant to the OP and the Blinding Protocol, FTCH will develop information identifying the spatial relationship of the test results for the identified chemical parameters from each station. In order to move forward with necessary sampling, and to work cooperatively with the City of Midland, MDEQ agrees that the Third Party shall maintain the confidentiality of this information; however, the Third Party shall make this information available to MDEQ as set forth in the OP, until such time as a site-specific criteria is agreed upon for Midland Area Soils, or an alternative criterion or procedure is agreed upon. MDEQ agrees that it will not initiate action to compel disclosure of this information in a manner inconsistent with this Agreement, the Blinding Protocol, or the OP unless Miller Canfield or the TPC have acted with gross negligence or in willful disregard of the Blinding Protocol, the OP or the undertakings set forth in this letter.

7. By agreeing to serve as the Third Party and TPC, respectively, neither Miller Canfield nor FTCH assume any responsibility or liability for any aspect of the SAP, nor any rights, obligations, liabilities, or requirements that would otherwise belong to or be imposed upon the MDEQ or Dow. Neither Miller Canfield nor FTCH shall be subject to the obligations of Parts 201 or 111 of the Michigan Natural Resources and Environmental Protection Act, MCL 324. 20101 *et. seq.* and MCL 324.11101 *et. seq.* with respect to their participation in this matter except as stated in the OP, Blinding Protocol, or this Agreement.

8. Miller Canfield reserves the right to terminate its work as the Third Party if a conflict of interest develops or if other circumstances arise that would cause it to be unable to fulfill its legal representation of the City of Midland. In such event, Miller Canfield will work cooperatively with MDEQ and Dow to transfer all information related to this undertaking to the successor Third-Party, and will assure that the TPC preserves all samples and records it holds on account of this undertaking. Miller Canfield also agrees to assign its agreement with the TPC to the successor Third Party.

9. Neither Miller Canfield nor FTCH shall be liable to MDEQ for any consequential or incidental damages arising from or related to their acts, errors, or omissions in connection with this Agreement, the Blinding Protocol, the OP, or any other matter related to their undertaking as the Third Party or TPC except in the event of a judgment which specifies that Miller Canfield or FTCH, respectively, have acted with gross negligence or willful misconduct

10. MDEQ acknowledges that Dow will reimburse Miller Canfield for the fees, costs and expenses associated with its work as the Third Party, including but not limited to attorney fees, all expenses and costs necessary to undertake the blinding protocol, including the storage of soil samples, the rental of equipment and storage space, and the retention of scientific and technical consultants. Notwithstanding this obligation, such payments by Dow shall not create an attorney-client relationship between Dow and MCPS.

11. MDEQ also acknowledges that Dow will indemnify and hold harmless Miller Canfield, FTCH, and any of their respective officers, principals, employees, contractor, agents, and representatives for any and all claims or liability (including defense costs or attorneys fees) arising from or related to this undertaking, except in the event of a judgment which specifies that Miller Canfield or FTCH, respectively, have acted with gross negligence or willful misconduct

12. Once MDEQ approves the Blinding Protocol, Miller Canfield is free to carryout its responsibilities under that protocol independent of and without interference by MDEQ or Dow, so long as it acts in accordance with the Agreement..

We would appreciate it if you would please confirm in writing your agreement to these terms and conditions. If you have any questions or concerns, please do not hesitate to contact me.

Very truly yours,

MILLER, CANFIELD, PADDOCK AND STONE, P.L.C.

By: _____
Thomas C. Phillips
Its: Principal

Pc: Mr. Ben Baker
James O. Branson, III, Esq.
Mr. Jim Sygo
Mr. Ken Wiley

LALIB:145659.3\060636-00094

Attachment E-2

Independent Science Advisory Panel

Independent Science Advisory Panel

The concept that both exposure and toxicity inputs to the Human Health Risk Assessment (HHRA) process, as well as the final products, will be reviewed by Independent Science Advisory Panels (ISAPs) is firmly ensconced in the Framework for an Agreement Between the State of Michigan and The Dow Chemical Company (Dow and Michigan Department of Environmental Quality [MDEQ], 2005), and Scopes of Work for Midland and the Tittabawassee River Flood Plain (Dow, 2005a and 2005b). The purpose of including ISAPs in the process is to ensure that the best available data and science are used in the risk assessment methodologies; that both inputs and results are credible; that when data are not fully concordant alternative explanations are fully considered; and that the end results are protective of the public health and the environment.

A typical ISAP is composed of 6 to 12 members of differing expertise depending on the issues being addressed, although the number may increase when a particularly complex issue is under consideration. Panel members can be drawn from government, academia, or industry as long as they have expertise relevant to the questions under review and have no conflicts of interest with the issue under consideration, and have made their biases on the subject known publicly. Sponsors and other stakeholders may submit names of experts for consideration; object to any proposed panel member who they feel may have a conflict, or whose expertise is questionable. Ultimately, the selection of the panel is left to the independent contractor to ensure impartiality and credibility of each panel.

Charge questions relevant to the issue under consideration are also developed to ensure that the panel maintains a focus on the critical issues and do not stray into other areas. An independent contractor acts as a facilitator for the panel to maintain this focus and complete the peer review in a timely manner. Sponsor(s) and stakeholders may review the charge questions and offer suggestions to sharpen the focus, but the final charge questions are the responsibility of the facilitator. Each panel member is vetted and provided with the background information well in advance of the actual ISAP meeting(s).

The logistics involved in carrying out an ISAP remain the same although the scope and length of such a peer review may change according to the type of data or issue under review and its intended application. The sponsor(s) of the research or risk assessment prepare a presentation describing the issues and assemble the background information underlying both the experimental data and the methodologies used to reach the conclusions drawn. The independent contractor handles the actual organization of the meeting and serves to manage the day-to-day effort involved in carrying out and completing the panel work and peer review. The costs of carrying out an ISAP are borne by the sponsor(s).

The meeting venue is selected by the contractor and located in an area convenient to the sponsor(s) and panel, and that has the necessary support systems in place and accessible to the panel. Typically, such panels meet face-to-face over a one to two day period, although the length may vary according to the amount of information to be reviewed and the scope of the panel. The meeting starts with a presentation by the sponsor(s) summarizing the background information and the results. Following this presentation, the panel members may ask questions and provide feedback to the sponsors. Once this portion of the review is completed, the panel enters executive session to address the charge and the formal questions intended to address the issue before them. While the panel deliberations remain open to the sponsors and other interested parties, they are not allowed to comment or interact with the panel during this period (except through the facilitator, for example to provide further information

requested by the panel). The facilitator maintains the schedule and focus of the ISAP meeting, and keeps a record of the discussion and findings of the panel. The facilitator develops a written transcript of the meeting and the panel responses to the charge question and findings. This is circulated in draft form to the panel members, the sponsor(s), and other interested parties for comment. Once all comments are received and considered by the panel, which may modify the findings or not as they deem necessary, the facilitator issues the final report and recommendations of the panel. The sponsor(s) may address in writing critical issues or concerns prior to the issuance of the final report, or subject any revisions to another panel review if need be.

In this instance there are three categories of data or risk assessment outcomes that may require an ISAP. These are: 1) exposure parameter distributions for use in developing probabilistic estimates of exposure or dose; 2) point estimates or probabilistic estimates (or both) of *de novo* toxicity criteria such as Cancer Slope Factors and Reference Doses for Contaminants of Potential Concern (CoPCs) , as well as probabilistic treatments of Toxicity Equivalency Factors (TEFs) for use in estimating risks from other dioxins and furans; and 3) development and output of Probabilistic Risk Assessments (PRAs) utilizing the exposure variable and toxicity criteria distributions. A brief description of the type of ISAP and process for each follows.

Exposure Parameter Distributions

Certain variables used in the exposure algorithms to estimate exposure to CoPCs may be expressed as a distribution. Some of these variables have sufficiently robust data sets that the uncertainty surrounding them is low and there would be little anticipated debate about them, although some site-specific adjustment may be necessary. These include variables like body weight, skin surface area, lifespan, certain physiological parameters and so forth. Others are more uncertain, but the needed data has or can be obtained with some effort. These include parameters like residential duration, frequency of contact with media of concern, and contaminant concentrations in media of concern. Others may be more uncertain due to lack of data and difficulty in obtaining it, or due to uncertainty in site-specificity of available data. These include variables such as ingestion rates, bioavailability, and contaminant uptake in foodstuff, or loss due to food preparation. Only those variable distributions where agreement cannot be reached between MDEQ and Dow would be assigned to an ISAP.

Following identification of the exposure parameter distributions of issue, review by an ISAP or ISAPs should be scheduled as soon as possible. Because of the potentially large number of variables and distributions involved, a single extended panel can be assembled over the course of several days to review all (or most of) the distributions and the supporting information at once. In this case, panel members may change over the course of the extended review because of the different types of expertise that would be needed. Alternatively, more than one ISAP could be formed to address individual or groups of exposure parameter distributions. Since some of the needed exposure distributions are more certain than others and some distributions will require more in-depth evaluation due to the uncertainty or controversy that surrounds them, this may be the more practical solution although it will take more time and effort.

The type of expertise needed will depend on the specific exposure parameters under review. Expertise in environmental fate and transport, statistics, sampling, human physiology, dietary and other behavioral issues, exposure assessment, and probabilistic analysis along with others will be needed to address the specific exposure distributions developed. Distributions that need to be reviewed individually because of the complexity or uncertainties involved (e.g., child or adult soil ingestion rates, other ingestion rates, oral or dermal bioavailability, skin adherence, etc.) will utilize more specialized expertise, although over a shorter period. The ISAP or ISAPs will be assembled, staffed with expertise relevant to the distributions to be reviewed, and a report issued in a timely manner.

The reports will address the adequacy, completeness and overall credibility of the underlying data used for the distributions, the manner in which the distributions were developed, and their intended applications in the PRA.

Toxicity Criteria Distributions

The largest area of uncertainty in risk assessment involves the development and application of toxicity criteria. This is due to the large number of uncertainties that are required in developing the toxicity criteria, for example, due to animal-to-man and high-to-low dose extrapolations. Such toxicity criteria as currently used for tetrachlorodibenzo-p-dioxin (TCDD) by MDEQ is deterministic (i.e. point estimates), and based on experimental data that have since been augmented or supplanted, or used extrapolation techniques that have since been replaced. It is intended that for TCDD and 4-pentachlorodibenzofuran (PeCDF) at least, for which new toxicity data are available, toxicity criteria or new toxicity criteria (for cancer in the case of TCDD) be developed, both as a point estimate and perhaps probabilistically, to fully represent the advances in science and extrapolation methodologies. Additionally, probabilistic treatment of the TEFs developed for other dioxin-like chemicals that lack specific toxicity data would also be undertaken.

Probabilistic Risk Assessment

The exposure parameters and toxicity criteria generated and reviewed by prior ISAPs will be combined together in a PRA to enable the full range of risks to be readily visualized. While the individual components have been peer-reviewed, the final product and its interpretation require an added level of independent review to maintain credibility.

For this review, the ISAP would consist of individuals not involved in the previous reviews (unless otherwise unavoidable due to specific needs). The panel would be asked to review not only the inputs to the PRA, but the manner in which they were combined, the outputs developed, and the proper interpretation of the results for purposes of risk communication and management. The ISAP assembled for review of the results of the PRA for Midland and the Tittabawassee River Floodplain would require expertise in the areas of exposure assessment, dose-response extrapolation, probabilistic analysis, risk communication and risk management. It is anticipated that it will take between one and two days to complete an evaluation of the PRA. As with other ISAPs, a report would be issued as to the scientific credibility and completeness of the PRA, the manner in which the PRA was developed, and its interpretation in terms of risk management and communication.

References

The Dow Chemical Company (Dow). 2005a. Scope of Work for Midland Area Soils Remedial Investigation. October.

The Dow Chemical Company (Dow). 2005. Scope of Work for Titabawassee River Sediments and Floodplain Remedial Investigation. October.

The Dow Chemical Company (Dow) and Michigan Department of Environmental Quality (MDEQ). 2005. Framework for an Agreement between the State of Michigan and The Dow Chemical Company. January.

Attachment E-3

Studies to Support the Human Health Risk Assessment

Garden Vegetable Sampling Work Plan

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DRAFT GARDEN VEGETABLE SAMPLING WORK PLAN FOR THE MIDLAND SOILS STUDY AREA

Prepared by:
ENTRIX, Inc.
East Lansing, Michigan

Prepared for:
The Dow Chemical Company
Midland, Michigan

December 2006

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Definitions and Acronyms

AhR	Aryl Hydrocarbon Receptor
DOW	The Dow Chemical Company
DQOs	Data Quality Objectives
ESA	Endangered Species Act
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HSD	Honestly Significant Difference
LOD	Limit of Detection
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDL	Method Detection Limit
MDNR	Michigan Department of Natural Resources
MLE	Maximum Likelihood Estimates
MSU	Michigan State University
ND	Non-detect
PCA	Principal Components Analysis
PCBs	Polychlorinated Biphenyls
PDF	Probability Density Function
PCDDs	Polychlorinated Dibenzo-p-Dioxins
PCDFs	Polychlorinated Dibenzofurans
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
S-HASP	Study Area Specific Health and Safety Plan
TAs	Target Analytes

TEFs	Toxic Equivalency Factors
TEQs	TCDD equivalents
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
UMDES	University of Michigan Dioxin Exposure Study
URCF	University Research Containment Facility
USEPA	United States Environmental Protection Agency
WHO	World Health Organization

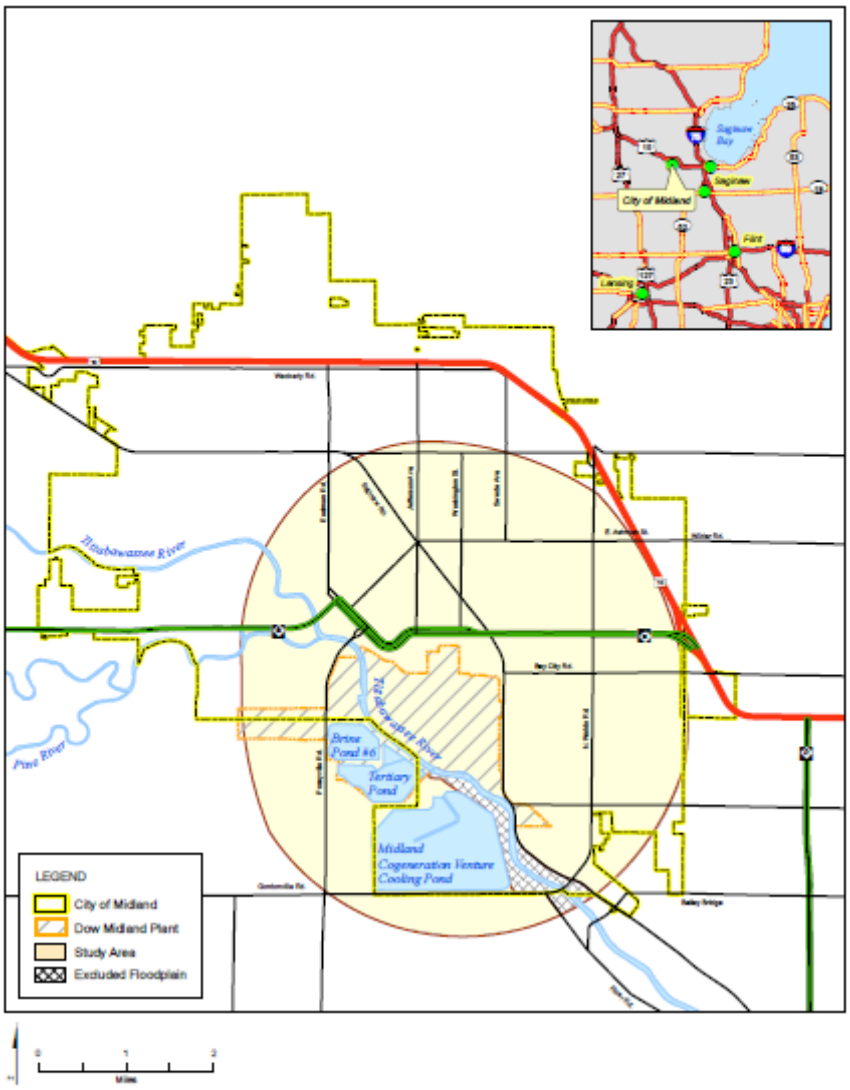
1.0 INTRODUCTION

The "Study Area" referred to in the remainder of this document includes the Midland Soils Study Area. The Study Area includes soils affected by offsite migration or transportation of hazardous substances from the Midland Plant that exceed state criteria and is depicted in Figure 1-1.

Previous documents have reported concentrations of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) in Study Area soils that exceed some state generic criteria (Hilsherova et al., 2003, MDEQ, 2003). Previous studies suggest that compounds such as PCDDs and PCDFs may enter the food chain via ingestion of soil from poorly washed vegetables (Buckley-Golder, 1999 as cited in Augusto et al., 2004). Data from the University of Michigan Dioxin Exposure Study (UMDES, 2006) indicate that root vegetables raised in the Study Area are being consumed by humans (8.5 and 15.2% of floodplain and near floodplain respondents reported consuming floodplain-raised root vegetables during the last 5 years). Despite this, no PCDD or PCDF concentration data exists for vegetables or fruits such as root crops, fruiting crops, leafy and/or waxy crops (collectively referred to as "vegetables" throughout the remainder of the document) raised in Study Area soils. The lack of Study Area-specific data, impact of dietary substitution of home-raised vegetables, the issue of cooking loss, and the remaining uncertainty over potential human exposure makes it difficult to draw firm conclusions regarding the potential for human health risks posed by consumption of vegetables raised in Study Area soils. Because vegetables raised within the Study Area are likely consumed by the general public, ingestion of these products may constitute a complete exposure pathway that would require inclusion and evaluation in the Human Health Risk Assessment (HHRA). It is expected that residential (i.e., privately-owned) gardens will account for the majority of vegetables raised in the Study Area for the purpose of consumption by humans. Some gardens located within the Study Area have already received remedial work including, but not limited to soil replacement or garden bed relocation. Therefore, this Study will focus solely on "undisturbed" gardens (hereafter referred to simply as "gardens") which have not received any remedial work. At this time, the number of such gardens in the Study Area is not clear and the evaluation of the extent to which vegetables are raised in gardens on the Study Area will be a top priority in this work plan.

This work plan provides options for the collection of vegetable samples from the Study Area for analysis based on vegetables preferentially consumed by the general public. The sampling plan and methods for acquiring quantitative data on the type, location, and seasonal aspects of consumption of home-raised vegetables by persons residing along the Study Area will be developed in part from United States Department of Agriculture (USDA) data as well as other sources of information including, but not limited to, Study Area-specific ground and/or aerial surveys, Michigan Department of Agriculture (MDA) input, and the University of Michigan Dioxin Exposure Study (UMDES) results, and the upcoming Study Area-specific HHRA Activity Survey. This work plan also details the methods for preserving and shipping the edible portions of local vegetables from the Study Area to a laboratory for analysis of PCDDs and PCDFs.

Figure 1-1. Greater Midland Area and Midland Soils Study Area



1.1 Purpose

The overall purpose of this vegetable work plan is to provide an outline for studies that would result in Study Area-specific information for the HHRA in the form of vegetable samples collected from gardens in the Study Area. At this time, specific study objectives include the following:

- To identify those locations in the Study Area where gardens are maintained and vegetables are raised for consumption by humans,
- To identify the types of vegetables most commonly raised for the purpose of consumption by humans, and how they are used for consumption,

- To identify and collect an adequate number of vegetable samples from residential gardens within the Study Area (contingent on presence of gardens and landowner permission),

- In the absence of any locally-raised vegetables, to discuss alternate to gather such information for purposes of risk assessment,

- To identify and prepare individual edible portions of various locally-raised vegetables for analysis in the same manner as is commonly done by consumers, and

- To submit those vegetable tissue samples to a qualified laboratory for analysis of PCDDs and PCDFs relevant to soils in the Study Area.

Tissue from the vegetables samples will be archived in case additional or confirmatory analyses are required. The analytical results from the vegetable tissue sampling will be used to estimate a probability density function (PDF) for target analyte (TA) concentrations and this will be used to estimate TA exposure through ingestion of various vegetable types. The necessary data inputs, methods and decisions used to create this PDF are detailed in the Human Health Risk Assessment (HHRA) currently under development. Other aspects of TA exposure through vegetable ingestion, such as weighting the consumption of specific vegetable types, accounting for cooking loss of TAs, and determining the frequency and rate of consumption will also be detailed in the relevant HHRA currently under development.

1.2 Rationale

Soils from the Study Area have been shown to contain residual levels of PCDDs and PCDFs. Studies have shown that some of these compounds can accumulate on the surface or in the tissue of vegetation including garden vegetables via routes including, but not limited to dry and wet deposition of particulate matter, volatilization, vapor sorption, and root uptake and transport (Hulster et al., 1994; USEPA, 2000). Consumption of such vegetation has prompted questions regarding human consumption of vegetables that have been raised on the Study Area.

1.3 Data Quality Objectives

All sample and data collection activities will be carried out under QA/QC conditions specified in the relevant Quality Assurance Project Plan (QAPP). To this end, a set of data quality objectives (DQOs) has been developed in accordance with the EPA DQO process (EPA, 2006). The DQOs for this work plan are summarized in the following steps.

1.3.1 DQO Step 1. State the Problem

Define the problem that necessitates the study; present a conceptual Study Area model, and identify the planning team and schedule

Problem statement – There is concern that human consumption of vegetables that have been raised in the Study Area could result in unacceptable risk through exposure to PCDDs and PCDFs. Data are needed to fill data gaps, increase Study Area-specific relevance, and reduce uncertainty regarding the potential risks to human health resulting from exposure to PCDDs and PCDFs via this pathway.

Conceptual Study Area model – Exposure of vegetables to PCDDs and PCDFs in the Study Area likely occurs through dry and wet deposition of particulate matter, volatilization, vapor sorption, and root uptake and transport. Factors such as route of exposure, soil type, land use and cover conditions, and type of vegetable might also affect concentrations PCDDs and PCDFs.

Planning team - The initial planning will be coordinated by Dow and its contractors. However, gardening and/or farming experts familiar with mid-Michigan agricultural gardens (e.g., MDA personnel, local farmers etc.) will also be interviewed to ensure that the sampling effort is Study Area-specific and relevant. Resources to be considered include recent USDA and MDA crop data, the planned Study Area-specific Activity Survey, UMDES results, and Study Area-specific ground and/or aerial surveys of properties within the Study Area. Any suggested modifications relevant to this plan in terms of vegetable type/species, numbers, and preparation methods based on their inputs will be adopted in order to improve the relevance, accuracy, and Study Area-specificity of the vegetable sampling protocol, thereby further reducing uncertainty.

Schedule - Collection of vegetables will be accomplished during or as close to the period when the various vegetables species are most frequently harvested (generally summer and early fall). It is anticipated that all aspects can be completed within 12 months following approval of a work plan by MDEQ.

1.3.2 DQO Step 2. Identify the Goal of the Study

Identify study questions, state how environmental data will be used in meeting objectives and solving the problem, and consider alternative outcomes or actions that could occur upon answering the question(s)

Study Questions - Decisions to be made that are relevant to determine whether TEQs pose an unacceptable risk(s) to humans are outlined below:

- Are vegetables being raised within the Study Area for the purpose of human consumption, and if so, what types/species are most frequently raised?
- What are the concentrations of PCDDs and PCDFs in vegetables that are most frequently raised on the Study Area and consumed?
- How are the concentrations of PCDDs and PCDFs affected by cooking?
- How are the concentrations of PCDDs and PCDFs affected by preparation technique (e.g., removal of peel from carrots)?

State how data will be used in meeting objectives and solving the problem – The data from this study will be one of many inputs as part of a comprehensive human health risk assessment.

1.3.3 DQO Step 3. Identify Information Inputs

Identify types and sources of information needed to resolve decisions or produce estimates and select appropriate sampling and analysis methods for generating the information.

Identify types and sources of information needed – Data on concentrations of PCDDs and PCDFs are needed for vegetables most commonly raised in the Study Area for the purpose of consumption by humans.

There are currently no vegetable data from the Study Area that would be suitable for risk assessment purposes. Therefore, this work plan proposes options for studies to collect vegetables for analysis based on the types/species preferentially raised by private farmers, hobbyists, and others, and prepared for analysis in the manner most common to these groups as revealed by a planned Study Area-specific Activity Survey. Interviews with local experts and other sources will supplement this information.

At this time, no commercial vegetables facilities (farms) have been located within the bounds of the Study Area. Private gardens (sometimes referred to as "backyard" or "hobby" gardens) that may or may not produce vegetables for the purposes of consumption by humans are present throughout the Study Area. At this time however, the number of vegetable gardens (as defined in Section 1.0) present on the Study Area has not been precisely defined. In order to determine this, UMDES survey results as well as the results from the Residential Property Use and Agricultural Property Use Activity Surveys will be evaluated. In addition, ground and/or aerial surveys may also be conducted to further reduce uncertainty regarding the number of vegetable gardens in the Study Area.

Sampling and analysis methods – Collection of vegetable samples will be accomplished via hand-picking, the most common technique employed by private gardeners. Sufficient vegetable tissue will be collected and prepared in a manner relevant to human consumption so that the concentrations of PCDDs, PCDFs, or other TAs and lipids can be determined. When possible, vegetables will be retained to analyze separately if needed or to conduct studies on the effects of cooking on the concentrations of TAs. Preparation of samples will reflect Study Area-specific and commonly recommended practices.

1.3.4 DQO Step 4: Define Boundaries of the Study

Define the target population of interest and its relevant spatial boundaries, define what constitutes a sampling unit, specify temporal boundaries, and other practical constraints associated with sample/data collection.

Target population and spatial boundaries - The spatial boundaries of this Study include Study Area lands as described in the work plan introduction. The target population of interest includes vegetables raised in gardens on the land within the bounds of the Study Area.

Temporal boundaries - The temporal boundaries consist of time frames that are as close as possible to the period in which the selected vegetables are most frequently harvested for the purpose of consumption by humans.

Sampling unit - The sampling unit is defined as one individual vegetable or component of an individual vegetable (e.g., carrot peels).

Practical constraints associated with sample/data collection - Practical constraints that could interfere with sampling include low abundance of vegetable gardens, difficulty gaining permission to sample vegetable gardens, and poor success raising vegetables in private gardens.

If there is poor success in the sample collection, a longer sampling period may be employed. As for potential permit constraints, appropriate agencies will be included in the planning to minimize constraints that impact the successful completion of this Study. It is not expected that these problems will interfere with the completion of this Study.

1.3.5 DQO Step 5: Analytic Approach

Specify appropriate population parameter(s) estimates and the estimation procedure.

The occurrence of PCDDs and PCDFs in vegetables are intended to be descriptive and, therefore, do not involve conventional rules for decision making. However, statistical procedures that are appropriate based on the distribution of any given data set will be used for comparing significant differences between data collected from locations within the Study Area.

The analytical approach is to identify and report the concentrations of PCDDs, PCDFs, and TEQs measured in vegetables species that have been collected from the Study Area and calculate summary statistics (i.e., range, mean, 95% confidence limits on the arithmetic mean, median, geometric mean, standard deviation, and standard error) on a wet weight and lipid normalized basis by location within the Study Area, species, and tissue. These data will be utilized to develop a valid PDF for use in exposure and risk assessment. Descriptive statistics will be provided for concentrations of individual PCDD and PCDF congeners and total TEQs as outlined in the Exposure Assessment work plan currently under development for submission on December 1, 2006.

In addition, comparative statistical procedures (described in detail elsewhere in this work plan) will be used for evaluating significant differences between locations or preparation methods. While data will be reported for non-detected (ND) residues [i.e., less than the method detection limit (MDL)] with three proxy values (ND=0, ND=1/2 MDL, and ND=MDL), a proxy value of one-half of the MDL will be utilized for comparative statistical calculations. Depending on the various outcomes of those results, a decision will be made whether the data are sufficient to conclude whether further evaluation and/or studies are necessary and/or whether a technically valid conclusion can be made.

Finally, patterns of relative concentrations (frequency and magnitude) of congeners will be compared among locations (described in detail elsewhere in this work plan).

1.3.6 DQO Step 6: Specify Performance or Acceptance Criteria

Specify acceptable limits on decision errors and estimation uncertainty

Specifying limits on decision errors involves defining the possible decision errors and the consequences of making these errors. Typically, this is done by describing the decisions in terms of hypothesis tests or other objective decision criteria and by specifying the hypotheses to be tested using an appropriate statistical model. Limits can also be specified by identifying the decision errors as false-positive and false negative errors. In this Study, the type I error (the false positive decision error; α) will be set at 0.05. The type II error (the false negative decision error; β) will be set at 0.2. The strength of statistical analyses, however, will depend on the statistical power of the study to actually detect differences that truly do exist, on the quality of data

generated by instrumental analyses, and on the representativeness of the samples that are collected.

1.3.7 DQO Step 7: Optimize the Design

The study design will be optimized based in part on discussions with MDA, MDEQ and other interested parties and agencies. If analysis shows that the sample size is too small while the variability is too great to reduce the probability of a type II error, then subsequent studies may be designed and implemented.

1.4 Target Analytes

The 17 PCDDs and PCDFs congeners are the primary analytes of interest in this study. Other TAs as identified during the remedial investigation will be added to the TA list, as appropriate.

1.5 Outline of General Strategy

To accomplish the study objectives, information will be collected and evaluated to determine the presence or absence of vegetable gardens in the Study Area from which vegetables could be collected to determine the concentrations of PCDDs and PCDFs for use in the HHRA. The field studies described in this vegetable work plan have been designed to maximize the utility of the information gained.

The following is a summary of the general strategy for the vegetable work plan:

1. Determine presence or absence of active vegetable gardens in the Study Area using the results of the UMDES study, MDEQ "Residential Property Use Activity Survey" and "Agricultural Property Use Activity Survey" as well as ground and/or aerial surveys,

2. If active vegetable gardens are absent, determine alternate methods of obtaining useful information.

3. If active vegetable gardens are present within the Study Area, collect vegetable samples from them,

4. Conduct congener-specific PCDD and PCDF analysis on samples (results to be reported on a wet weight and lipid-adjusted basis),

5. Evaluate the effect of preparation methods (e.g., removal of peel from carrot) on concentrations of PCDDs and PCDFs; and

6. Calculate the concentration of TEQs based on measured concentrations of PCDDs and PCDFs.

1.6 Description of Study Area

1.6.1 Overview

This section provides a brief physical description of the lands within the Study Area

1.6.2 Agricultural Characteristics

The vast majority of agricultural property in the Study Area is farmed for field crops such as corn, soybeans, and sugarbeets (Saginaw and Bay counties were among the top 5 counties in Michigan for these crops in 2005). In 2005, Michigan produced 887,560 tons of fresh and processed vegetables worth approximately $216 million dollars. Nationally, Michigan ranked eighth and fifth, respectively, for fresh market and processing vegetable value of production (USDA, 2005). Vegetables commonly raised in Michigan by commercial, large-scale, farms include potatoes, asparagus, tomatoes, carrots, cabbage, cucumbers, and onions. However, at this time, no commercial vegetables farms have been identified on Study Area lands, and vegetable production on lands within the Study Area is likely limited to "backyard" or "hobby" gardens, for which there are no data.

1.7 Work plan Organization

The remainder of the vegetable work plan is organized into the following sections and appendices as follows:

Section 2.0. Field Study Options

This section provides an overview of the options for field studies and details the chemical, physical, and biological measurements that can be made while conducting the studies described.

Section 3.0. Schedule and Reporting

This section provides an overview of the project schedule.

Section 4.0. References

Appendix A. Standard Operating Procedures (SOP)

The Standard Operating Procedures (SOP) provide the procedures that will be followed in the laboratory (SOPs for collection of samples will be submitted once study method(s) has been determined).

2.0 FIELD STUDY OPTIONS

2.1 General Strategy

Studies detailed in this vegetable work plan are designed to simulate as close as possible the harvesting of vegetables by those who raise vegetables on Study Area lands. Development of the final vegetable sampling plan will be based on input from the stakeholders, agency (USDA, MDA, MDCH, MDEQ) personnel, and local residents that raise vegetables. The primary considerations for this sampling effort are the collection of a representative and robust set of vegetable samples as well as chain-of-custody and sample integrity issues.

The extent to which vegetables are present and being raised in gardens on Study Area lands must be determined before sampling can commence. To determine this, Dow or its contractors will review data from previously conducted surveys (e.g., Residential Property Use, Agricultural Property Use Activity Surveys) and if necessary, conduct Study Area visits and ground/aerial surveys to locate Study Area lands which contain vegetable gardens. It is anticipated that this information as well as input from stakeholders, agency personnel, and others will help determine a path forward which may or may not include one or more of the study options described in section 2.2.

2.2 Study Options

The current study will focus on properties within the Study Area as described in the work plan Introduction.

2.2.1 Collection of samples from existing vegetable gardens

In this scenario, samples of vegetables would be collected from existing vegetable gardens on Study Area lands. Residents raising vegetables on their property who are willing to participate in the Study would be provided compensation in exchange for samples of vegetables from their garden(s). The overall success of the sampling effort would be contingent on the extent to which vegetable gardens exist on the Study Area and the proportion of property owners that agree to take part in the Study. Additional factors to consider include, but are not limited to the location of the gardens, type and number of vegetables being raised, the length of time in which the vegetables have been exposed to Study Area soils, proximity of gardens to existing soil concentration data, soil type and condition, land use and cover near gardens, as well as seasonal aspects that may confound sampling opportunities. Soil will be collected from any gardens from which vegetables are sampled in order to determine the PCDD/PCDF total TEQ concentration and congener pattern.

2.2.2 Establishment of vegetable farm(s) and collection of samples from existing vegetable gardens

If circumstances are such that no vegetable gardens were found on Study Area lands or if sample size was minimal for HHRA purposes due to poor landowner participation, the option of establishing one or more vegetable gardens on Dow property could be considered. In this

scenario, Study Area-specific vegetable samples would be collected from small gardens established in the Midland Soils Study Area. If possible, gardens would be established on or near property for which soil concentration data (PCDDs and PCDFs) already exists. Vegetables collected from these gardens could supplement any samples collected from existing Study Area gardens as described in 2.2.1. Factors to consider include, but are not limited to PCDD and PCDF concentrations in potential garden plots, soil type, land use and cover, the type and number of vegetables desired, as well as implementation issues (e.g., the spatial and logistical feasibility of establishing one or more gardens). Soil will be collected from any gardens from which vegetables are sampled in order to determine the PCDD/PCDF total TEQ concentration and congener pattern.

If sample collection is unsuccessful (minimal sample size due to poor Study participation, no existing vegetable gardens, Dow vegetable gardens cannot be established, etc.), other methods of obtaining relevant information such as the use vegetation data from similar Study Areas, or the development of models (e.g., soil to plant, etc.) will be considered.

2.3 Sampling Objectives

The sampling objective for the studies listed above is to collect a representative sample of vegetables that are most frequently raised on Study Area lands for the purpose of consumption by humans. Sample collection activities will be initiated only after the work plan is approved by MDEQ.

2.4 Target Species Selection, Types and Numbers of Samples to be Collected

At this time, it is not known which garden crops are preferentially raised on Study Area lands for the purposes of human consumption. Crops that are in contact with soil or have characteristics that may increase absorption of PCDDs and PCDFs would make potentially the best indicators of exposure conditions in the Study Area. Thus, is anticipated that a cole crop, a fruit crop, a root crop, and a cucurbit crop will be targeted as this diversity is representative of crops raised throughout Michigan (according to USDA and MDA data) and covers a variety of physiological crop types. The final selection of crops for inclusion in the sampling plan will be based on the presence or absence of vegetables on Study Area lands, the UMDES questionnaire results, the HHRA Activity Survey, and discussions with agency (USDA, MDA, MDEQ) personnel and other sources of reliable information that can be verified.

For all gardens, the objective will be to collect samples representative of that which is consumed by residents raising vegetables on Study Area lands. If existing gardens are utilized, attempts will be made to control for variables such as crop species, size of vegetables, length of exposure, watering and fertilizing regimes, etc. However, because access to existing gardens will likely be limited, it may not be possible to match all variables. Separate samples will be collected from the outer skin (e.g., carrot peel) and inner contents of all vegetables sampled. Foliage may also be collected from vegetable plants near the end of the growing season so as not to reduce vegetable production. Depending on sample size collected, vegetables may be composited together for analysis or analyzed individually.

Achieving the target numbers of samples will be based on the study method(s) selected, the relative abundance of vegetables in the Study Area, and the overall participation of property owners raising vegetables. Table 2-1 lists a summary of the expected crop and sample types and numbers.

Table 2-1. Summary of crop types, sample types, and number of samples.

Crop type and examples (preliminary list)	Location(s)[1]	Sample Type	# Tissue Samples/Location[2]	Total # Samples[3]
Cole crop (lettuce)	TBD	Edible portion	1-10	TBD
Fruit crop (tomatoes)	TBD	Edible portion	1-10	TBD
Root crop (carrots, potatoes)	TBD	Edible portion	1-10	TBD
Curcubit crop (zucchini, cucumber)	TBD	Edible portion	1-10	TBD

[1] Specific sampling locations will be determined at a later date

[2] Preliminary numbers only, number will vary if composited (instead of individual) samples are analyzed

[3] Estimates only, dependent on study methods selected and anticipated success of sampling effort

2.5 Sample Designation

Sample labeling, preservation and tracking procedures are described in detail in the SOP entitled "Documentation, Preservation, Handling, and Tracking of Samples for Analysis", which will be provided at a later date. SOPs detailing collection methods for vegetables will also be provided once study methods have been determined.

2.6 Sampling Frequency and Duration

The sampling effort will be dependent on the presence of Study Area gardens, garden location, property owner participation, the selection of appropriate sampling periods, and the duration in which the vegetables have been growing in the gardens. Every effort will be made to collect samples during the period in which the various target crops are most frequently harvested for consumption by humans. Each sampling location will be sampled until the target size for each crop is attained. It is anticipated that gardens will be sampled multiple times in order to obtain adequate sample mass and mimic realistic consumption scenarios. The actual sampling period and the rationale for its selection will be documented fully and the final report will include an assessment of sampling period effects on the results.

2.7 Sampling Methodology and Design

It is this Study's intention to utilize existing vegetable gardens to the furthest extent possible. If this is not possible, alternate methods as described in section 2.2 may be employed. All practices will be conducted in such a way to maximize public and worker safety.

For each vegetable sample collected, the following field observations and measurements will be recorded:

- Sample ID
- Species
- General Study Area description
- Photographs
- GPS coordinates
- Date and time of harvest
- Collectors initials

After recording observations and measurements, the sample will be processed as described in the standard operating procedures (SOPs).

2.8 Sample Type and Processing

This section briefly discusses the processing procedures. Specific details of processing will be included in the associated SOPs. The preparation of vegetable samples collected will be done to reflect the general practice among consumers and will reflect as well the preparatory steps (if any) prior to cooking. When relevant, both the outer skin (e.g., carrot or potato skin) and inner tissue of vegetables may be analyzed. Preparation methods for various vegetable types and other factors that might influence residues will be verified in the Study Area-specific Activity survey. A sufficient amount of tissue from each vegetable collected will be retained for possible additional analysis if cooking loss needs to be ascertained or other analysis is required for purposes of ascertaining or refining exposure estimates.

After samples have been collected and initial documentation has been completed, samples will be separated by location, wrapped individually, labeled, bagged, placed on wet ice and transported to a secure field facility, or transported directly to the University Research Containment Facility (URCF) at Michigan State University (MSU), or similar facility, for processing and homogenization. Specific details of processing will be included in the associated SOPs. At the secure field facility or the URCF, or similar facility, garden vegetable samples will be dried and massed before being cut into small cubes (approximately 1 cubic inch) and ground and homogenized in chilled stainless steel blenders. The ground sample will then be repeatedly hand-mixed until homogeneous. If chunks of tissue are still present the grinding and mixing procedure will be repeated. Homogenates will then be aliquoted into chemically clean I-CHEM jars. One jar will be shipped to the appropriate analytical laboratory, while remaining jars will be archived at the URCF, or similar facility. Splits will be made available to MDEQ provided adequate sample size is available. Garden vegetables will be stored at –20° C until they are

ready for compositing and/or homogenization. Replicate samples or samples not immediately utilized will be stored in the same manner.

2.9 Selection of Analytical Suite

At present, the primary focus of this sampling effort is to determine the concentrations, patterns, and variability of polychlorinated dioxins and furans (PCDD/Fs) in vegetable tissue collected from the Study Area. If other TAs are identified in the course of the remedial investigation that might accumulate in vegetable tissue, these may be included in the analysis of the samples or replicate samples after consultation with MDEQ.

2.10 Analytical Methodology and Detection Limits

The Limits of Detection (LODs) are based on currently acceptable laboratory performance for certified EPA standard methods 1613 and 8290A. The analysis of PCDD and PCDF congeners is particularly susceptible to matrix-based interferences that can significantly alter sample-specific detection limits. Therefore, the target detection limits provided in Table 2-2 must be considered as 'targets' and not absolute criteria. All efforts shall be made by the laboratory to attain these detection limits. In addition, exceedance of any of these targets for a laboratory (reagent) blank sample would require reanalysis of that batch of samples. Standard reference materials will be included in the samples analyzed. However, if standard reference materials do not exist for these specific tissue types, the most suitable available substitutes will be used. In addition, matrix spike samples based on the collected tissues will also be analyzed. Non-detects will be handled as ND=0, ½ MDL, and MDL.

Table 2-2. Target Detection Limits

Chemical	LOD (pg/g)
2378-TCDD	0.1
2378-TCDF	0.1
12378-PeCDD	0.3
12378-PeCDF	0.3
23478-PeCDF	0.3
123478-HxCDD	0.5
123678-HxCDD	0.5
123789-HxCDD	0.5
123478-HxCDF	0.5
123678-HxCDF	0.5
234678-HxCDF	0.5
123789-HxCDF	0.5
1234678-HpCDD	0.5
1234678-HpCDF	0.5
1234789-HpCDF	0.5
OCDD	1
OCDF	1
TOTAL WHO-TEQ	**0.9**

2.11 Study Area Facilities

After samples have been collected in the field and initial documentation has been completed, samples may be initially processed at a secured field facility nearby the Study Area. If this facility is used, vegetables samples will be processed as stated previously and as detailed in the relevant SOPs. Samples will then be prepared for shipment to the URCF for further processing (i.e., homogenization and separation of sample into aliquots).

2.12 Health and Safety

Health and safety requirements which are applicable to persons who perform work on the Study Area pursuant to this vegetables work plan are described in the S-HASP. The S-HASP describes known hazardous substances at the Study Area, exposure limits, and contingency plans for the vegetables work plan field work. Modifications to the S-HASP may be necessary depending on the study or studies selected.

2.13 Statistical Analyses and Reporting of Analytical Results

2.13.1 Descriptive Statistics

Descriptive statistics of the results will be reported for all samples collected. For each sample, results will include concentrations of Total TEQs, percent lipids, congener-specific concentrations of PCDDs and PCDFs on a wet weight (converted from dry weight) and lipid-normalized basis. In addition, TEQs for each congener and percent contribution of each congener to the total within a sample will be compiled. Descriptive statistics will include the range, arithmetic mean, 95 percent confidence limits on the arithmetic mean, median, geometric mean, standard deviation, and standard error. Non-detect concentrations will be handled as ND=0, ½ MDL, and MDL. In addition, descriptive statistics will be provided for concentrations of individual PCDD and PCDF congeners, when analyzed, and total TEQs (on a wet weight and lipid normalized basis) by location, species, and tissue.

2.13.2 Comparative Statistics

Comparative statistics for samples between different locations will be conducted with concentrations of TEQs on a wet weight basis. In addition, a comparison will be made for congener patterns. The specific strategies for conducting the statistical analyses are outlined below.

2.13.2.1 Tests for Normality and Homogeneous Variances

Before statistical comparisons are conducted, data sets will be evaluated to determine if parametric or non-parametric statistics will be used in the analyses. Parametric statistics assume that the data distribution is normal or bell-shaped and the variances of each population are homogeneous (equal). Non-parametric statistical tests are not dependent on a specific distribution; rather, they are "distribution-free" and can be used to test the distribution of data relative to different types of distribution functions. The data from each sample type and location will first be tested for a normal distribution by using the One Sample Kolmogorov-Smirnov test with Lillifor's transformation (Wilkinson, 2000). If data for a sample type and/or location are not normally distributed, then the data will be log-transformed and the data set re-tested. To determine if the variances are homogeneous in the data sets, one of two tests will be used depending on the number of locations being evaluated. For comparisons among two locations, the variances of samples collected from each location will be tested by an F-Test. If greater than two locations are to be evaluated, a Levene's Test will be conducted to evaluate variance homogeneity (Wilkinson, 2000). If the data are not normally distributed or do not have homogeneous variances, then the use of parametric statistics becomes suspect and the results difficult to interpret. Under this scenario a non-parametric statistical test would be used for comparisons of TEQ concentrations among sample groups.

2.13.2.2 Statistical Comparisons of TEQs

In all cases statistical analyses will be conducted with concentrations of TEQs derived from the concentrations and relative potencies of the 7 PCDDs and 10 PCDFs that exhibit AhR agonist activity. Separate analyses will be performed for each species to test for differences in concentrations of total TEQs among sample locations and preparation methods.

The general approach to evaluate differences in TEQ concentrations for vegetables is as follows. If data from vegetables samples meet the requirements for parametric tests, then a Student's t-test (equal sample sizes) or the tabled t-test (unequal sample sizes) will be used to compare TEQs between two sample types or locations. If greater than two sample types or locations are compared, an ANOVA with Tukey's Honestly Significant Difference (HSD) will be used to evaluate differences (Wilkinson, 2000).

If data are not normally distributed and do not meet the criteria for homogeneous variances, then non-parametric statistical tests will be used to evaluate differences between or among sample types or locations. If only two sample types or locations are to be tested, a Mann-Whitney U test will be used to evaluate differences. If greater than two sample types or locations are to be evaluated, then the Kruskal Wallis test will be used for statistical analyses (Wilkinson, 2000). In all cases, one-tailed statistical tests will be used to evaluate potential differences between sampling locations. One-tailed statistical tests tend to have a greater ability to detect smaller differences between populations, reducing the probability of a Type II error.

If data are not normally distributed and do not meet the criteria for homogeneous variances, then non-parametric statistical tests will be used to evaluate differences. If only two sample types or locations are to be tested, a Mann-Whitney U test will be used to evaluate differences between locations. If greater than two sample types or locations are to be evaluated, then the Kruskal Wallis test will be used for statistical analyses (Wilkinson, 2000). In all cases, one-tailed statistical tests will be used to evaluate potential differences between sampling locations. One-tailed statistical tests tend to have a greater ability to detect smaller differences between populations, reducing the probability of a Type II error.

As an integral step in the statistical evaluation, the appropriate treatment of non-detect (ND) data will be evaluated. This will be accomplished by conducting a sensitivity analysis to determine the effect of varying values for ND data. Specifically, this will be accomplished by calculating TEQ concentrations based on substituting various proxy values for congeners that are less than their method detection limit (MDL). The proxy values that will be used to calculate TEQ concentrations will be the following: ND=0, ND=1/2 MDL, and ND=MDL. However, if the proportion of non-detect values is greater than 50%, and sample size permits, it might be possible to develop more sophisticated estimates of values for ND congeners. This approach would involve the use of distributional methods (regression on order statistics, ROS) such as maximum likelihood estimates (MLE). In this method, observed data are used to estimate summary statistics of the distribution assumed to represent the underlying chemical concentrations at the location. Another approach would be the use of a distributional method to estimate data values corresponding to the percentiles of non-detect values. These estimates replace the non-detected values in the data set, and summary statistics are calculated from the data set containing both the reported and surrogate values.

2.13.2.3 Statistical Criteria

The criteria for acceptance or rejection of all testable hypotheses specifies a significance of probability for committing a Type I error (false positive claim) and the probability for Type II error (false negative claim). Thus, in this study the significance level for a Type I error (α) will be less than (<) 0.05 [providing confidence as (1- α) greater than (>) 95%] and a probability for Type II error (β) to be less than (<) 0.20 [producing power as (1-β) > 80%] (Salsburg, 1986).

The Type II error rate (β) depends on four main factors; specified α, available sample size, sample variance, and the selected relative effects distance (Equation 2-1).

$$n = \frac{\left(z_\alpha + z_\beta\right)^2 * \sigma^2}{\delta^2} \qquad \textbf{(Equation 2-1)}$$

Where n is the sample size, zα and zβ are the standard normal deviates associated with α and β, respectively, σ2 is the population variance for TEQ concentrations, and δ is the relative effects distance (difference) chosen for the analysis. Shown in Equation 2-1, the magnitude of the relative effects distance is linked to sample size, variance of the populations and the probabilities of a Type I (α) and Type II (β) error used in the statistical analysis.

When appropriate, a power analysis will be conducted for each test to evaluate the potential for a Type II error (i.e., concluding that there is no difference between locations when in fact there is). For the statistical power tests, the Type I error (α) will be set to 0.05 and the relative effect's distance (difference between locations) will be selected as 3-fold the TEQ concentration found in comparable upstream reference samples. Sample size will be dependent on the number of each species collected at each sampling location. If the results of the power analysis indicate that there is insufficient power (i.e., 1-β less than 0.8), then a sufficient sample size will be estimated to detect differences between locations based on the criteria outlined above.

Unless noted otherwise, the above statistical criteria will be applied in evaluating potential differences between locations and preparation methods for each sample type. However, strict adherence to these requirements should not preclude sound professional observations about the data, such as trends or tendencies with slightly lower levels of statistical significance of α such as $p < 0.1$ or β-values greater than 0.2

2.13.3 Congener Patterns

Congener pattern analyses will be conducted with multivariate statistics, such as Principal Components Analysis (PCA) or other appropriate discriminate analyses, including cluster analyses and/or canonical correlations. PCA identifies linear combinations of standardized congener concentrations that best explain the overall variance in the data. These linear combinations are known as Principal Components (PCs). The PCs are calculated and can be plotted in a multidimensional array to allow visualization of locations of data that are most similar. While PCA provides a mechanism for combining data in such a way that the maximum discrimination power is concentrated on a reduced number of variables, it does not provide a rigorous test of which samples are statistically dissimilar. A null hypothesis relative to individual locations can not be tested using PCA, because PCA is basically a data reduction technique used to reduce the number of variables from a larger set describing the multivariate state and space of a group of samples. Once PCs are established for standardized concentrations, then a profile analysis will be conducted. Profile Analysis will be used to test for differences in the relative concentrations of congener distributions. This test consists of a multivariate analysis of variance (MANOVA) of the differences in the concentrations of individual congeners, followed by a Hotelling's t-test to test for statistical differences among sample populations. A non-parametric test can be performed if results are not normally distributed, or boot-strapping may be considered for use.

3.0 SCHEDULE AND REPORTING

3.1 Schedule

Depending on the study (or studies) selected, it is anticipated that vegetables will be collected in the summer and fall of 2007. Analytical results are expected within six months of sample collection with a subsequent final report shortly thereafter.

3.2 Reporting

Reports from this project will include all data obtained from the field and laboratory phases of the study. MDEQ will be provided with an electronic copy of the laboratory data packages and field data. If any major deviations from the approved work plan are necessary because of unanticipated field conditions, the proper agencies will be notified as soon as possible for approval and modification of the work plan, if needed. The chemical and physical data will be statistically analyzed and summarized.

The results of these studies will also be published in the scientific literature in order to provide useful data for health professionals, risk assessors and individuals interested in this information.

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Appendix A. Standard Operating Procedures (SOPs)

(To be provided upon approval of workplan)

Bioavailability Pilot Study Report

Bioavailability Pilot Study Follow-up Report

University of Massachusetts
Child Soil Ingestion Project

Appendix E-3

University of Massachusetts Child Soil Ingestion Project

Dr. Edward Calabrese and Dr. Edward Stanek III

It is likely that most children ingest soil, but the amount of soil ingested by a child differs from one day to the next, and the average ingestion rate differs over the long-term between children. Ideally, risk assessors would like to know what the distributions of soil ingestion rates are for children, both for short-term (daily) variations for an individual and for long-term variations between children. This project aims to develop a distribution(s) of soil ingestion rates between children over the period studied, and shed light on the daily distribution of soil ingestion rate for a given child.

Estimates of children's soil ingestion are constructed from mass-balance research studies conducted on children. The University of Massachusetts researchers plan to conduct a meta-analysis of soil ingestion study data. The analysis will use data from a principal set of soil ingestion studies, including data from the studies conducted in Amherst, Anaconda, and Washington State. The meta-analysis methods for combining study data, and for individual studies will be developed as a team-effort between the University of Massachusetts investigators and a science advisory panel currently comprised of the Michigan Department of Environmental Quality (MDEQ), U.S. Environmental Protection Agency (USEPA) and The Dow Chemical Company (Dow) representatives. The meta-analysis and its methods will be well-documented in order to provide transparency. The study goal is to develop a distribution of average soil ingestion rate estimates across children for a four to seven day averaging period, and a distribution of daily soil ingestion rates for a given child. The primary study will focus on the tracers Aluminum and Silicon.

Challenges of soil ingestion studies include selection of tracers, matching transit times, and separating variability from uncertainty in mass-balance studies. Selection of trace elements requires consideration of the level of trace element ingestion from food, and the variability in this ingestion and the variability in transit time for the food. An additional factor that has affected soil ingestion estimation validity is apparent trace element ingestion from non-food, non-soil sources. Such ingestion, referred to as source error, can inflate soil ingestion estimates if it is falsely ascribed to soil. Evaluating both food and fecal samples for individuals over a common study time period, such as 4 days, can reduce the uncertainty in trace element amounts from foods that are found excreted in fecal samples. However, such combinations will also mask source errors, leading to biases in soil ingestion estimates. Drs. Stanek and Calabrese have recently developed a novel methodology that has potential to address these issues, and are currently preparing this plan for discussion with the soil ingestion project advisory panel (MDEQ, USEPA and Dow).

A sensitivity analyses will also be completed to assess the impact of key assumptions on the predicted soil ingestion distribution. Drs. Stanek and Calabrese will submit a plan describing the approaches associated with these analyses.

Exponent®

Pilot Study Report: Oral Bioavailability of Dioxins/Furans in Midland and Tittabawassee River Flood Plain Soils

Exponent®

Pilot Study Report: Oral Bioavailability of Dioxins/Furans in Midland and Tittabawassee River Flood Plain Soils

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Acronyms and Abbreviations

CV	coefficient of variability
EROD	ethoxyresorufin O-deethylase
HR-GC/MS	high-resolution gas chromatography/mass spectrometry
MROD	methoxyresorufin O-deethylase
MSU	Michigan State University
NTP	National Toxicology Program
PCDD/F	polychlorinated dibenzo-*p*-dioxin/furan
4-PeCDF	2,3,4,7,8-pentachlorodibenzofuran
RBA	relative bioavailability
RPD	relative percent difference
SOP	standard operating procedure
TCDD	tetrachlorodibenzo-*p*-dioxin

Executive Summary

The overall objective of this pilot study is to evaluate two animal models (Sprague-Dawley rats and juvenile swine) for measuring the oral bioavailability of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), 2,3,4,7,8-pentachlorodibenzofuran (4-PeCDF), and the other dioxin/furan congeners of importance in soils from Midland, Michigan, and the Tittabawassee River flood plain. The study design includes a test soil from each of these two areas, because the toxic equivalent (TEQ) for dioxins/furans in Midland soils is dominated by TCDD, while that of the Tittabawassee River flood plain soils is dominated by furans (4-PeCDF in particular). The results from this pilot study will be used to complete the design of a full-scale study of dioxin/furan bioavailability from soil.

Specific objectives of the pilot study include:

- Evaluate the feasibility of detecting dioxins/furans in the tissues of rats and swine dosed with soil from Midland and the Tittabawassee River flood plain
- Evaluate the proposed study design in rats and swine for measuring the relative bioavailability of dioxins/furans in soil
- Evaluate whether five animals per dose group will be an adequate number for the full study (note that for the rats in the pilot study, 10 animals will be used, and the tissues from each pair of rats will be combined to provide 5 samples for analysis).

Each of the two soils was administered to rats in a soil/feed mixture for 30 days. Reference materials (feed and corn oil gavage) were spiked with the five most predominant TEQ-contributing congeners for each soil at concentrations designed to result in administered doses equivalent to those received in the soil/feed mixtures. Soils were administered to swine for 30 days wrapped in dough balls. The reference corn oil materials with matched doses of the five most predominant TEQ contributors for each soil were administered to swine in gelatin capsules wrapped in dough balls. At the conclusion of dosing, liver and adipose tissues were collected from experimental animals, and concentrations of the congeners of interest and EROD/MROD[1] activity in hepatic tissues were measured in all rats and swine. EROD and MROD activity was measured to evaluate whether or not differential enzyme induction (CYP1A1 and CYP1A2) was occurring between the soil and reference groups. Different levels of enzyme induction could result in different rates of metabolism or different distribution patterns between the two groups.

Relative bioavailability was estimated by comparing the fractions of administered dose retained in liver, adipose, and a combination of the two tissues between the soil and reference materials. This method relies on two assumptions. First, this method assumes that the majority of each compound would be distributed to liver and adipose tissues, and that the proportion of material distributed to other tissues would not be different between the soil and reference groups.

[1] Ethoxyresorufin O-deethylase (EROD) and methoxyresorufin O-deethylase (MROD) assays.

Second, the method assumes that the rate of elimination for each congener is the same in the soil and the reference-material group animals.

The concentrations of test compounds in both liver and adipose tissue were consistently above the detection limits in rats for both soils. In swine, tissue concentrations of congeners of interest were not consistently above detection or lower calibration limits for the Midland soil, but were consistently detectable and quantifiable in the group administered the Tittabawassee River flood plain soil, which had higher levels of contaminants.

Hepatic EROD activity was statistically significantly increased in rats in all reference-material groups compared to the respective soil groups. In swine, no statistically significant difference in EROD/MROD activity was observed between soil and reference groups for either soil.

The two animal models produced statistically significantly different estimates of relative bioavailability (RBA) for all of the congeners in the Tittabawasse River flood plain soil and for two of the congeners in the Midland soil (Figures 10 and 11). These differences may be due in substantial part to the differential induction in the rat soil and reference-material groups. Increased enzyme induction in the reference groups could result in increased metabolism rates in these groups compared to the soil groups, violating the assumption of equal elimination rates between the soil and reference groups. Increased EROD activity in the reference groups, as a marker for the CYP1A1 enzyme, would result in increased metabolism of TCDF in the reference groups compared to the soil groups, with accompanying lower retained fractions of administered dose. This would result in a false elevation of the estimated RBA in the soil groups compared to the reference groups.

Issues associated with differential enzyme induction in rats for both soils, and achieving detectable tissue concentrations in swine for the Midland soil, render most of the RBA estimates resulting from this pilot study unreliable. The swine-based RBA estimates for the Tittabawassee River flood plain soil do not suffer from either of these limitations and may provide a reliable estimate of the RBA values for this soil.

Several design modifications are recommended for future studies, in order to reduce costs, achieve detectable compound concentrations, and reduce the likelihood of differential enzyme induction between soil and reference groups. In summary, the following changes are recommended:

1. Omit the feed reference group, as results in this study confirm the general conclusion that feed has a relative bioavailability compared to corn oil gavage of about 70%. Further demonstration of this is unnecessary.

2. For purposes of reducing costs, it would be desirable to use a single animal model. Based on the results of this pilot study, either animal could be used in experiments going forward, with modifications to the study design. Pros and cons of each model are discussed in more detail in the report below, but specific considerations apply to either model:

   – If rats are used, reference material dose levels will need to be matched more closely to anticipated *absorbed* doses in the soil groups in order

to avoid differential induction of enzyme activity between soil and reference groups.

- If swine are used, the administered doses of soils with lower TEQ concentrations (for instance, Midland-area soils with TEQ concentrations at or below the levels in the soil tested in this study) will need to be increased in order to achieve reliably detectable and quantifiable tissue concentrations.

3. For purposes of reducing costs, it would be desirable to analyze only a single tissue (liver or adipose) from each test animal. Data on compound distribution from this study support use of a single tissue for either animal model, with the most consistent measures resulting from liver tissue in the rat and adipose tissue in the swine.

4. Retain hepatic EROD/MROD measurements as part of the study design, as a means of ensuring that differential induction of hepatic enzymes is not occurring in subsequent tests.

Introduction

The overall objective of this pilot study is to evaluate two animal models (Sprague-Dawley rats and juvenile swine) for measuring the oral bioavailability of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), 2,3,4,7,8-pentachlorodibenzofuran (4-PeCDF), and the other dioxin/furan congeners of importance in soils from Midland, Michigan, and the Tittabawassee River flood plain. The study design includes a test soil from each of these two areas, because the toxic equivalent (TEQ) for dioxins/furans in Midland soils is dominated by TCDD, while that of the Tittabawassee River flood plain soils is dominated by furans (4-PeCDF in particular). Because the TCDD and 4-PeCDF may behave differently in these two animal models, a soil from each of these two areas was chosen for evaluation in the pilot study. The results from this pilot study will be used to complete the design of a full-scale study of dioxin/furan bioavailability from soil.

Specific objectives of the pilot study include:

- Evaluate the feasibility of detecting dioxins/furans in the tissues of rats and swine dosed with soil from Midland and the Tittabawassee River flood plain
- Evaluate the proposed study design in rats and swine for measuring the relative bioavailability of dioxins/furans in soil
- Evaluate whether five animals per dose group will be an adequate number for the full study (note that for the rats in the pilot study, 10 animals will be used, and the tissues from each pair of rats will be combined to provide 5 samples for analysis).

The study in the rat model will be used to assess the oral bioavailability of dioxins/furans from soil relative to that from both rat feed and oral gavage doses. This is warranted because relevant toxicology studies underlying estimates of cancer slope and serving as possible sources for reference doses have used both corn oil gavage and feed for administration of compounds. Thus, if dioxins/furans in soil are less bioavailable than those in rat feed, an adjustment in the risk assessment is warranted to account for this difference. In addition, the rat studies will allow for comparison to the recent National Toxicology Program (NTP) chronic carcinogenesis bioassays, in which the rats were dosed by corn oil gavage.

The swine study will be conducted to evaluate the oral bioavailability of dioxins/furans from two Midland soils in an *in vivo* model that is more similar to humans than the rat. The results of the swine and rat studies using corn oil as a vehicle will provide a basis for comparison of results across species.

Methods and Materials

Soil Selection

In preparation for the pilot study, six candidate test soils were collected by CH2M Hill in June 2004. The soils were collected as described in the *Sampling and Analysis Plan – Soil Sampling for the Pilot Bioavailability Study* (provided in Appendix A). These soil samples (approximately 3 gallons each) were shipped to Exponent's Boulder, Colorado, laboratory, where they were air-dried and homogenized, and approximately 500 g was sieved to <250 μm (60 mesh). A 50-g aliquot of each sieved sample was then shipped to Alta Analytical Laboratory (Alta) in El Dorado Hills, California for analysis of polychlorinated dibenzo-*p*-dioxin and furans (PCDD/Fs) by high-resolution gas chromatography/mass spectrometry (HR-GC/MS; EPA Method 8290). Results from these analyses are presented in Table 1. Neither of the Midland soils (TCDD concentrations of 15.2 and 59.5 pg/g TCDD, respectively; Table 1) had TCDD concentrations as high as those in a soil that had been collected previously in bulk from Midland (CC-S-27, which contains 163 pg/g TCDD [Table 1] as reported in Exponent 2003; collected from the southeast portion of the Dow Corporate Center lawn in May 2002 and archived dry in Exponent's Boulder laboratory). Because the CC-S-27 soil exhibits a congener profile consistent with Midland soils (TEQ dominated by TCDD and 1-PeCDD) this soil was selected for the pilot study. Sample THT02769 (from location Imerman Park 2) was selected as the Tittabawassee River soil for use in the pilot study, because it exhibited a congener profile consistent with the flood plain sediments (TEQ dominated by 4-PeCDF and TCDF) and had a total TEQ concentration close to 1,000 pg/g (Table 1).

The remainder of soil THT02769 was sieved to <250 μm, and the entire sieved soil mass was homogenized. Triplicate splits of soils CC-S-27 and THT02769 (collected using a soil splitter, as were all soil aliquots used in this study) were sent to Alta to test for homogeneity of the soil batches. Results from these analyses are presented in Table 2. Coefficients of variability (CVs) for the five congeners that contribute the most to total TEQ in soil CC-S-27 ranged from 1.9% to 5.6% for the triplicate analysis. CVs for the triplicate analysis of soil THT02769 ranged from 16.1% to 19.7%, and resulted from one of the triplicate samples contributing greater concentrations of PCDD/Fs than the other two (Table 2). Soil THT02769 was subsequently rehomogenized and used for the study. Co-planar PCB concentrations in each of the two study soils were also analyzed in one of the triplicate samples (EPA Method 1668); these data are also presented in Table 2.

Methods used to perform the pilot bioavailability study are described in the document titled, *Pilot Study Design: Oral Bioavailability of Dioxins/Furans in Midland and Tittabawassee River Flood Plain Soils* (provided in Appendix B).

Dose Preparation and Administration

Rat Study

Each of the test soils (<250-μm size fraction) was blended with PMI Nutrition International, Rodent LabDiet® 5001 (meal) (5% w/w) at WIL Research Laboratories, Inc. (WIL) in Ashland, Ohio. The WIL report describing the diet blending is provided in Appendix C, and results for PCDD/Fs in the Rodent LabDiet® batches used in this study are provided in Table 3. To accomplish the blending of soil into the rat diet, soil (475 g) and diet (1,000 g) were blended in a Hobart mixer for 5 minutes to create a diet pre-mixture. The pre-mixture was then blended with 8,025 g of diet in a V-blender to create the final 9,500-g diet batch. Diet homogeneity samples (25 g) were collected from the initial, middle, and final material that emerged from the V-blender; these samples (three samples per blended diet) were sent to Alta for analysis of PCDD/F concentrations. Results for the pre-dosing soil/diet mixtures (Table 4) indicate that for the CC-S-27/diet blend (Test Article #1), the five congeners that contributed most greatly to TEQ were recovered at 79%–131% of expected concentrations (based on concentrations measured in the test soil), and CVs for the pre-dosing triplicate analyses ranged from 2.3% to 12%. For the THT02769/diet blend (Test Article #2), the five most important congeners were recovered at 76%–100% of expected concentrations, with CVs ranging from 4.5% to 14%. These measurements of blended diet PCDD/F concentrations and homogeneity were considered acceptable to proceed with the study.

For the reference material in diet (matched to soil CC-S-27), TCDD, 1-PeCDD, 1,6-HxCDD, 1,4,6-HpCDD, and 4-PcCDF (the five dioxin/furan congeners contributing most greatly to TEQ for this soil) were spiked into 200 mL acetone (B&J Brand®, High Purity Solvent; previously analyzed for dioxins/furans and determined to be below detection limits for all congeners) at concentrations that, once blended with feed, would deliver the same dose of these five congeners as the CC-S-27/diet blend. Analytical results for the reference mixture in acetone are provided in Table 5. At WIL, the acetone (100 mL) and diet (1,000 g) were blended in a Hobart mixer for 5 minutes to create a diet pre-mixture. The pre-mixture was then blended with 8,500 g of diet in a V-blender to create the final 9,500 g diet batch (Test Article #3). Diet homogeneity samples (25 g) were collected from the initial, middle, and final material that emerged from the V-blender; these samples were sent to Alta for analysis of PCDD/F concentrations (Table 4). For Test Article #3, the five spiked congeners were recovered at 83%–118% of expected concentrations in the pre-dosing diet samples, with CVs ranging from 1.0% to 3.0%. Based on these results, the concentrations and homogeneity of PCDD/Fs in Test Article #3 were considered acceptable to proceed with the study.

The two gavage reference materials for the rat study were prepared in corn oil/acetone (99:1), and were designed to deliver the same dioxin/furan doses as the soil/diet blends. To create these reference mixtures, the five dioxin/furan congeners that contribute most greatly to TEQ in each soil were spiked into acetone (20 mL), and the concentrations of the five congeners in the spiked acetone was measured to confirm that analytical concentrations were close to target concentrations. Subsequently, 8.26 mL of this acetone was added to 817.7 mL corn oil (Spectrum Chemicals & Laboratory Products, National Formulary [NF] grade; analysis of the corn oil indicated negligible dioxin/furan concentrations [Table 3]). The two corn oil/acetone

reference materials were then assayed for concentrations of the five target congeners (Table 5). Relative percent differences (RPDs) between target and pre-dosing measured concentrations were generally in the range of 3%–13%, except for 1,2,3,6,7,8-HxCDD, which was present at a concentration approximately 40% greater than the target concentration. Because this compound contributed less than 5% of the total TEQ of the soil and reference oils, this variation was considered acceptable for use in the study. The gavage reference mixtures were stored in amber glass bottles sealed with Teflon-lined lids, and were used within 60 days of preparation.

Swine Study

For the swine pilot study, the test-soil doses were delivered by placing 1 g of the soil (either CC-S-27 or THT02769 in the center of a 10-g moistened dough ball (Zeigler Bros. Swine Diet) and offering it to the swine. The swine were fasted for two hours prior to dosing, because previous studies conducted in this animal model have indicated that a 2-hour fast will ensure eager acceptance of the 10-g dough ball containing the dose. Soil-containing dough balls were prepared every 3–4 days. Five dough balls (containing a total of 5 g of test soil) were given twice daily, at 9 a.m. and 4 p.m., for a total dose of 10 g soil/day. Immediately after dosing, the animals were given one-half of their standard ration of swine feed. The two dose groups receiving the soil doses (Groups 3 and 4) had their feed rations reduced by 80 g/day to compensate for the greater number of feed balls given these animals during dosing, relative to the corn oil–dosed animals. Dosing and feeding continued twice daily for 30 consecutive days.

The dosing materials for the two reference groups were prepared in corn oil/acetone (99:1), and were designed such that 2 mL of the corn oil/acetone mixture would deliver an equivalent dose to 5 g of the test soil to which it was matched. To create these reference mixtures, the five dioxin/furan congeners that contribute most greatly to TEQ in each soil were spiked into acetone (20 mL), and the concentrations of the five congeners in the spiked acetone were measured to confirm that analytical concentrations were close to target concentrations. Subsequently, 10 mL of this acetone was added to 990 mL corn oil (Spectrum Chemicals & Laboratory Products, National Formulary [NF] grade; analysis of the corn oil indicated negligible dioxin/furan concentrations [Table 3]). The two corn oil/acetone reference materials were then assayed for concentrations of the five target congeners (Table 6). Relative percent differences (RPDs) between target and measured concentrations were in the range of 1%–21%, which was considered acceptable for use in the study. The swine reference mixtures were stored in amber glass bottles sealed with Teflon-lined lids, and were used within 60 days of preparation.

For dosing, 1 mL of corn oil/acetone mixture was placed in each gel capsule (Torpac, 1.2 mL volume), and these were embedded in the center of a 10-g ball of moistened swine feed. The oil-filled gel capsules were inserted in dough balls immediately prior to dosing. Two dough balls (containing a total of 2 mL of reference mixture) were given twice daily, at 9 a.m. and 4 p.m., for a total dose of 4 mL reference mixture/day. Immediately after dosing, the animals were given one-half of their standard ration of swine feed. Dosing and feeding continued twice daily for 30 consecutive days.

Animal Handling and Dosing

Rat Study

Animal handling and dosing during the rat study were performed as described in the pilot study design document (see Appendix B), a brief summary of which follows.

Fifty 4-month-old female Sprague-Dawley rats, weighing between 210 and 240 g, were obtained from Harlan (Indianapolis, Indiana) and placed in individual stainless steel cages. Each rat was weighed on arrival (Day –6), then on Day –2 (during the quarantine period) and Day 3 of the dosing period, and then weekly until study termination. The rats were provided with PMI Nutrition International Rodent LabDiet® 5001 (meal) and de-ionized water *ad libitum* during the one-week quarantine period, and their health status was monitored. All LabDiet® 5001 fed to the rats (including during the quarantine period and to the gavage dose groups during the dosing period) was from the same two batches of LabDiet® 5001 that were used by WIL Research to prepare the blended rat diets (Table 3). Two days prior to the start of dosing, healthy animals were randomly assigned to five dose groups (10 rats/group; dose groups are identified in Table 7).

During the 30-day dosing period, each rat received 50 g of feed every 2 days (background feed for Groups 1 and 2, and dosed feed for Groups 3, 4, and 5). The weight of any unconsumed feed at the end of each 2-day period was measured, and an estimate was made of the weight of any spilled feed. Dose groups 1 and 2 were gavaged daily at 11 a.m. with 1 mL of the corn oil/acetone reference mixtures.

Twenty-four hours after the last dose was administered, the rats were weighed and terminated under CO_2 anesthesia. Their livers were excised, blotted dry, weighed and wrapped in foil. The liver samples for the ethoxyresorufin O-deethylase (EROD) and methoxyresorufin O-deethylase (MROD) assays were collected (1-g samples) from the livers of each pair of rats (i.e., 0.5 g collected from each individual liver). The sample was minced, placed in a 2-mL cryovial, immediately frozen in liquid nitrogen, and sent to Michigan State University (MSU) for analysis. The remainder of the pair of livers was then frozen and shipped to Alta, where they were homogenized together to create a sample of sufficient mass for the analytical work. As much fatty tissue as possible (3–6 g) was collected from within the abdominal cavity of each rat, weighed, and wrapped in foil. The fat samples were frozen and shipped to Alta, where the fat samples from each pair of rats were homogenized together to create a sample of sufficient mass for the analytical work.

Triplicate 25-g post-dosing subsamples of each blended rodent diet were collected and shipped to Alta for analysis of dioxins/furans, to evaluate the stability of the blended diets during the 30-day dosing period, and to confirm the doses of dioxins/furans delivered to the rats (Table 4). The CV between all six samples of the blended rodent diet (three pre-dosing and three post-dosing) was no greater than 22% for any congener, indicating that the diets were stable during the study. In addition, the gavage reference mixtures were shipped to Alta for post-dosing analysis (Table 5). The CV between the pre- and post-dosing gavage reference mixtures was no

greater than 21%, indicating that the reference mixtures were also stable during the study period.

Only two rats, both from Group 2, did not complete the 30-day dosing period. Rats #29 and #24 were sacrificed after 15 and 20 days of dosing, respectively, due to persistent problems with administering the gavage dose. On necropsy, it appeared that there was a stricture immediately prior to the stomach of the first rat, and it was found that the esophagus of the second rat had been perforated.

Rat carcasses from the pilot study were wrapped in foil, placed in individual labeled zipper-sealed freezer bags, and archived (–80 °C) for possible further analysis.

Swine Study

Animal handling and dosing during the swine study were performed as described in the pilot study design document (see Appendix B), a brief summary of which follows.

Twenty intact male swine weighing between 8.4 and 10.7 kg were obtained from Chinn Farms (Clarence, Mississippi) and were fed a specially formulated diet (Ziegler Bros. Inc., Gardners, Pennsylvania). Swine were weighed on arrival (Day –8), on Days –4 and –1 during the quarantine week, and then every three days until study termination. Feed was given at 4% of body weight per day, and was adjusted every three days to maintain a constant feed rate during the study. The swine were housed in stainless steel cages, and their health status was monitored during the 1-week quarantine period. Two days prior to the start of dosing, healthy animals were randomly assigned to four dose groups (five swine/group; dose groups described in Table 8).

Three swine were culled prior to the start of the dosing period (e.g., 23 animals were obtained from Chinn Farms, but only 20 were dosed during the study), and these animals were maintained on the weighing/feeding schedule described above, but were not given any doses. At the end of the study, these three animals were necropsied, and body composition of skin, fat, and muscle, as a proportion of body weight, was determined for each animal.

All doses were delivered twice daily in purified feed dough balls, as described in the dose administration section, at 9:00 a.m. (immediately prior to the morning feeding) and at 4:00 p.m. (immediately prior to the afternoon feeding) for 30 days. Twelve hours after the final dose, the animals were weighed and humanely sacrificed, and liver and fat samples were collected for analysis.

Only one animal, from Group 4, did not complete the 30-day dosing period. This animal was found dead in his pen on the morning of the 25th day of the study (he had been ill with what appeared to be a systemic infection, and had been given the antibiotic Naxcel [sodium ceftiofur] for the 9 days prior to his death).

The whole liver of each animal was excised, blotted dry, and weighed. Three 1-gram samples were collected for EROD and MROD assays (for each sample, subsamples from three sections of the liver were collected and diced), placed in 5-mL cryovials, and immediately frozen in

liquid nitrogen. These samples were shipped in liquid nitrogen to MSU for EROD/MROD analysis. The remainder of the liver was wrapped in foil, placed in a zipper-sealed freezer bag, and frozen at –80 °C. Fatty tissue from the abdominal wall, plus a small amount from the abdominal cavity (40–65 g, total) was collected, wrapped in foil, and frozen at –80 °C. The liver and fat were shipped (frozen) to Alta. The residual reference mixtures were shipped to Alta for analysis. The CV between the pre- and post-dosing reference mixtures ranged from 9% to 28%, indicating that the reference mixtures were stable during the study period (Table 6).

All swine carcasses were were double-bagged in heavy black plastic trash bags and stored at –20 °C, in case additional samples were needed.

Tissue Sample Homogenization and Analysis

At MSU, liver microsomes were prepared from each liver sample, and the protein levels and enzymatic activities were measured according to the MSU Standard Operating Procedure (SOP) No. 250 (v 1.1), titled *Protocol for Liver Microsome Preparation, and Microsomal Protein Measurement and AROD Assays in the same 96-Well Plate*. EROD/MROD activities and protein concentrations were measured fluorometrically at the end of the assay, using a Cytofluor multiplate reader.

At Alta, the rat liver samples were homogenized using a Cuisinart mini-prep processor. The processor was run on the "high" setting until the sample was liquefied (for the liver samples) or thoroughly homogenized (for the fat samples). The sample was then poured into separate 40-mL amber glass VOA vials for extraction. After homogenization of each sample, all parts of the processor that were in contact with sample material were washed with soap and hot water, rinsed with de-ionized water, and then rinsed with ultra-high-purity solvents (hexane followed by dichloromethane).

The swine liver samples were homogenized using a Villaware model 5265-05 power grinder. The grinder was fitted with a 4-mm-diameter mesh gate for all grinding. Samples were collected directly from the grinder into labeled amber glass jars. Between samples, all parts of the grinder that were in contact with sample material were washed with soap and hot water, rinsed with de-ionized water, and then serially rinsed with ultra-high-purity solvents (acetone, toluene, hexane, and dichloromethane).

The rat and swine fat samples were homogenized with a Sumeet Multi-Grind Model 964, a small-volume grinder suitable for small sample sizes. Samples were collected directly from the grinder into labeled amber glass jars. Between samples, all stainless steel parts of the grinder that were in contact with sample material were washed with soap and hot water, rinsed with de-ionized water, and then serially rinsed with ultra-high-purity solvents (acetone, toluene, hexane, and dichloromethane). The polycarbonate grinder lid was washed with soap and hot water, rinsed with de-ionized water, and then serially rinsed with ultra-high-purity methanol followed by hexane.

Subsamples of the liver and fat homogenates were extracted in methylene chloride/hexane and analyzed for lipid content (EPA Method 1613), and PCDD/F concentrations by HR-GC/MS

(EPA Method 1613). Selected samples were also analyzed for co-planar PCBs (EPA Method 1668).

Estimation of Relative Bioavailability

Relative bioavailability was estimated by comparing the fraction of administered dose retained in the tissues of animals in the groups dosed with soil with the fraction of administered dose retained by animals given the reference vehicle(s) (oil or feed), similar to the method used by Wittsiepe et al. (2004). Several assumptions were made in this estimation process:

1. *The whole-body elimination rate for each compound would be the same in the reference-dosed animals as in the soil-dosed animals, and can be approximated by a first-order model.* Diliberto et al. (2001) demonstrated that, in mice exposed subchronically to TCDD, the fraction of administered dose retained in the animal tissues decreased as the body burden increased, indicating an increase in elimination rate with increasing body burden. To account for this issue, reference dosing materials for each group were formulated to try to match the anticipated administered soil doses for that group. In addition, measurements of hepatic EROD and MROD activity were made for each group to assess whether enzyme induction (and the associated increase in hepatic metabolism) was occurring, and if so, whether it was occurring to a different extent in soil-dosed groups than in reference groups. EROD activity is a marker for the CYP1A1 enzyme, while MROD activity is a marker for CYP1A2 activity. CYP1A1 is the enzyme that mediates metabolism of several PCDD/F compounds, while the CYP1A2 protein in the liver serves as a binding protein for many PCDD/F compounds. When CYP1A2 is induced, hepatic sequestration of these compounds occurs. For some compounds, this hepatic sequestration may result in either a greater or lesser elimination rate, depending on the compound, its binding affinity for CYP1A2, and the mechanism of metabolism. If either enzyme is induced to a different extent in the soil-group animals compared to the reference-group animals, the assumption of equivalent whole-body elimination rates between groups would likely be violated.

2. *The majority of retained administered dose would be distributed in liver and adipose tissues, and the proportion of retained dose distributed to* ***tissues other than liver and adipose*** *would not be different in soil-dosed groups compared to reference-dosed groups.* Distribution studies following subchronic administration of TCDD in mice and rats demonstrate that, at the lowest doses tested, liver and adipose account for 70% to 80% of retained body burden; this percentage increases to approximately 90% at higher tested doses (Diliberto et al. 2001; Hurst et al. 2000). The remainder of the retained compound in these studies was found in skin and muscle, and concentrations were consistent with simple lipid-based partitioning of compound in these tissues.

The relative bioavailability (RBA) of a compound from soil administration, compared to administration of a reference material ($RBA_{soil:ref}$), is the ratio of the absolute absorption fractions (f_{abs}) of the compound from the two media:

$$RBA_{soil:ref} = \frac{f_{abs,soil}}{f_{abs,ref}}$$

In general, after daily administration of a compound, the amount of compound in the body at the end of 30 days is a function of both the administered dose rate and the elimination rate. Using the assumption of first-order elimination, the whole-body amount of compound as a function of time can be estimated as follows:

$$Q_{body} = \frac{D * f_{abs}}{k}(1 - e^{-kt})$$

where:

Q_{body} = mass of compound in body, ng

D = daily administered dose, ng/d

k = elimination rate, d^{-1}

t = duration of dosing, d

Solving for f_{abs},

$$f_{abs} = \frac{Q_{body}\, k}{D\,(1 - e^{-kt})}$$

Solving for the RBA,

$$RBA = \frac{Q_{body,soil}\, k \,/\, D_{soil}\,(1 - e^{-kt})}{Q_{body,ref}\, k \,/\, D_{ref}\,(1 - e^{-kt})}$$

Because the elimination rate, k, is assumed to be equal between the two groups, and because the time of administration, t, is the same, this simplifies to:

$$RBA = \frac{Q_{body,soil} \,/\, D_{soil}}{Q_{body,ref} \,/\, D_{ref}}$$

Again, the time of administration is the same for both groups, 30 days, so the daily doses for the two groups can be converted to the total administered dose:

$$RBA = \frac{Q_{body,soil} / Q_{ad\,\min,soil}}{Q_{body,ref} / Q_{ad\,\min,ref}}$$

where:

Q_{admin} = total mass of compound administered

The ratio of Q_{body}/Q_{admin} for a given dose group is the fraction of administered dose retained in the body (*FR*). Thus, the RBA evaluation for soil compared to a reference group simplifies to:

$$RBA = \frac{FR_{soil}}{FR_{ref}}$$

As discussed above in assumption 2, distribution studies for dioxin demonstrate that liver and adipose tissue account for the majority of dioxin retained in the body (70% to 90%, depending on the species and dose range tested; Diliberto et al. 2001; Hurst et al. 2000). Thus,

$$Q_{body} = Q_{liver} + Q_{adipose} + Q_{other}$$

where Q_{tissue} is the product of the concentration of compound in the tissue, C_{tissue}, and the weight of the tissue, w_{tissue}. Then, the fraction of administered dose retained in a given tissue is:

$$FR_{tissue} = \frac{Q_{tissue}}{Q_{ad\,\min}}$$

If the proportional distribution of compound among tissues is the same among dose groups, then an RBA value can be calculated on the basis of a single tissue or on the basis of a combination of tissues. As discussed above, for this effort, liver and adipose tissues serve as the basis for the RBA calculation. Liver weights were measured at sacrifice for rats and swine. Adipose tissue weights for the rats were estimated as a function of body weight at sacrifice using the relationship from Brown et al. (1997) based on data for male Sprague-Dawley rats developed by Bailey et al. (1980; as cited by Brown et al. 1997).

$$w_a = (0.0199*BW + 1.644) / 100$$

Adipose tissue weights for the swine were estimated as a percentage of body weight using the results of the total fat dissection for the three control swine described above.

Results

Rat Study

As discussed in the Animal Handling and Dosing section, two rats from the Tittabawassee River gavage oil reference group (Group 2) were sacrificed before the end of the study (after 15 and 20 days of dosing) due to persistent problems with administering the gavage dose. Results from this rat pair were not included in the data analysis discussed below.

Feed Intake

Details of feed intake for all groups are presented in Table D-1, and the feed intake is illustrated in Figure 1. The mean daily feed intake for all dosing groups was approximately 16 g/day. The mean daily intakes for the two oil reference groups were 14 g/day and 13 g/day, for the Midland oil and Tittabawassee River oil reference groups, respectively. The mean daily feed intake for the Midland soil group was 17 g/day (Group 3) and 19 g/day for the Tittabawassee River soil group. The mean daily feed intake for the Midland feed reference group (Group 5) was 16 g/day. The lower feed consumption in the oil gavage groups compared to the soil/feed and reference feed groups is consistent with the expectation that these groups might consume less feed due to caloric intake from the oil gavage vehicle (9 kcal per g, or about 8 kcal per mL; USDA National Nutrient Database for Standard Reference, Release 17, 2004). This is approximately 15% of the caloric intake from feed observed in the soil groups, so the lower feed intake in the oil gavage groups is consistent with an adjustment of feed intake by the animals, reflecting the caloric intake from corn oil gavage.

The doses and reference materials had been prepared assuming that the rats would consume 23 g/day, based on a literature value (Freeman et al. 1992), so the observed daily feed intake was less than anticipated. The feed was administered in a loose meal form rather than pellets, and this may have influenced feed intake rates. This lower feed consumption resulted in the administered doses of study compounds for the gavage oil groups being higher than the soil groups (see below in Administered Dose section).

Body and Liver Weights

Rat body weights for all five dosing groups averaged 238 g at study initiation (study day –2), and 259 g at study termination (Figure 2; detailed data for all animals are presented in Table D-2), a gain of 9% over the 30-day study period. This weight gain was similar to the 10% gain observed in the background study, and reflects the fact that female Sprague-Dawley rats have already reached adult body weight at 4 months of age. Rat liver weights at study termination ranged from 7.3 to 11.4 g (average of 9.0 g) over all dosing groups, approximately 3.5% of body weight (Table D-3).

Administered Doses

The average daily doses of contaminants in each group are summarized in Table 9. Doses received by the rats in the oil and feed reference groups were generally somewhat higher than the doses received in the soil group. This is due primarily to two factors: lower feed consumption rates for the soil/feed-dosed animals than expected based on literature values, and deviations from the targeted concentrations in both the soil/feed mixture and in the reference materials. The literature-based feed consumption values were used to establish the target corn oil concentrations.

EROD and MROD Activity

Mean EROD and MROD activities in rat liver tissue from all dose groups are reported in Table 10, and the complete data set is presented in Table D-4. EROD activity was statistically significantly elevated in both reference material groups compared to the paired soil groups. MROD activity was elevated in reference groups compared to soil groups, but the difference was not statistically significant. This result is consistent with the difference in dosing rates between the reference and soil groups, and indicates that the dosing rates in the reference groups were sufficiently greater than the soil groups to result in increased enzyme induction.

RBA Estimates

Concentrations of contaminants in liver and adipose tissues from each pair of rats are reported in Tables D-5 and D-6. Tissue concentrations of the contaminants of interest were all above detection limits for all dose groups and compounds and were also greater than the instrument calibration limits in nearly all samples (Table 11). Figure 3 illustrates the fraction of administered dose present in liver and adipose tissues, and in the summed tissues, for all dose groups. A larger proportion of administered dose was retained in liver than in adipose tissue for all dose groups. The coefficient of variability was generally in the range of 10% to 15%, with one exception (Table 12). In the Tittabawassee River flood plain soil group, the liver concentration in one rat pair of 1,2,3,6,7,8-HxCDD was approximately four times greater than the concentrations in the other rats in this group, and corresponded to a retained dose in liver greater than the total administered dose of this compound. The adipose tissue concentration for this rat pair was not significantly different from the others in the group. This data point qualifies as an outlier at the 1% level using Dixon's extreme value test, and was omitted from further calculations of relative bioavailability.

Estimates of average relative bioavailability of the two soils in rats, based on comparisons of fraction of dose retained in liver, adipose, or the sum of liver and adipose tissues in reference materials, are presented in Table 12 and Figure 4 (calculated as described in the section on Estimation of Relative Bioavailability). For the Midland soil, comparison to the reference feed produces higher relative bioavailability estimates than comparison to the reference oil gavage. This is expected due to the lower absolute bioavailability of contaminants from feed compared to corn oil.

The relative bioavailability of the feed reference mixture compared to the corn oil reference mixture for the Midland soil congener pattern is shown in Figure 5. As expected, congeners in feed were somewhat less bioavailable than congeners in the reference corn oil, with RBA (reference feed compared to reference oil) ranging from about 60% to 80%.

Swine Study

One animal from the Tittabawassee River soil group (Group 4) became ill during the study and was found dead on day 25. Results from this animal were not included in the data analysis discussed below.

Body and Liver Weights

Swine weights for all dosing groups averaged 11.3 kg at study initiation (Study Day –1), and 28.0 kg at study termination (Figure 6; see Table D-7 for detailed individual animal data), a gain of 149% over the 30-day maintenance on the Ziegler Bros. swine diet. This rapid weight gain is typical of juvenile swine. For each dosing group, the initial group mean body weights ranged from 10.8 kg to 11.7 kg, and at study termination, group mean body weights ranged from 27.2 kg to 28.6 kg. The group mean weight gains ranged from 145% to 155%, with consistent weight gains for all four groups throughout the 30-day study. Swine liver weights for all four groups ranged from 501 to 796 g (average of 653 g, or 2.3% of bodyweight). The group mean liver weights ranged from 585 g to 731 g (Table D-8).

Swine Necropsy and Body Fat Dissection Results

As described earlier, three additional swine were maintained on the weighing and feeding schedule, but were not dosed. These three swine were analyzed to determine the body composition of muscle, skin, and fat as a percentage of body weight (Table D-9). The percent of body weight that was muscle ranged from 52.9% to 57.6% (average 55.2%), and the percent of body that was skin ranged from 7.25% to 7.50% (average 7.41%). The body fat as a percent of body weight ranged from 6.22% to 7.22%, with an average of 6.74%. This average value was used to determine the weight of adipose tissue based on body weight in the RBA calculations.

Administered Doses

The average daily doses over the 30-day study for all swine study groups are summarized in Table 13. The administered dose for the reference oil groups matched those for the soil groups much more closely than in the rat study. This is due primarily to the mode of administration of soils in the swine study, in which weighed amounts of soil were wrapped in dough balls and fed directly to the swine, rather than mixed with loose feed material. Administered doses on a ng/kg bw/day basis were much lower than in the rat study, due to the larger animal size and limitations in how much soil can be effectively administered to the animals.

EROD and MROD Activity

Mean EROD and MROD activities in swine liver tissue from all dose groups are reported in Table 10, and the complete data set is presented in Table D-10. In contrast to the rat study, no statistically significant differences in EROD or MROD activity between soil and corresponding reference oil groups were observed. This is consistent with the better matching of doses between soil and reference oil groups in the swine study compared to the rat study.

RBA Estimates

Concentrations of contaminants in liver and adipose tissues from each animal are reported in Tables D-11 and D-12. In contrast to the rat study, tissue concentrations of the contaminants of interest did not always exceed the limits of detection, particularly for the Midland soil group. Table 14 summarizes the numbers of non-detected results per tissue and dose groups for the swine study. The prevalence of non-detected results in the swine studies necessitates consideration of appropriate handling of non-detects in the analysis of the data. Dual data analyses were conducted for all swine data, assuming either one-half the detection limit or the detection limit for all non-detects in the data set. There were also a number of results that were below the lower calibration limit of the lab equipment (qualified with a "J"). These were identified and handled as detected values with the reported concentrations used in calculations.

Figure 7 illustrates the fraction of administered dose present in liver and adipose tissues, and in the summed tissues, for all dose groups, assuming either one-half the detection limit or the detection limit for all non-detected results. The fraction of administered dose retained in adipose is greater than in liver in the swine, in contrast to the pattern observed in rats. The inter-animal variability in tissue concentrations and fractions retained is greater in the Midland soil and corresponding oil reference group compared to the Tittabawassee River flood plain groups. This is consistent with the lower doses in the Midland soil groups, which resulted in tissue concentrations near or below the detection limits in many cases, resulting in greater variability. However, the variability among animals in the Tittabawassee River flood plain soil group and corresponding oil reference group was comparable to the variability observed in the rat data.

Estimates of average relative bioavailability of the two soils in swine based on comparisons of fraction of dose retained in liver, adipose, or the sum of liver and adipose tissues in reference materials, are presented in Tables 15a and 15b and Figure 8. The RBA values across tissues are generally consistent with one another. No reliable RBA values for 1-PeCDF and TCDF for the Tittabawassee River flood plain soil using liver tissue only could be calculated. Liver tissue concentrations for these compounds were undetectable in all of the soil group animals. In addition, in the corn oil reference group, 1-PeCDF was undetectable for four of the five liver samples, and below the instrument calibration limit in the fifth sample. Given the lack of detectable liver concentrations in the soil group for these compounds, RBA estimates based on swine ***liver*** tissue for these two compounds cannot be made. The RBA estimates for these compounds based on adipose tissue are based on detectable results, and the combined fraction retained in liver and adipose tissue is dominated by the adipose tissue results, so the RBAs based on adipose tissue and the combined tissue are reliable.

Discussion

Sensitivity of Models

Tissue concentrations achieved in rats after 30 days of administration of soils and reference compounds were consistently above analytical detection limits for both liver and adipose tissue (Table 11). In contrast, in swine dosed with the Midland soil, a substantial fraction of both adipose tissue and liver samples displayed specific congener concentrations below detection or analytical lower calibration limits. In swine dosed with Tittabawassee River flood plain soil, adipose tissue levels were generally detectable. In liver tissue, TCDF and 1-PeCDF were not detected in any of the soil group animals, but the remaining compounds were generally detectable in swine liver (Table 14).

For animal tissues and compounds in which the analytes were generally detectable, the results were generally consistent from one animal (or pairs of animals, in the case of the rats) to another, resulting in coefficients of variation (CVs) on the estimated mean RBA values in the range of 10% to 25% (Tables 12 and 15). The CVs were larger for specific congeners in the swine study of Midland soil for which a substantial number of non-detects were obtained. The use of fraction of dose retained in liver plus adipose tissue as the basis for the RBA calculations produced generally stable results, although, as discussed further below, the rats and swine showed different patterns of distribution between liver and adipose tissue. Increasing the number of animals per dose group might decrease the CVs observed, but the variation observed in this study is probably sufficiently small to be acceptable.

Consistency of Models

Distribution Patterns

The retention and distribution of test compounds between liver and adipose tissues in the rats and swine are summarized in Figure 3 and 7. In general, rats retained higher percentages of the total administered dose at the end of 30 days than did swine for both soils. Swine exhibited modest liver sequestration for most compounds, compared to substantial liver sequestration for most of the tested compounds in rats (Figure 9). This may reflect, in part, physiological differences between swine and rats, or it may be a result of the lower liver tissue concentrations resulting from the lower administered dose and large swine growth rate compared to the rats. At the higher dose rates used in the rat study, the relatively high hepatic retention compared to adipose tissue suggests that some induction of CYP1A2 protein is likely occurring in all groups, even though differences in MROD activity between groups were not significant. CYP1A2 protein in liver binds several of the PCDD/PCDF compounds effectively, resulting in hepatic sequestration. In the swine, lower doses on a body-weight basis were used, resulting in lower hepatic TEQ concentrations. The concentrations in swine tissue may be low enough that substantial induction of CYP1A2 protein did not occur, and thus, less marked hepatic sequestration occurred.

RBA Estimates

The RBA estimates obtained in swine were statistically significantly lower than those obtained in rats for all of the congeners tested in the Tittabawassee River flood plain soil and for TCDD in the Midland soil (Figures 10 and 11). In contrast, the RBA obtained in swine for 1,2,3,4,6,7,8-HpCDD in the Midland soil was statistically significantly higher than in rats (mean RBA estimates of 0.55 in swine and 0.34 in rats, $p<0.05$). The EROD and MROD enzyme activity data may shed light on some of these differences. The EROD data suggest differential enzyme induction in the rats between the reference and soil groups for both soils, with significantly greater EROD activity in the reference groups compared to the soil groups (Table 10). As discussed above, EROD activity is a marker for induction of CYP1A1. CYP1A1 is responsible for the metabolism of 2,3,7,8-TCDF in rats (Tai et al. 1993), and induction of CYP1A1 has been shown to strongly increase the hepatic metabolism rate for TCDF in rats (McKinley et al. 1993; Olson et al. 1994). 4-PeCDF also can induce its own metabolism due to induction of CYP1A enzymes (Brewster and Birnbaum 1987). Other compounds, including TCDD and 1-PeCDF, show decreased retention of administered dose with increasing dose in subchronic studies, suggesting autoinduction of metabolism, although the specific metabolic pathways have not been identified (DeVito et al. 1998; Diliberto et al. 2001; Jackson et al. 1998). The metabolic pathways for the other compounds that contribute substantially to the total TEQ in the Midland and Tittabawassee River flood plain soils have not been examined to date, but may be influenced by CYP1A1 induction.

The statistically significant increase in EROD activity in rats treated with the reference corn oil and reference feed materials corresponds to the increased doses of these compounds received by the reference groups compared to the soil groups. This was due to lower-than-targeted concentrations of key contaminants in the soil/feed mixtures, as well as lower feed intake in the soil/feed rat groups than estimated prior to the experiment (although growth and body weight were not affected), resulting in lower administered dose in the rat soil groups than initially targeted (Table 9). In addition, if the relative bioavailability of the TCDF or other congeners in soil was low, the actual differential in absorbed dose of furan compounds between the two groups may have been much higher. The RBA estimates developed in swine for the Tittabawassee River flood plain soil PCDF congeners indicate that these congeners were approximately one-fourth as bioavailable as in corn oil. This indicates that, even if the administered doses of compounds in the soils and reference corn oil mixtures were equal, the absorbed doses may have differed by nearly a factor of four.

Increased EROD activity in reference-group rats compared to soil-group rats could result in an increase in hepatic metabolism rates in the reference-group rats, especially for TCDF. Such a differential in metabolism rates would violate the assumption (discussed above in the methods section) that rates of elimination in the soil and reference groups are the same. A greater elimination rate in the reference groups compared to the soil groups would result in an apparently greater relative bioavailability for the soil group. That is, a larger percentage of the *absorbed* dose would be retained in the soil groups compared to the induced reference groups that would be eliminating absorbed compound more rapidly. Thus, the high relative bioavailability estimate obtained in rats for TCDF in the Tittabawassee River flood plain soil may be in part due to elevated elimination rates in the reference groups, consistent with the elevated EROD activity observed in these groups. The statistically significant increase in

EROD activity in reference-group rats compared to soil-group rats may have resulted in higher metabolic rates in the reference-group rats for compounds of interest other than TCDF as well.

In contrast with the rats, the swine did not exhibit a statistically significant difference in EROD activity between the soil and reference material groups (Table 10). This is consistent with the better control of soil dosing rates in this model and could account for at least some of the apparent inconsistency in estimated relative bioavailability between the rats and swine in this study.

The EROD and MROD activities for all of the animals in the study are plotted in Figure 12. For rats, EROD activity is strongly correlated with hepatic TEQ, while MROD shows a weaker relationship. In swine, EROD and MROD activity are also correlated with hepatic TEQ, but MROD shows a stronger relationship. The positive dose-response for EROD and MROD, even at the low doses used in these studies, indicates that in future studies, in order to avoid differential EROD and MROD induction and activity among groups, soil and reference administered doses will need to be matched more closely. In fact, administered doses should probably be adjusted to reflect expected differences in relative bioavailability. That is, if the relative bioavailability is expected to be in the range of 25% to 75 percent for soil compared to reference corn oil materials, the administered dose of compounds in the reference corn oil material could be reduced by 25% to 50% compared to the soil dose, to try to ensure similar absorbed doses between the two groups. This approach should minimize any differences in enzyme induction between soil and reference groups.

Comparative Evaluation of Rat and Swine Models

For reasons of efficiency in a full bioavailability study of a number of soils, it would be desirable to identify a single animal model, rather than continue with two animal models. Swine are the preferred animal model for humans in research on the bioavailability of lead and arsenic from soils for a variety of biological reasons (Weis and Lavelle 1991). Wittsiepe et al. (2004) used minipigs in an evaluation of PCDD/F bioavailability from soils based on an evaluation of their gastrointestinal tract similarity to humans (Swindle and Smith 1998). Young pigs have comparable physiology and have been used successfully as a model for gastrointestinal function of children (Dodds 1982; Miller and Ullrey 1987). However, evaluation of swine as a model for humans in the study of highly lipophilic compounds is much less complete. Kararli (1995) notes that for highly lipophilic compounds, bile fluid plays an important role in absorption and uptake. Rats have no gallbladder, so the patterns of secretion of bile fluid are different from those in animals that do have gallbladders (including humans and pigs). However, there is a lack of comparative studies among swine, rats, and humans for assessing the bioavailability of lipophilic compounds, so there is no clear reason to prefer swine over rats as a model for human bioavilability of PCDD/Fs from soil.

From a practical perspective, additional issues could influence the choice of a single animal model. Arguments in favor of the rat model include:

- In this pilot study, rats were more sensitive than swine based on tissue detection limits, due to the ability to administer a larger dose of soil on a

body-weight basis and smaller relative changes in body weight over the course of the study. The swine dosing regimen would need to be altered to improve the sensitivity of this model for soils with contaminant concentrations in the same range as or lower than the Midland soil tested here.

- The swine growth rate was very large, with body weights more than doubling over the course of the 30-day experiment. In contrast, rat body weights were more consistent. The rapid growth of the swine decreases the sensitivity of the model, because the volume of distribution for the administered compounds more than doubles over the course of the study.

Arguments in favor of the swine model include the following. Control of soil dosing levels was easier to achieve in swine because of the method of administration. For swine, a measured amount of soil was wrapped in a dough ball and fed directly to the animal. For the rats, soil was mixed with rat feed (in a meal form) at the maximum proportion deemed palatable. The daily intake of soil and feed was then estimated by weighing the remaining feed and estimating spilled feed weights. In addition to the possible variability in doses and estimates of dose resulting from this dosing procedure, there is also the possibility of occasional inhomogeneities in the soil/feed mixture, resulting in variable doses.

Soil Bioavailability Evaluations

TEQ Weighting

The two soil samples tested each contained a number of dioxin and/or furan contaminants, but for each soil, the total TEQ of the soil was dominated by two congeners (Table 2). For the Midland soil, the TEQ was dominated by TCDD and PeCDD, accounting together for approximately 75% of the total TEQ concentration. The TEQ concentration of the Tittabawassee soil was dominated by TCDF and 4-PeCDF, again together accounting for 75% of the TEQ.

Table 16 provides estimates of the overall relative bioavailability for the two soils compared to the corn oil reference material based on weighting the RBA estimates for individual congeners in proportion to their contribution to the total soil TEQ. RBA estimates based on the rat model and on the swine model under the two assumptions regarding non-detects are presented.

Absolute Bioavailability Estimates

This pilot study allows direct estimates of relative biovailability from soil compared to corn oil (rats and swine) or, for the Midland soil, compared to diet (rats only). The absolute bioavailability of the congeners may be of of interest for the risk assessment of these soils if soil exposure is compared to established intake targets for humans that rely on absolute estimates of dose or body burden (for example, the WHO/JECFA or ECSCF TDI values). The absolute bioavailability of the tested congeners from soil can be estimated if the absolute bioavailability

from the corn oil reference material is known. Rats and mice absorb between 60% and 90% of TCDD from oral administration in corn oil (Hurst et al. 2000; Diliberto et al. 1996, 2001). Other congeners with 4 to 6 chlorine atoms probably have similar absorption rates from corn oil, although congeners with 7 and 8 chlorine atoms may be much more poorly absorbed from corn oil (Birnbaum and Couture 1988).

Table 16 presents estimates of absolute bioavailability for the tested congeners and soils, assuming that the PCDD/Fs in the corn oil reference material have absolute bioavailability of 80%. The absolute bioavailability estimates of the soils would decrease if the absolute bioavailability of the cornoil–administered compounds is lower than 80%, and would increase if the absolute bioavailability of corn oil–administered compounds is greater than 80%.

Comparison with *In Vitro* Bioaccessibility Data

A sample of the Midland soil tested in rats and swine (CC-S-27) was evaluated previously for dioxin/furan bioaccessibility using an *in vitro* assay (Ruby et al. 2002). This assay measured the ability of a synthetic digestive fluid in an *in vitro* system to disassociate dioxin and furan congeners from soil. Such a test could serve as a predictor of the fraction of contaminant likely to be available for absorption in the gastrointestinal tract. Congener-specific bioaccessibility estimates ranged from about 16% to 26% of the total soil contamination for the Midland soil (Table 16). These estimates are similar to, but slightly lower than, the estimated absolute bioavailability of this soil based on the swine results. No Tittabawassee River flood plain soil was evaluated using the bioaccessibility assay, so no results are available for comparison to the flood plain soil test results presented here.

Conclusions and Recommendations for Final Study Design

The RBA estimates derived in this pilot study based on the rat model cannot be relied upon due to differential enzyme induction between soil and reference groups. To our knowledge, no previous evaluations of relative bioavailability for PCDD/Fs in soil in rats have measured EROD or MROD activity in the study animals. This suggests the possibility that previous bioavailability estimates may have been influenced by this factor as well.

The RBA estimates for the Midland soil based on the swine model also suffer from limitations due to the low tissue concentrations attained and failure to consistently exceed analytical detection limits. However, there are no *a priori* reasons to reject the swine-based RBA estimates for the Tittabawassee River flood plain soil compounds.

The data developed in this pilot study indicate that either of these animal models could potentially be used to assess PCDD/F bioavailability and provide a basis for developing a final study design that can be used to evaluate a selection of soils from both Midland and the Tittabawassee River flood plain.

Following are our recommendations for a final study design.

1. Choose a single animal model for future studies. Based on a variety of considerations, the rat model may be more practical for further studies. The rats are a more sensitive model based on attained tissue concentrations for a given soil concentration, and this will be important in future studies. The Midland soil tested, CC-S-27, is toward the upper end of TCDD and TEQ concentrations for Midland city soils analyzed to date. Even if a higher rate of soil dosing can be achieved with the swine, the swine model still might not be sensitive enough to obtain detectable tissue levels using Midland soils with lower TCDD or TEQ concentrations, which would greatly limit the Midland soil selection for future testing. Although achieving good control over the dosing rate of soil for the rats is more complicated than for the swine, this issue should be surmountable based on the experience gained during the pilot study. In addition, the results of this pilot study exhibited good reproducibility from one rat pair to the next, with relatively low CVs on the mean RBA estimates for all congeners. This indicates good inter-animal reproducibility with the current rat study design. In addition, rats have a long history of use as a dioxin bioavailability model, whereas swine, although widely used for assessing bioavailability of lead and arsenic, have almost no track record as a model for lipophilic compounds. Finally, although the RBA estimates derived in this pilot study are questionable due to the enzyme activity differences among groups, these preliminary data suggest that, for the congeners of greatest concern, the rats are producing greater RBA estimates than the swine. The rats would therefore be a conservative choice for future bioavailability studies.

   If rats are chosen as the model for use in further studies, several specific study design changes should be made:

- Reduce administered doses somewhat for soils with TEQ concentrations above 500 ppt TEQ, to reduce enzyme induction but still maintain detectable, quantifiable tissue levels. The administered dose of Tittabawassee River flood plain soil used in this study was more than sufficient to produce detectable, reproducible tissue concentrations of the compounds of interest. The Midland soil used here consistently produced quantifiable liver concentrations, and adipose tissue concentrations were consistently above detection limits but were sometimes below the analytical lower calibration limit.

- Match oil gavage reference doses to anticipated *absorbed* doses of soil congeners as closely as possible. This involves three adjustments to the current protocol:

    1. Match reference-dose material to mixed soil/feed analysis results, rather than trying to match both materials to the "target" dosing concentrations.

    2. In addition, when establishing target congener concentrations for the reference soil, reduce the expected soil/feed consumption rate to 18 g/day, consistent with what was observed in the pilot study for both soil/feed groups.

    3. Account for the range of likely relative bioavailability in choosing target gavage oil concentrations and doses. That is, if the relative bioavailability is expected to be in the range of 25% to 50% for soil compared to reference corn oil materials, the administered dose of compounds in the reference corn oil material should probably be reduced by 50% to 75% compared to the *administered* soil dose, to try to assure similar *absorbed* doses between the two groups. This approach should minimize any differences in enzyme induction between soil and reference groups.

- Omit the reference feed study group, because the results in this pilot study are consistent with conventional assumptions regarding bioavailability from feed, and two reference groups are unnecessary going forward.

However, if swine are chosen, the following protocol changes should be considered:

- Increase administered dose as much as possible to ensure tissue concentrations above detection limits.

- Consider doing an intravenous comparison group for one soil each from Midland and Tittabawassee to assess the absolute bioavailability of the corn oil-administered compounds.

2. Choose one tissue (either liver or fat) to reduce study costs in the future. The choice of tissue would depend on the choice of animal model.

In the swine model, in the dose ranges used in this pilot study, adipose tissue accumulated a much greater fraction of administered dose and exhibited a greater rate of detectable tissue levels (Figure 7).

However, in rats, the fraction of retained dose of the two predominant congeners, TCDD and PeCDD, was similar between liver and adipose tissue, while the higher chlorinated PCDDs and the 4-PeCDF were found predominantly in the liver (Figure 3). In addition, the RBA estimates derived based on liver tissue alone vs. adipose tissue alone were very consistent in the rat for both soils, so a single tissue could be chosen. The liver tissue is the simplest tissue to collect. In addition, livers can be weighed directly, so the total mass of the tissue compartment can be measured rather than estimated (as was done for the adipose tissue weight). Finally, if liver tissue is the basis for comparison, it will not be necessary to use pairs of rats rather than single animals for the tissue collection, because this was done to facilitate collection of sufficient fat tissue for analysis.

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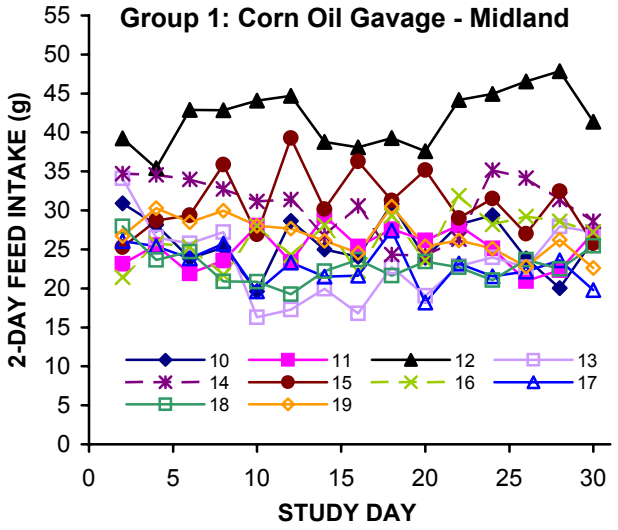
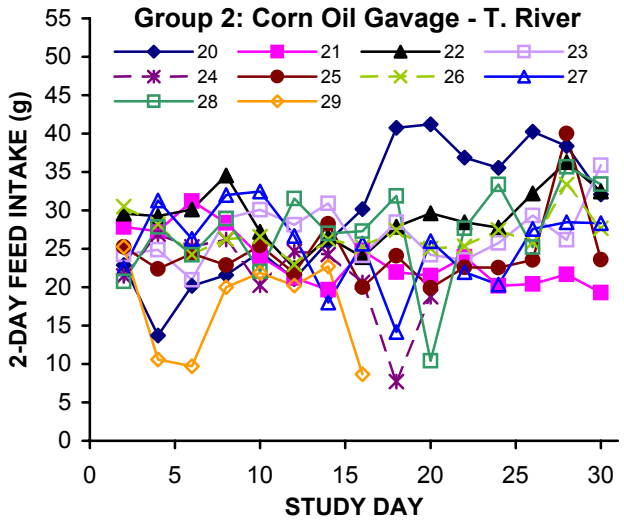
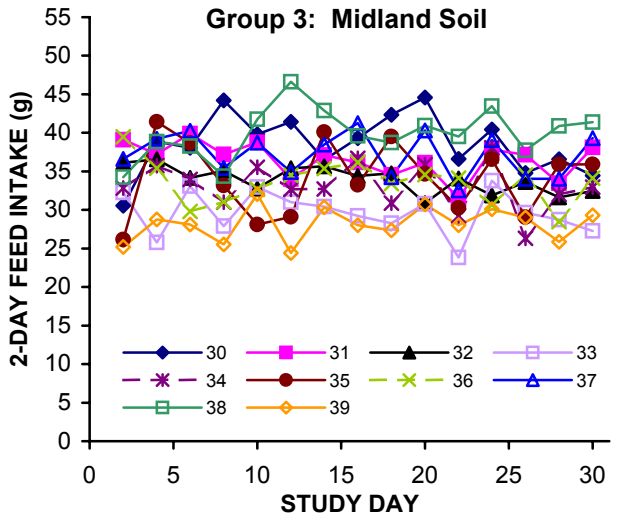
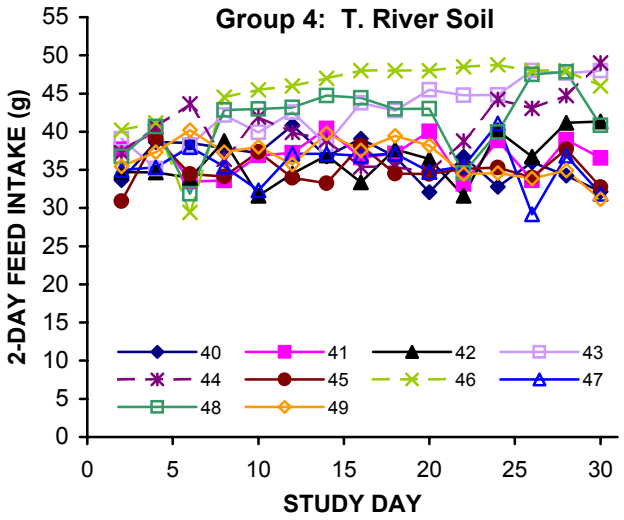
Figures









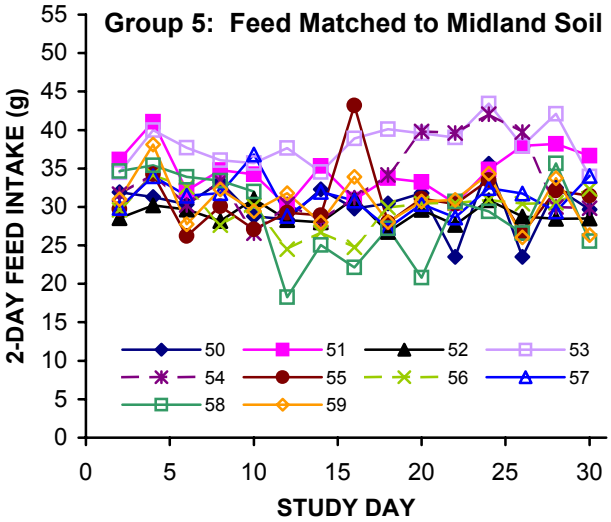


Figure 1. Feed intake for the rat pilot study

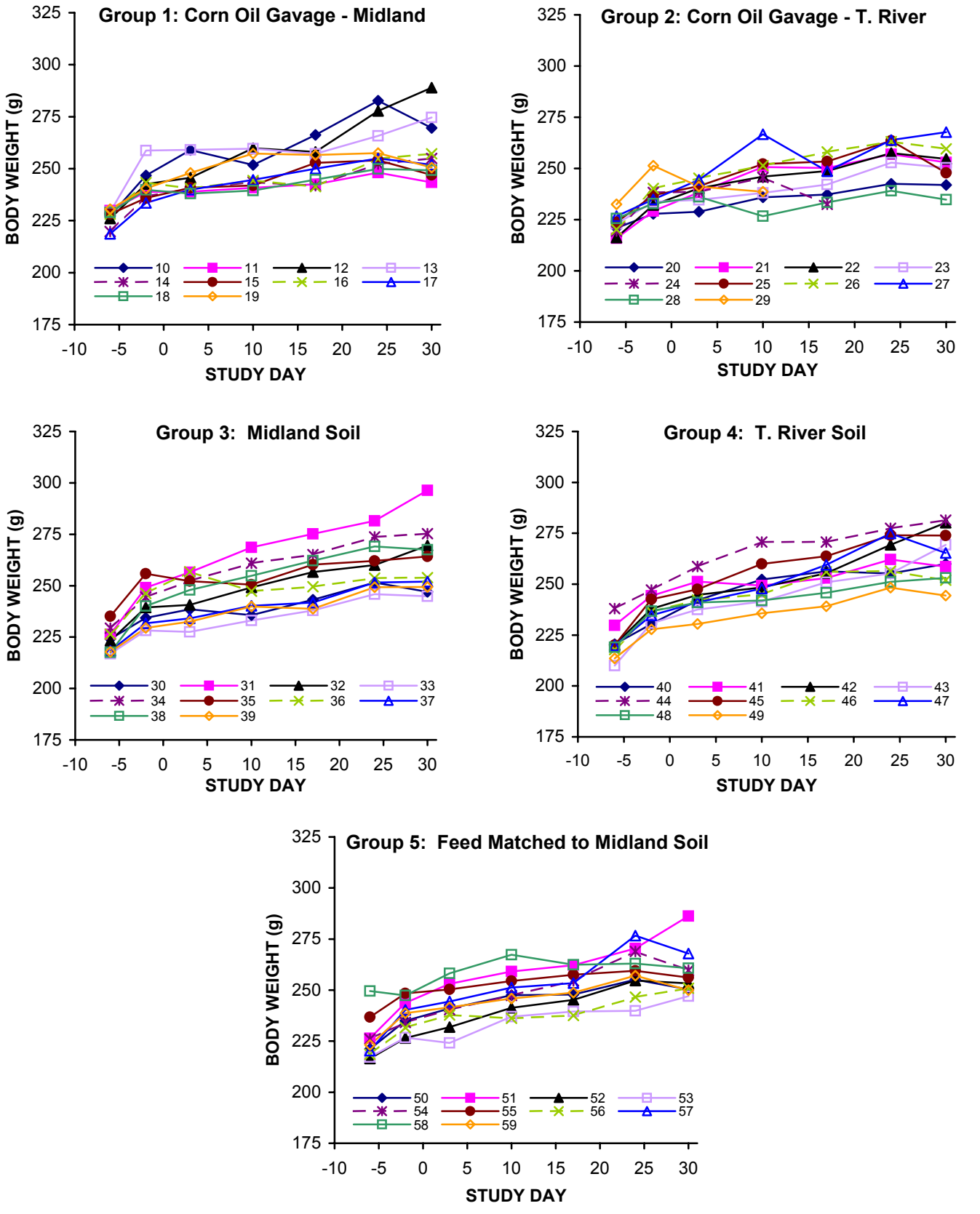


Figure 2. Body weights for the rat pilot study

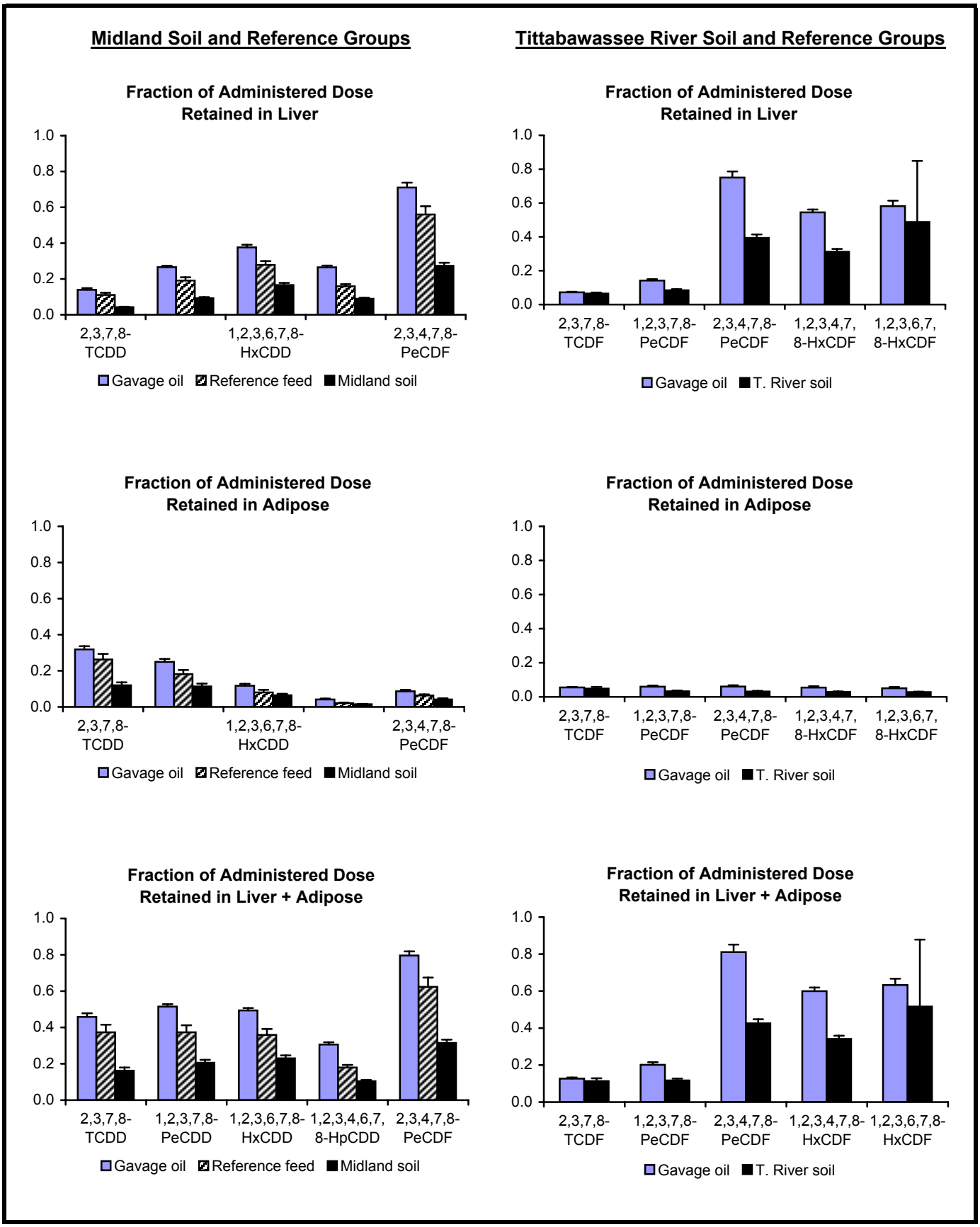
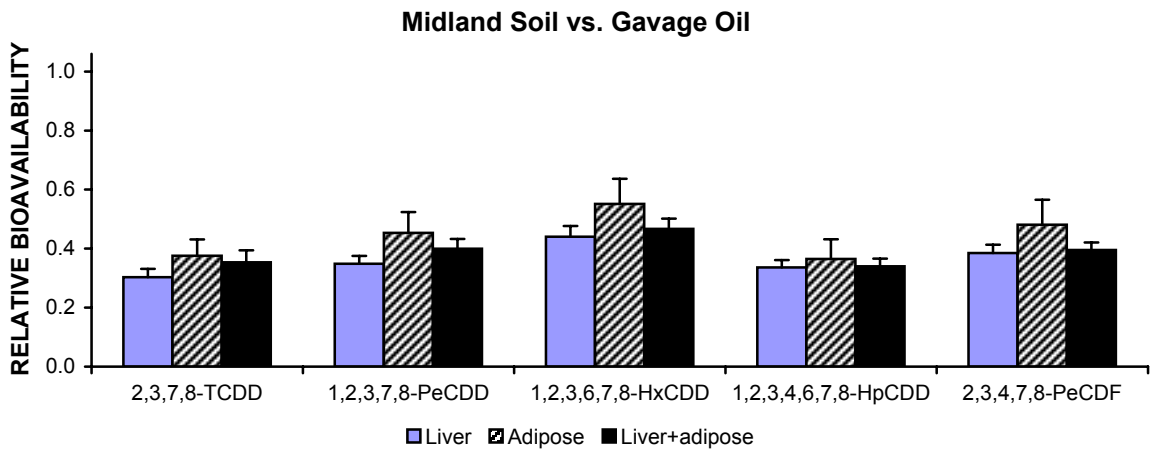
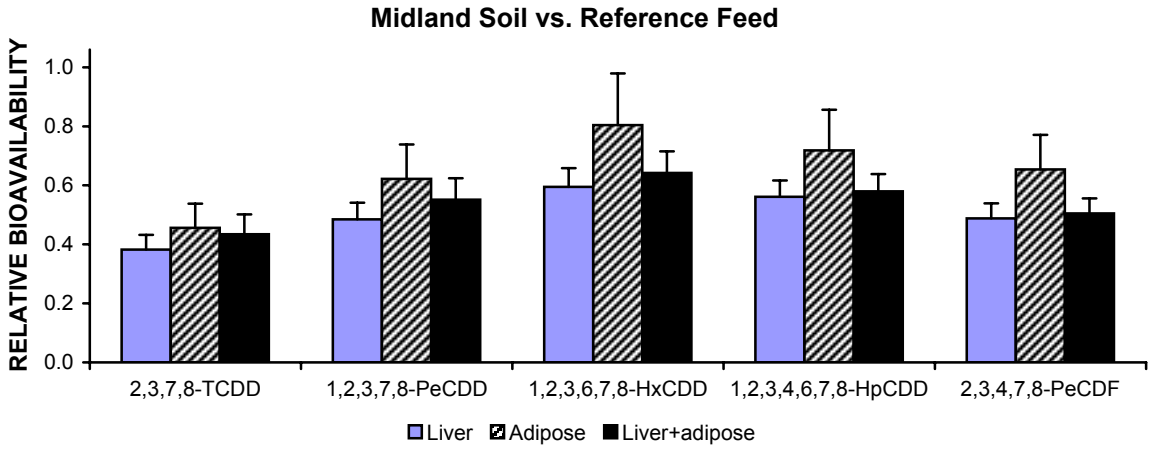
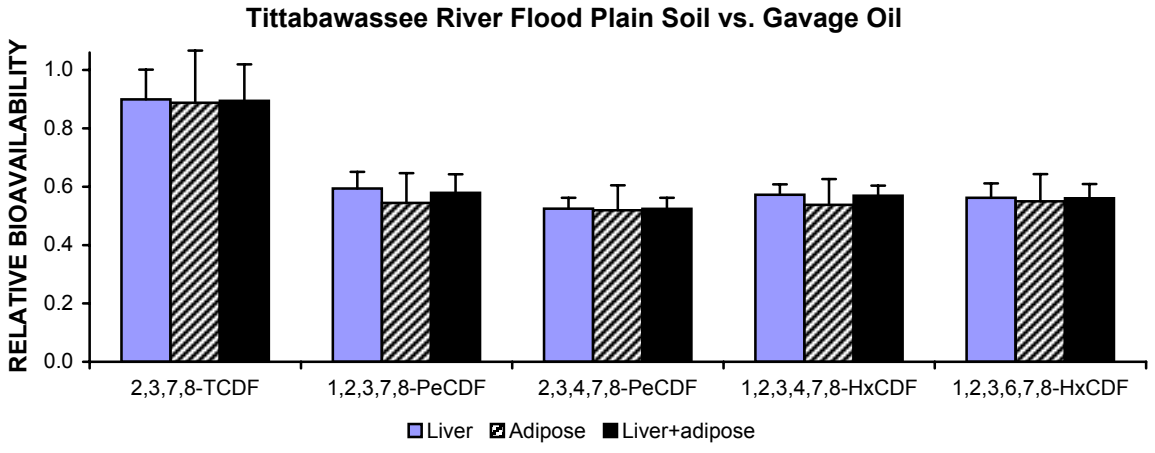


Figure 3. Distribution of administered doses in rat tissues







One outlier excluded for 1,2,3,6,7,8-HxCDF.

Figure 4. Relative bioavailability estimates for the rat pilot study

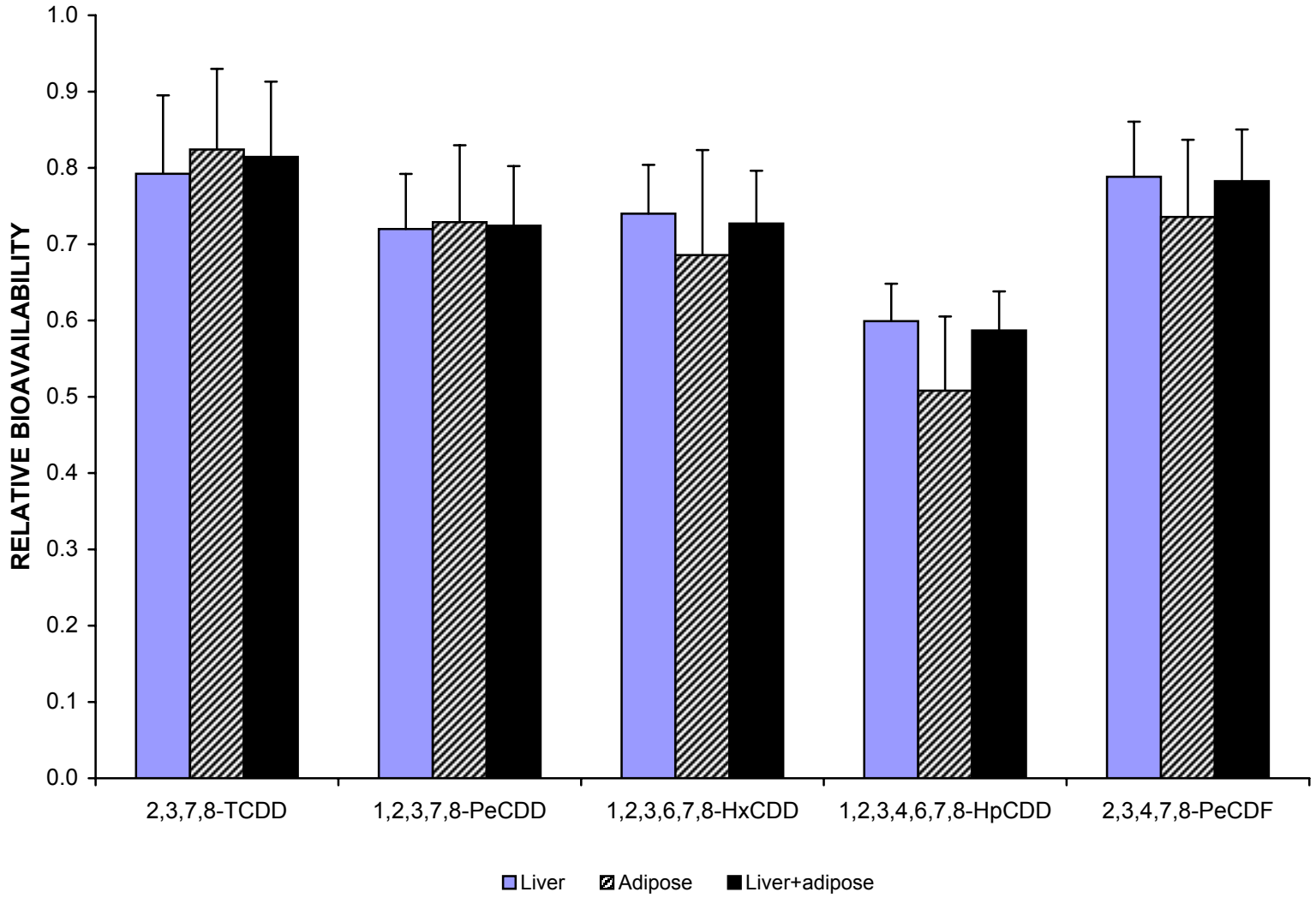


Figure 5. Relative bioavailability of the feed reference mixture compared to the corn oil reference mixture for the Midland soil

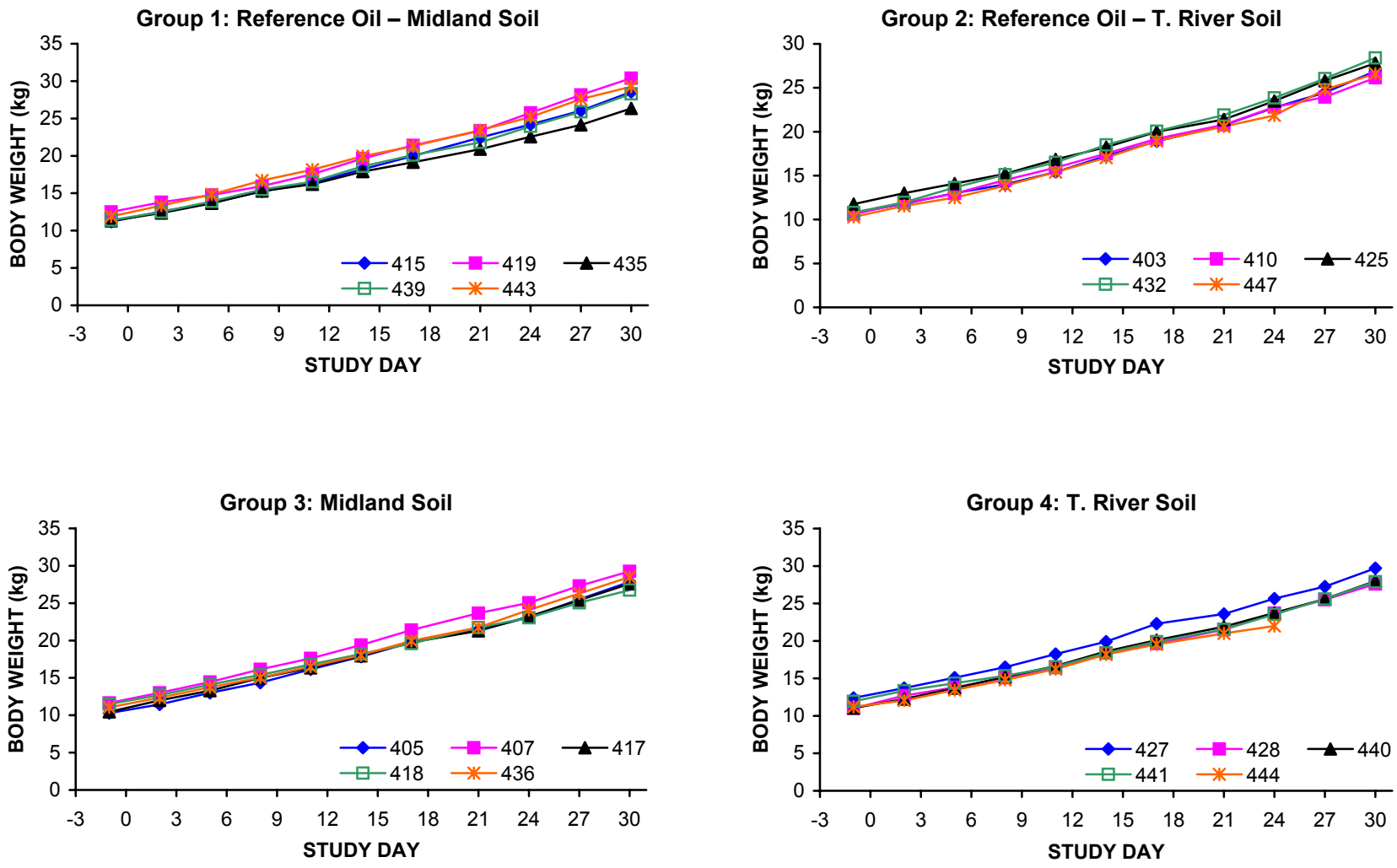


Figure 6. Body weights for the swine pilot study

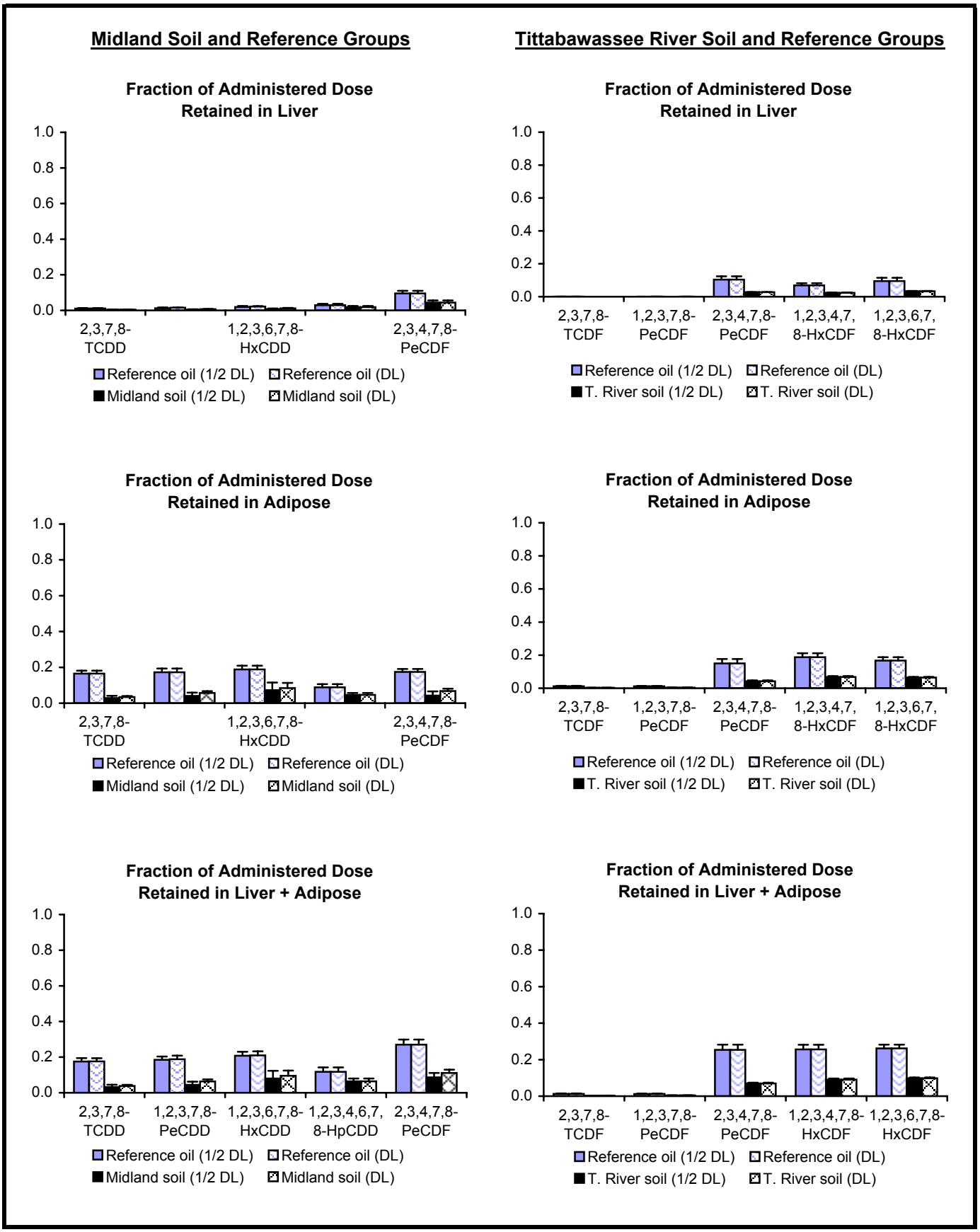
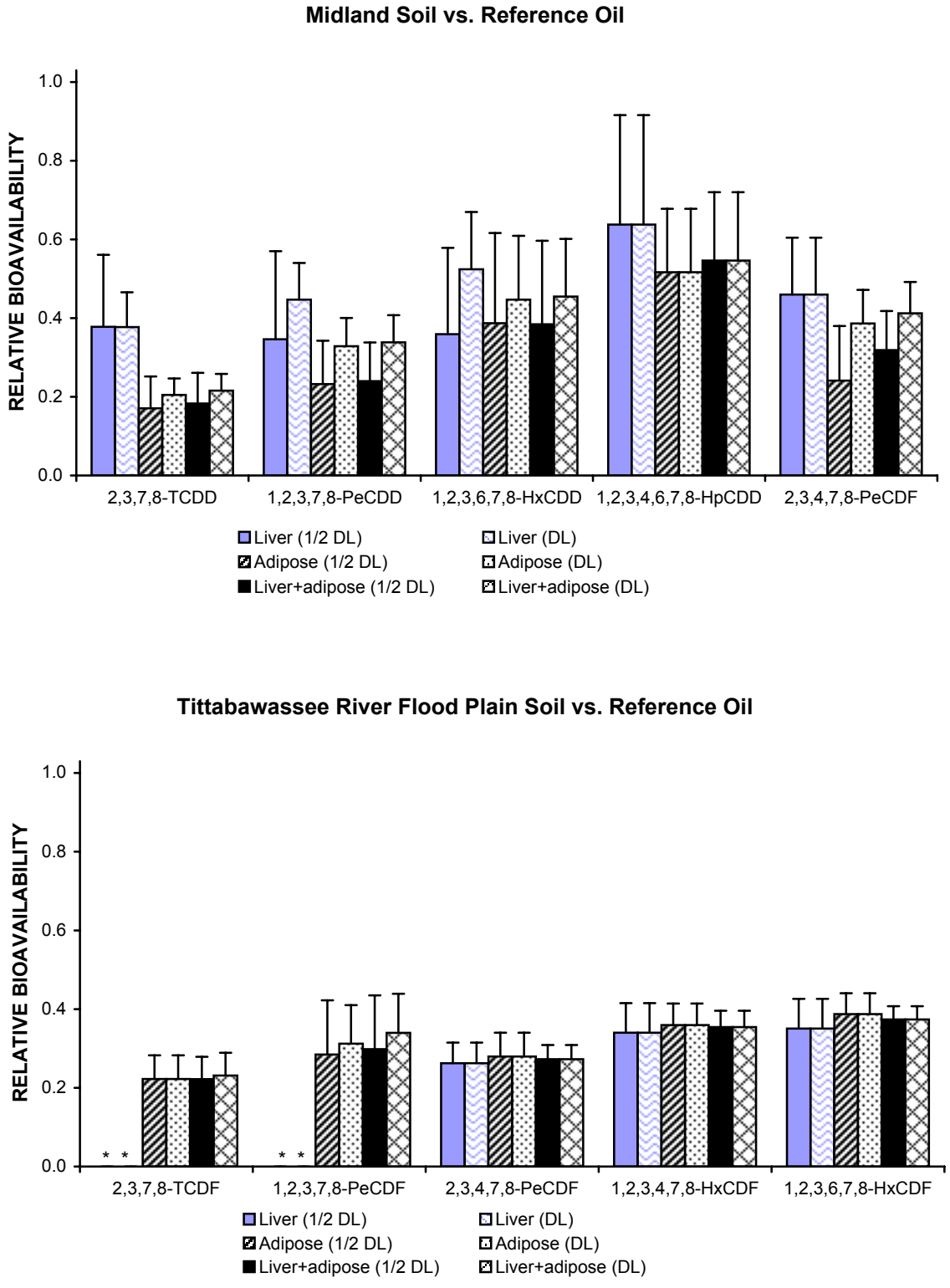
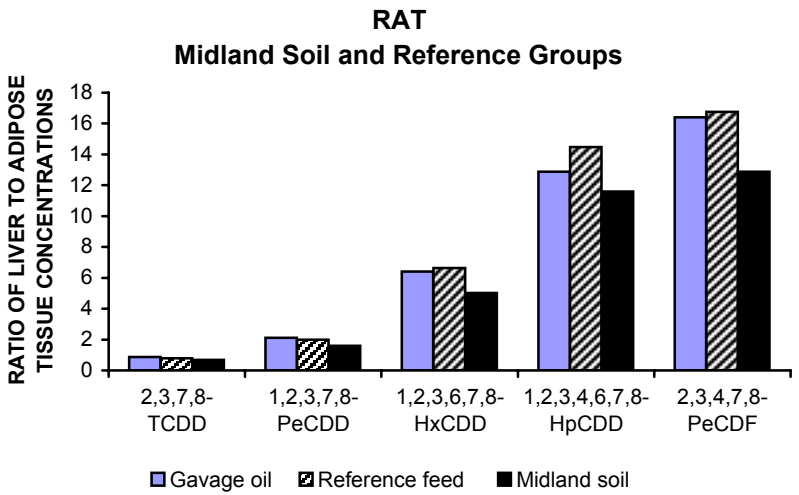


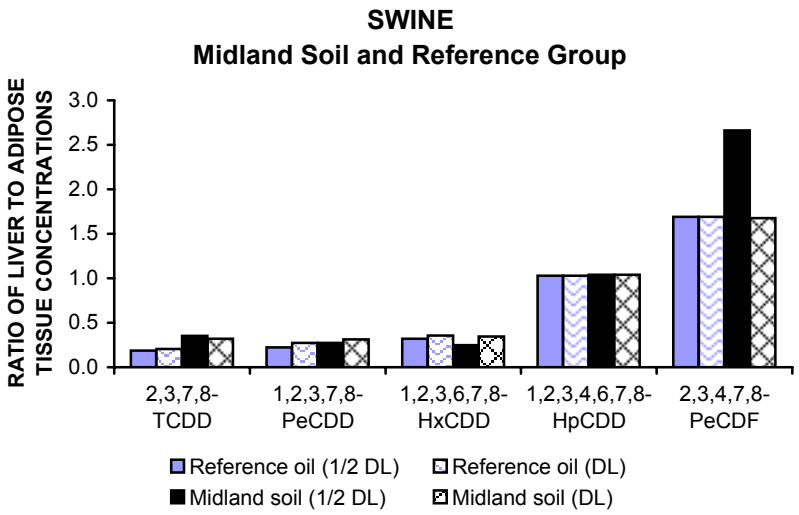
Figure 7. Distribution of administered doses in swine tissues

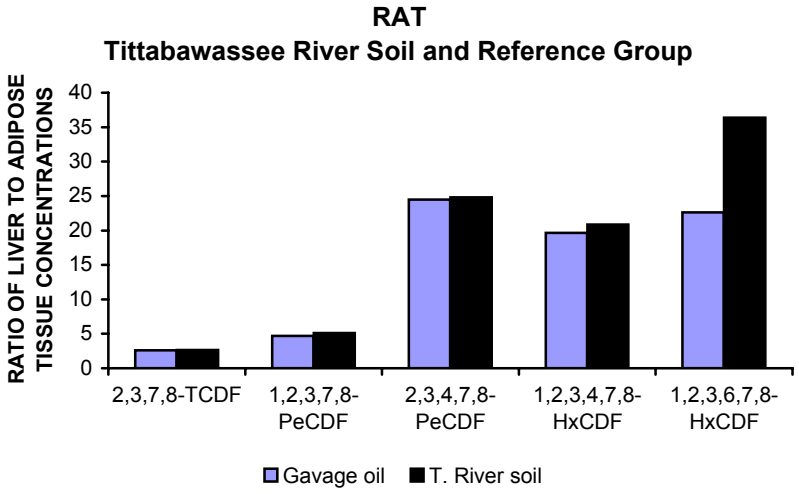


* Liver tissue concentrations were undetected in all soil group animals.

Figure 8. Relative bioavailability estimates for the swine pilot study







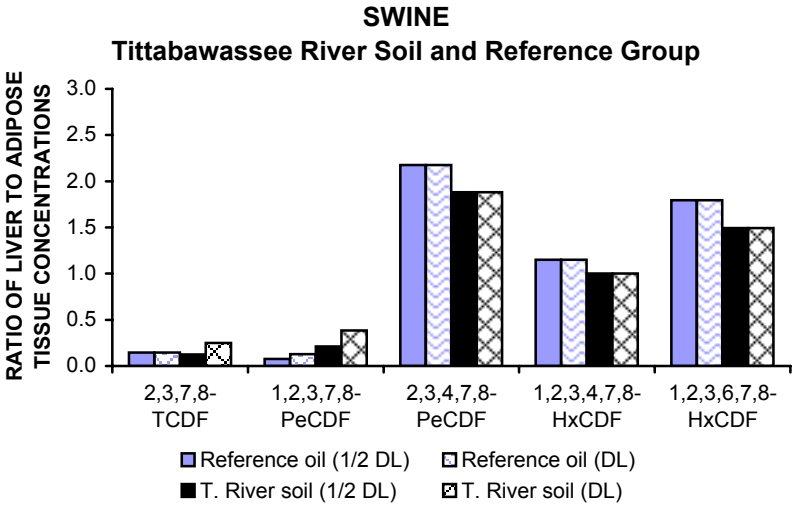


Figure 9. Ratio of liver to adipose tissue concentrations in the rat and swine pilot study

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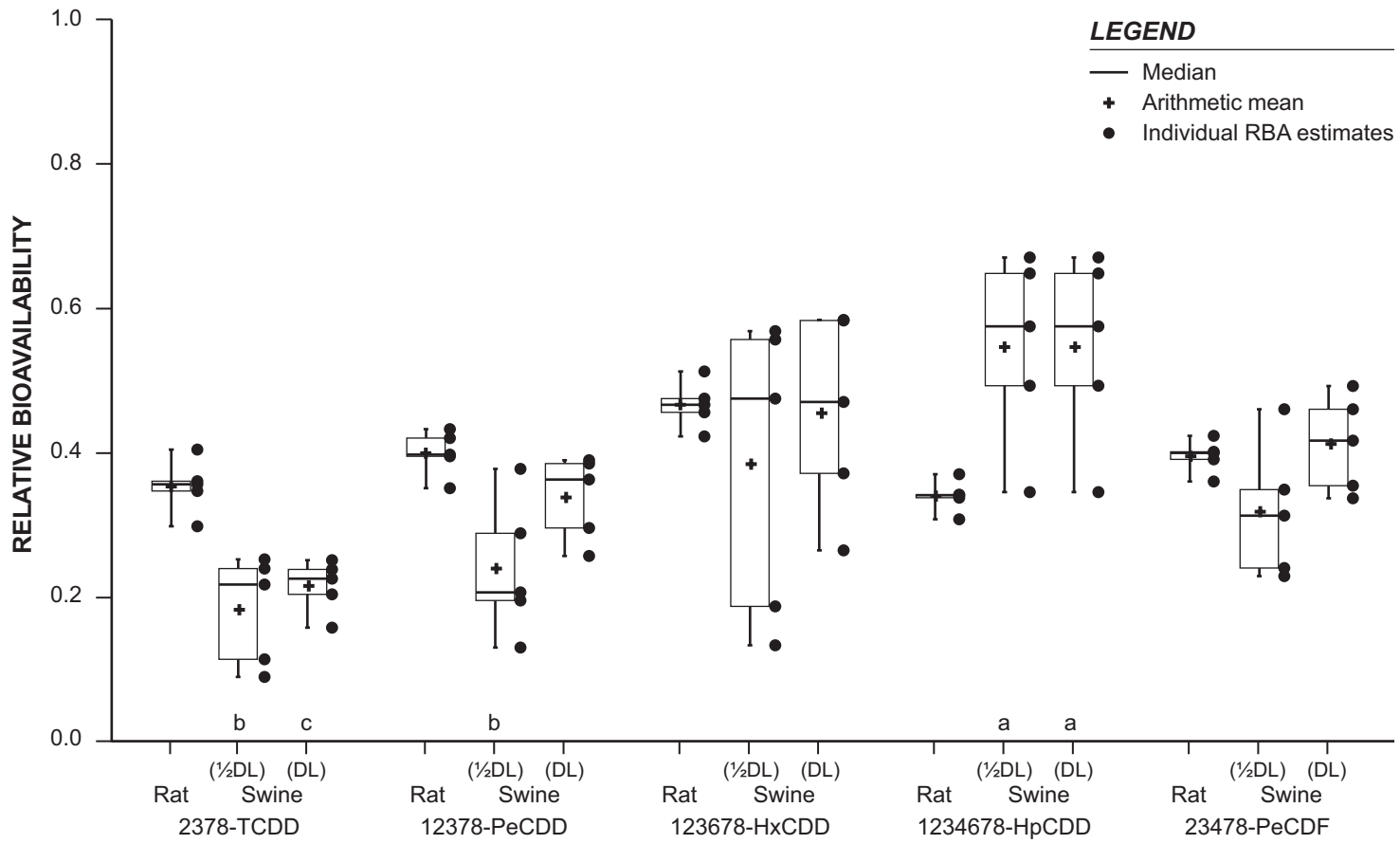
Data\TissueRatio.xls graphs 2/24/2005 (3:09 PM)

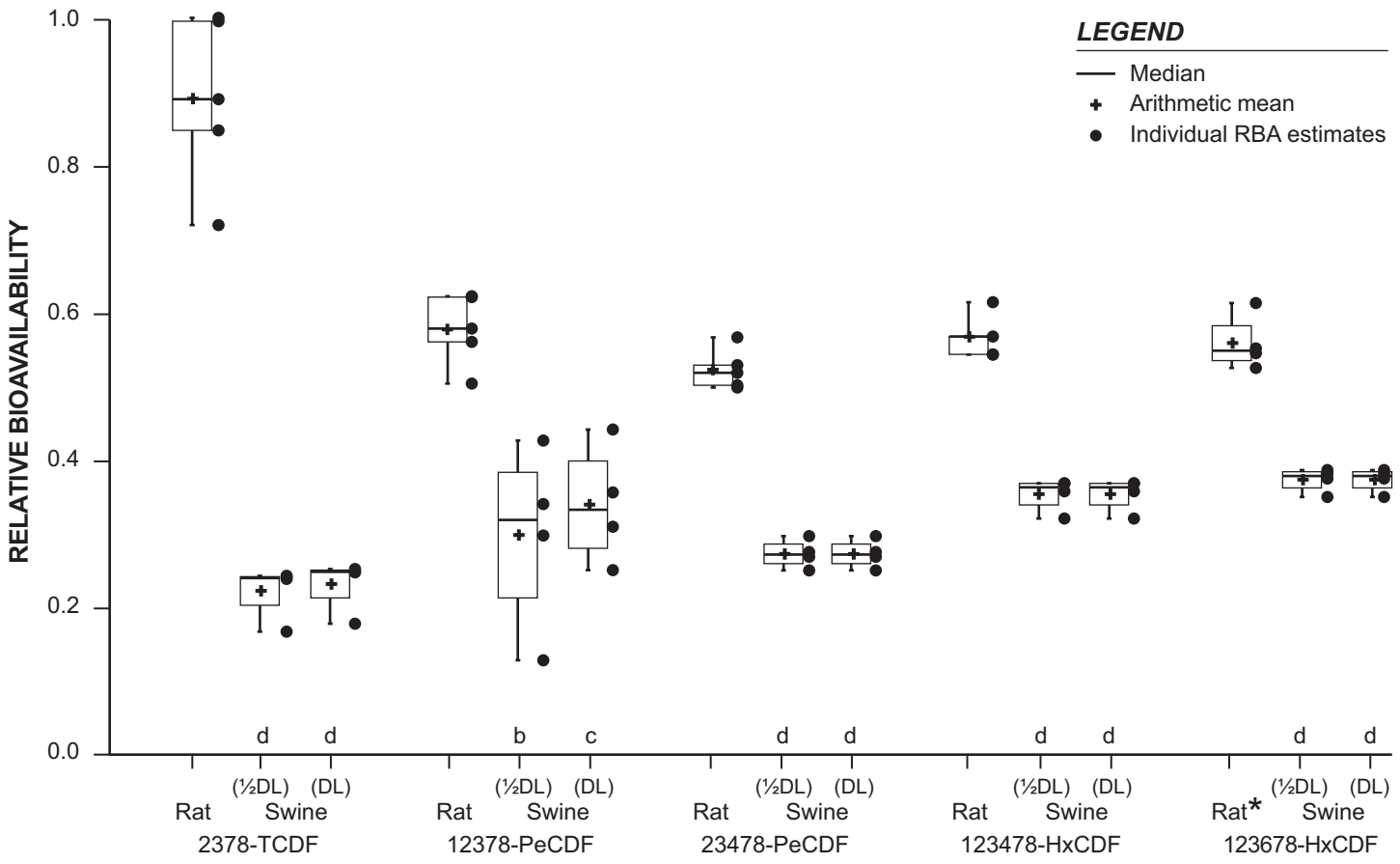


P-values:
Difference between rat and swine RBAs

a = p<0.05
b = p<0.01
c = p<0.001
d = p≤0.0001

Notes:
RBA estimates plotted for each animal (swine) or pair of animals (rats) based on the fraction of administered dose retained in liver plus adipose tissue compared to the average fraction of administered dose retained in liver plus adipose tissue in the respective corn oil reference group
½DL—Calculations performed using one-half the detection limit for non-detects
DL—Calculations performed using the detection limit for non-detects

Figure 10. Relative bioavailability estimates for the Midland soil in rats and swine



P-values:
Difference between rat and swine RBAs

a = p<0.05
b = p<0.01
c = p<0.001
d = p≤0.0001

Notes:

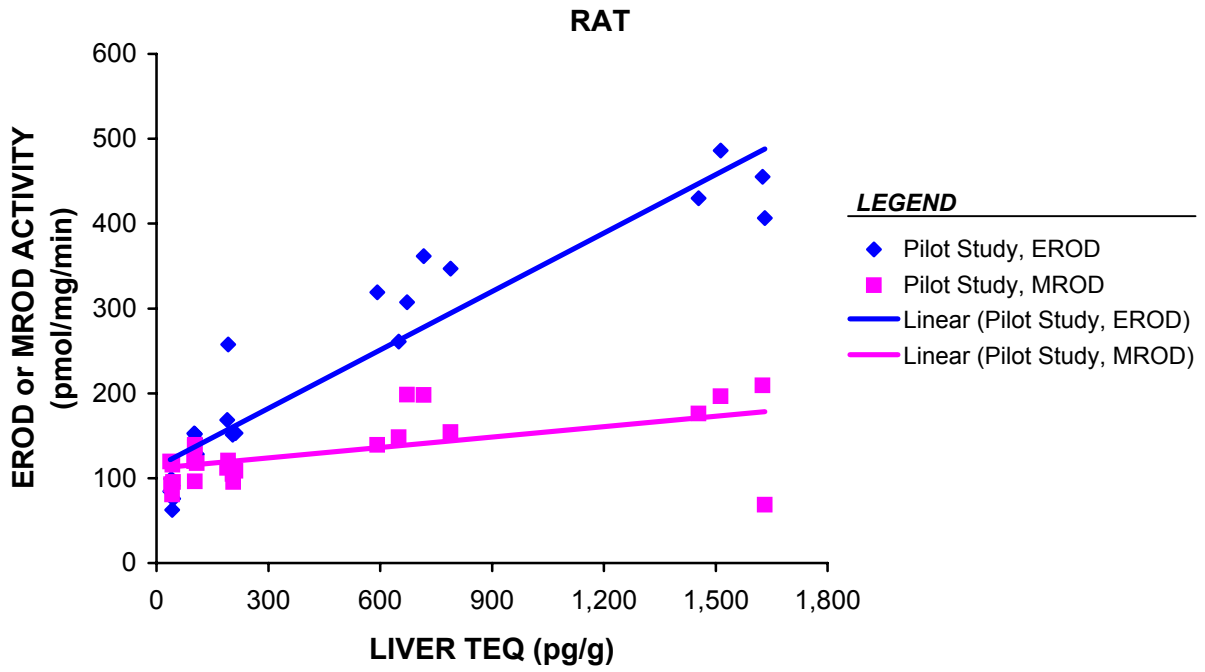
RBA estimates plotted for each animal (swine) or pair of animals (rats) based on the fraction of administered dose retained in liver plus adipose tissue compared to the average fraction of administered dose retained in liver plus adipose tissue in the respective corn oil reference group

½DL—Calculations performed using one-half the detection limit for non-detects

DL—Calculations performed using the detection limit for non-detects

*One outlier excluded from rat RBA estimate

Figure 11. Relative bioavailability estimates for the Tittabawassee River flood plain soil in rats and swine



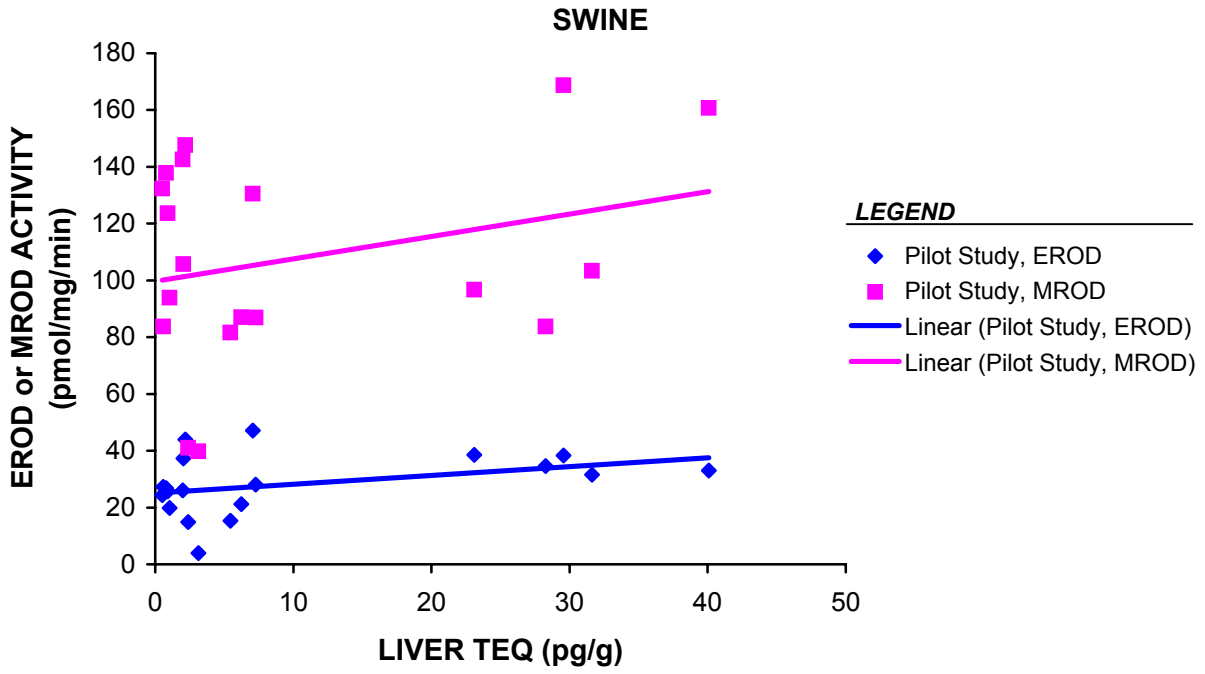


Figure 12. Enzyme activity in rat and swine liver microsomes for the pilot study

\\Boulder3\Data\Projects\1636_Dow\In Vivo Study\Pilot Study\Study Report\
DataEROD_MROD_Pig-rat_09-2004_samples.xls plot 2/24/2005 (3:10 PM)

Tables

Table 1. PCDD/F concentrations in candidate pilot study soils (<250 µm)

Sample Location:		Midland - 1		Midland - 2		N. of Caldwell Boat Launch		Imerman Park 1		Imerman Park 2	
Sample ID:		MNE02765		MNE02766		MIC02767		THT02768		THT02769	
Date:		6/25/2004		6/28/2004		6/28/2004		6/25/2004		6/28/2004	
Analyte	WHO TEF	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)
PCDDs/Fs											
2,3,7,8-TCDD	1	15.2	15.2	59.5	59.5	2.01	2.01	5.51	5.51	4.43	4.43
1,2,3,7,8-PeCDD	1	16.8	16.8	33.3	33.3	2.15 *J*	2.15	6.02	6.02	5.05	5.05
1,2,3,4,7,8-HxCDD	0.1	12.5	1.25	29.2	2.92	1.77 *J*	0.177	3.72 *J*	0.372	3.72 *J*	0.372
1,2,3,6,7,8-HxCDD	0.1	35.6	3.56	83.8	8.38	9.75	0.975	28.7	2.87	17.9	1.79
1,2,3,7,8,9-HxCDD	0.1	24.3	2.43	50.5	5.05	3.65 *J*	0.365	7.60	0.760	6.57	0.657
1,2,3,4,6,7,8-HpCDD	0.01	866	8.66	1,590	15.9	209	2.09	606	6.06	356	3.56
OCDD	0.0001	9,110 *E*	0.911	16,900 *E*	1.69	2,360	0.236	6,300	0.630	3,540	0.354
2,3,7,8-TCDF	0.1	4.94	0.494	69.5	6.95	64.3	6.43	2,160 *E*	216	2,380 *E*	238
1,2,3,7,8-PeCDF	0.05	4.08 *J*	0.204	51.6	2.58	34.1	1.71	1,020	51.0	1,230	61.5
2,3,4,7,8-PeCDF	0.5	9.82	4.91	81.3	40.7	35.8	17.9	898	449	984	492
1,2,3,4,7,8-HxCDF	0.1	18.4 *B*	1.84	114 *B*	11.4	59.7 *B*	5.97	685 *B*	68.5	822 *B*	82.2
1,2,3,6,7,8-HxCDF	0.1	14.5 *D*	1.45	48.1 *D*	4.81	13.6	1.36	145 *D*	14.5	187 *D*	18.7
2,3,4,6,7,8-HxCDF	0.1	13.6	1.36	55.3	5.53	7.67	0.767	86.7	8.67	107	10.7
1,2,3,7,8,9-HxCDF	0.1	5.34	0.534	21.2	2.12	9.50	0.950	130	13.0	156	15.6
1,2,3,4,6,7,8-HpCDF	0.01	416	4.16	949	9.49	286	2.86	881	8.81	681	6.81
1,2,3,4,7,8,9-HpCDF	0.01	16.1	0.161	47.0	0.470	23.8	0.238	74.5	0.745	71.4	0.714
OCDF	0.0001	1,020 *B*	0.102	1,700 *B*	0.170	712 *B*	0.0712	2,040 *B,D*	0.204	1,140 *B*	0.114
TEQ (pg/g)			**64.0**		**211**		**46.3**		**853**		**943**

Table 1. (cont.)

Sample Location:		W. Michigan Park		Dow Corporate Center	
Sample ID:		SHL02770		CC-S-27	
Date:		6/28/2004		5/17/2002	
Analyte	WHO TEF	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)
PCDDs/Fs					
2,3,7,8-TCDD	1	6.47	6.47	163	163
1,2,3,7,8-PeCDD	1	6.60	6.60	71.8	71.8
1,2,3,4,7,8-HxCDD	0.1	3.10 *J*	0.310	30.1	3.01
1,2,3,6,7,8-HxCDD	0.1	17.2	1.72	80.8	8.08
1,2,3,7,8,9-HxCDD	0.1	6.25	0.625	57.5	5.75
1,2,3,4,6,7,8-HpCDD	0.01	320	3.20	1,700	17
OCDD	0.0001	3,260	0.326	17,100 *B,E*	1.71
2,3,7,8-TCDF	0.1	1,330	133	28.3	2.83
1,2,3,7,8-PeCDF	0.05	642	32.1	22.5	1.125
2,3,4,7,8-PeCDF	0.5	565	283	31.7	15.85
1,2,3,4,7,8-HxCDF	0.1	440 *B*	44.0	56.9	5.69
1,2,3,6,7,8-HxCDF	0.1	95.7	9.57	26.1	2.61
2,3,4,6,7,8-HxCDF	0.1	56.4	5.64	30.5	3.05
1,2,3,7,8,9-HxCDF	0.1	88.3	8.83	13.1	1.31
1,2,3,4,6,7,8-HpCDF	0.01	633	6.33	784	7.84
1,2,3,4,7,8,9-HpCDF	0.01	47.8	0.478	30.5	0.305
OCDF	0.0001	1,110 *B*	0.111	1,290	0.129
TEQ (pg/g)			**542**		**311**

Note: *B* – This compound was also detected in the method blank.
D – The amount reported is the maximum possible concentration due to possible chlorinated diphenylether interference.
E – The amount detected is above the Upper Calibration Limit of the instrument.
J – The amount detected is below the Lower Calibration Limit of the instrument.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor

Table 2. PCDD/F and PCB concentrations in triplicate samples of pilot study test soils (<250 µm)

Sample Location:		Dow Corporate Center						
Sample ID:		CC-S-27						
Date:		7/8/2004						
Tag Number:		57278	57279	57280	Mean	Coefficient of		
Analyte	WHO TEF	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	Variability (%)	TEQ (pg/g)	% of TEQ
PCDDs/Fs								
2,3,7,8-TCDD	1	139	125	130	131	5.4%	131	49%
1,2,3,7,8-PeCDD	1	65.4	67.6	67.6	66.9	1.9%	66.9	25%
1,2,3,4,7,8-HxCDD	0.1	31.3	28.4	27.4	29.0	7.0%	2.90	1.1%
1,2,3,6,7,8-HxCDD	0.1	78.2	71.6	70.7	73.5	5.6%	7.35	2.7%
1,2,3,7,8,9-HxCDD	0.1	50.2	50.0	48.6	49.6	1.8%	4.96	1.8%
1,2,3,4,6,7,8-HpCDD	0.01	1,220	1,110	1,170	1,167	4.7%	11.7	4.3%
OCDD	0.0001	14,700	13,000 *B,E*	13,900 *B,E*	13,867 *B,E*	6.1%	1.39	0.5%
2,3,7,8-TCDF	0.1	34.9	29.1 *D*	36.9	33.6	12%	3.36	1.3%
1,2,3,7,8-PeCDF	0.05	26.8	25.1	25.3	25.7	3.6%	1.29	0.5%
2,3,4,7,8-PeCDF	0.5	38.0	34.8	35.4	36.1	4.7%	18.0	6.7%
1,2,3,4,7,8-HxCDF	0.1	57.9	52.8	54.5	55.1	4.7%	5.51	2.0%
1,2,3,6,7,8-HxCDF	0.1	29.3 *D*	31.3 *D*	28.0 *D*	29.5 *D*	5.6%	2.95	1.1%
2,3,4,6,7,8-HxCDF	0.1	33.1	29.9	30.2	31.1	5.7%	3.11	1.2%
1,2,3,7,8,9-HxCDF	0.1	13.2	12.0	11.8	12.3	6.1%	1.23	0.5%
1,2,3,4,6,7,8-HpCDF	0.01	643	623	650 *D*	639	2.2%	6.39	2.4%
1,2,3,4,7,8,9-HpCDF	0.01	32.1	28.8	30.2	30.4	5.5%	0.304	0.1%
OCDF	0.0001	1,240	1,200	1,250	1,230	2.2%	0.123	0.05%
TEQ (pg/g)							**269**	
PCBs								
PCB-77	0.0001	145	--	--	145	--	0.0145	--
PCB-81	0.0001	20.7	--	--	20.7	--	0.00207	--
PCB-105	0.0001	590	--	--	590	--	0.059	--
PCB-114	0.0005	32.7	--	--	32.7	--	0.0164	--
PCB-106/118	0.0001	1,100	--	--	1,100	--	0.11	--
PCB-123	0.0001	32.1	--	--	32.1	--	0.00321	--
PCB-126	0.1	25.5	--	--	25.5	--	2.55	--
PCB-156	0.0005	151	--	--	151	--	0.0755	--
PCB-157	0.0005	47.6 [a]	--	--	47.6 [a]	--	0.0238	--
PCB-167	0.00001	63.4	--	--	63.4	--	0.000634	--
PCB-169	0.01	9.54 *U* [c]	--	--	9.54 *U* [c]	--	0.0954	--
PCB-189	0.0001	15.5	--	--	15.5	--	0.00155	--
TEQ (pg/g)							**2.95**	
Total TEQ (pg/g)							**272**	
Other Parameters								
Solids, Total (%)	--	--	--	--	99.2	--	--	--
pH (s.u.)	--	--	--	--	5.77	--	--	--
Carbon, Total Organic (%)	--	--	--	--	3.14	--	--	--
Grain Size (%)								
Coarse sand (250 µm – 2 mm)	--	--	--	--	31.1	--	--	--
Fine sand (106 – 250 µm)	--	--	--	--	44.9	--	--	--
Very fine sand (75 – 106 µm)	--	--	--	--	11.4	--	--	--
Percent silt (4 – 75 µm)	--	--	--	--	12.1	--	--	--
Percent clay (< 4 µm)	--	--	--	--	0.50	--	--	--

Table 2. (cont.)

Sample Location:		Imerman Park 2						
Sample ID:		THT02769						
Date:		7/8/2004						
Tag Number:		57273	57274	57275	Mean	Coefficient of		
Analyte	WHO TEF	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	Variability (%)	TEQ (pg/g)	% of TEQ
PCDDs/Fs								
2,3,7,8-TCDD	1	4.70	4.90	4.77	4.79	2.1%	4.79	0.6%
1,2,3,7,8-PeCDD	1	5.36 *J*	4.87	5.16	5.13	4.8%	5.13	0.6%
1,2,3,4,7,8-HxCDD	0.1	4.30 *J*	2.92 *U*[b]	3.60 *J*	3.61 *J*	19%	0.361	0.04%
1,2,3,6,7,8-HxCDD	0.1	26.3	18.7	17.9	21.0	22%	2.10	0.2%
1,2,3,7,8,9-HxCDD	0.1	8.04 *J*	7.30	7.68	7.67	4.8%	0.767	0.09%
1,2,3,4,6,7,8-HpCDD	0.01	490	383	346	406	18%	4.06	0.5%
OCDD	0.0001	4,540	3,820 *B*	3,530 *B*	3,963 *B*	13%	0.396	0.05%
2,3,7,8-TCDF	0.1	2,550 *E*	1,950	1,950	2,150	16%	215	25%
1,2,3,7,8-PeCDF	0.05	1,320	965	943	1,076	20%	53.8	6.3%
2,3,4,7,8-PeCDF	0.5	1,060	808	780	883	17%	441	52%
1,2,3,4,7,8-HxCDF	0.1	869	654	635	719	18%	71.9	8.5%
1,2,3,6,7,8-HxCDF	0.1	196 *D*	151 *D*	144 *D*	164 *D*	17%	16.4	1.9%
2,3,4,6,7,8-HxCDF	0.1	112	88.0	85.9	95.3	15%	9.53	1.1%
1,2,3,7,8,9-HxCDF	0.1	171	121	119	137	22%	13.7	1.6%
1,2,3,4,6,7,8-HpCDF	0.01	842	670	657 *D*	723	14%	7.23	0.9%
1,2,3,4,7,8,9-HpCDF	0.01	83.6	60.5	60.8	68.3	19%	0.683	0.08%
OCDF	0.0001	1,530	1,160	1,100	1,263	18%	0.126	0.01%
TEQ (pg/g)							**847**	
PCBs								
PCB-77	0.0001	42.0	--	--	42.0	--	0.0042	--
PCB-81	0.0001	10.0	--	--	10.0	--	0.001	--
PCB-105	0.0001	145	--	--	145	--	0.0145	--
PCB-114	0.0005	67.0	--	--	67.0	--	0.0335	--
PCB-106/118	0.0001	354	--	--	354	--	0.0354	--
PCB-123	0.0001	17.8	--	--	17.8	--	0.00178	--
PCB-126	0.1	10.3	--	--	10.3	--	1.03	--
PCB-156	0.0005	54.8	--	--	54.8	--	0.0274	--
PCB-157	0.0005	12.7	--	--	12.7	--	0.00635	--
PCB-167	0.00001	25.4	--	--	25.4	--	0.000254	--
PCB-169	0.01	9.60 *U*[c]	--	--	9.60 *U*[c]	--	0.096	--
PCB-189	0.0001	12.5	--	--	12.5	--	0.00125	--
TEQ (pg/g)							**1.25**	
Total TEQ (pg/g)							**849**	
Other Parameters								
Solids, Total (%)	--	--	--	--	98.9	--	--	--
pH (s.u.)	--	--	--	--	7.69	--	--	--
Carbon, Total Organic (%)	--	--	--	--	2.73	--	--	--
Grain Size (%)								
Coarse sand (250 µm – 2 mm)	--	--	--	--	42.1	--	--	--
Fine sand (106 – 250 µm)	--	--	--	--	26.8	--	--	--
Very fine sand (75 – 106 µm)	--	--	--	--	8.78	--	--	--
Percent silt (4 – 75 µm)	--	--	--	--	21.4	--	--	--
Percent clay (< 4 µm)	--	--	--	--	0.86	--	--	--

(notes appear on following page)

Table 2. (cont.)

Note: *B* – This compound was also detected in the method blank.
D – The amount reported is the maximum possible concentration due to possible chlorinated diphenylether interference.
E – The amount detected is above the Upper Calibration Limit of the instrument.
J – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor
Highlighting indicates the five congeners in each sample that contribute most to the total TEQ
If more than half of the results for a chemical were qualified with a *B*, *D*, *E*, or *J*, then the associated mean concentration was also qualified.

[a] Taken from a dilution of the extract.
[b] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).
[c] Nondetect reported to the reporting limit.

Table 3. PCDD/F concentrations in Rodent Lab Diet 5001 and corn oil

Sample ID:		Rodent Lab Diet 5001		Rodent Lab Diet 5001		Corn Oil (Spectrum Chemical)	
Date:		5/17/2004		8/25/2004		8/9/2004	
Analyte	WHO TEF	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/g)	TEQ (pg/g)
PCDDs/Fs							
2,3,7,8-TCDD	1	0.143 *U*	0.143	0.152 *U*	0.152	0.0576 *U*	0.0576
1,2,3,7,8-PeCDD	1	0.268 *U*	0.268	0.532 *U*	0.532	0.0617 *U*	0.0617
1,2,3,4,7,8-HxCDD	0.1	0.278 *U*	0.0278	0.262 *U*	0.0262	0.206 *U*	0.0206
1,2,3,6,7,8-HxCDD	0.1	0.295 *U*	0.0295	0.283 *U*	0.0283	0.246 *U*	0.0246
1,2,3,7,8,9-HxCDD	0.1	0.275 *U*	0.0275	0.266 *U*	0.0266	0.190 *U*	0.0190
1,2,3,4,6,7,8-HpCDD	0.01	0.541 *J*	0.00541	0.934 *J*	0.00934	0.753	0.00753
OCDD	0.0001	8.97 *J*	0.000897	10.5	0.00105	7.12	0.000712
2,3,7,8-TCDF	0.1	0.279 *U*	0.0279	0.144 *U*	0.0144	0.0605 *U*	0.00605
1,2,3,7,8-PeCDF	0.05	0.195 *U*	0.00975	0.370 *U*	0.0185	0.187 *U*	0.00935
2,3,4,7,8-PeCDF	0.5	0.190 *U*	0.095	0.333 *U*	0.1665	0.161 *U*	0.0805
1,2,3,4,7,8-HxCDF	0.1	0.136 *U*[a]	0.0136	0.175 *U*	0.0175	0.126 *U*	0.0126
1,2,3,6,7,8-HxCDF	0.1	0.0920 *U*	0.0092	0.170 *U*	0.017	0.127 *U*	0.0127
2,3,4,6,7,8-HxCDF	0.1	0.110 *U*	0.011	0.190 *U*	0.019	0.112 *U*	0.0112
1,2,3,7,8,9-HxCDF	0.1	0.0651 *U*	0.00651	0.263 *U*	0.0263	0.118 *U*	0.0118
1,2,3,4,6,7,8-HpCDF	0.01	0.136 *U*	0.00136	0.177 *U*	0.00177	0.420 *U*	0.00420
1,2,3,4,7,8,9-HpCDF	0.01	0.0913 *U*	0.000913	0.268 *U*	0.00268	0.495 *U*	0.00495
OCDF	0.0001	0.429 *J*	4.29E-05	0.526 *U*	5.26E-05	0.218 *U*	2.18E-05
TEQ (pg/g)			**0.677**		**1.059**		**0.345**

Note: *J* – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).

Table 4. PCDD/F and PCB concentrations in triplicate samples of blended rat diet

Sample ID:		Soil CC-S-27/Diet Blend (Test Article #1)					
Date:		8/25/2004					
		Pre-Dosing Analysis					
Analyte	WHO TEF	Bottom Concentration (pg/g)	Middle Concentration (pg/g)	Top Concentration (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	% of Expected Concentration
PCDDs/Fs							
2,3,7,8-TCDD	1	4.97	4.71	5.89	5.19	12%	79%
1,2,3,7,8-PeCDD	1	2.70	2.72 *J*	2.92	2.78	4.4%	83%
1,2,3,4,7,8-HxCDD	0.1	1.28 *J*	1.51 *J*	1.30 *U*[a]	1.36 *J*	9.3%	--
1,2,3,6,7,8-HxCDD	0.1	3.85	4.02	3.99	3.95	2.3%	107%
1,2,3,7,8,9-HxCDD	0.1	2.54 *J*	2.33 *J*	2.40 *J*	2.42 *J*	4.4%	--
1,2,3,4,6,7,8-HpCDD	0.01	74.6	75.6	78.3	76.2	2.5%	131%
OCDD	0.0001	921	973	929	941	3.0%	--
2,3,7,8-TCDF	0.1	1.27	1.15	1.71	1.38	21%	--
1,2,3,7,8-PeCDF	0.05	1.18 *J*	1.16 *J*	1.33 *J*	1.22 *J*	7.6%	--
2,3,4,7,8-PeCDF	0.5	1.59 *J*	1.67 *J*	1.52 *J*	1.59 *J*	4.7%	89%
1,2,3,4,7,8-HxCDF	0.1	2.63	2.53 *J*	2.58 *J*	2.58 *J*	1.9%	--
1,2,3,6,7,8-HxCDF	0.1	1.98 *J,D*	1.85 *J,D*	2.67 *D*	2.17 *J,D*	20%	--
2,3,4,6,7,8-HxCDF	0.1	1.33 *J*	1.28 *U*[a]	1.32 *J*	1.31 *J*	2.0%	--
1,2,3,7,8,9-HxCDF	0.1	0.633 *U*[a]	0.592 *J*	0.655 *J*	0.627 *J*	5.1%	--
1,2,3,4,6,7,8-HpCDF	0.01	30.1	28.2	29.9	29.4	3.6%	--
1,2,3,4,7,8,9-HpCDF	0.01	1.41 *J*	1.38 *J*	1.47 *J*	1.42 *J*	3.2%	--
OCDF	0.0001	64.9	62.2	65.8	64.3	2.9%	--
TEQ (pg/g)							
PCBs							
PCB-77	0.0001	--	7.62	--	7.62	--	--
PCB-81	0.0001	--	2.75 *U*[b]	--	2.75 *U*[b]	--	--
PCB-105	0.0001	--	49.5	--	49.5	--	--
PCB-114	0.0005	--	2.75 *U*[b]	--	2.75 *U*[b]	--	--
PCB-106/118	0.0001	--	129	--	129	--	--
PCB-123	0.0001	--	2.94	--	2.94	--	--
PCB-126	0.1	--	2.75 *U*[b]	--	2.75 *U*[b]	--	--
PCB-156	0.0005	--	16.3	--	16.3	--	--
PCB-157	0.0005	--	4.48	--	4.48	--	--
PCB-167	0.00001	--	7.68	--	7.68	--	--
PCB-169	0.01	--	2.75 *U*[b]	--	2.75 *U*[b]	--	--
PCB-189	0.0001	--	2.75 *U*[b]	--	2.75 *U*[b]	--	--
TEQ (pg/g)							
Total TEQ (pg/g)							

Table 4. (cont.)

Sample ID:	Soil CC-S-27/Diet Blend (Test Article #1)							
Date:	8/25/2004							
	Post-Dosing Analysis			Pre- and Post-Dosing Analysis				
Analyte	Concentration Rep 1 (pg/g)	Concentration Rep 2 (pg/g)	Concentration Rep 3 (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	TEQ (pg/g)	% of TEQ	% of Expected Concentration
PCDDs/Fs								
2,3,7,8-TCDD	3.57	3.78	3.46	4.40	22%	4.40	43%	67%
1,2,3,7,8-PeCDD	1.98 *J*	2.36 *J*	2.30 *J*	2.50 *J*	14%	2.50	24%	75%
1,2,3,4,7,8-HxCDD	1.19 *J*	1.85 *J*	1.24 *J*	1.40 *J*	18%	0.140	1.4%	--
1,2,3,6,7,8-HxCDD	2.83 *J*	3.88 *J*	2.94 *J*	3.59	15%	0.359	3.5%	97%
1,2,3,7,8,9-HxCDD	1.94 *J*	3.42 *J*	1.91 *J*	2.42 *J*	23%	0.242	2.4%	--
1,2,3,4,6,7,8-HpCDD	57.5	78.1	57.1	70.2	14%	0.702	6.9%	120%
OCDD	774	893	783	879	9.3%	0.088	0.9%	--
2,3,7,8-TCDF	0.960 *J*	1.10	0.904 *J*	1.18	25%	0.118	1.2%	--
1,2,3,7,8-PeCDF	0.832 *U*[a]	1.03 *J*	0.839 *J*	1.06 *J*	19%	0.0530	0.5%	--
2,3,4,7,8-PeCDF	1.34 *J*	1.35 *J*	1.25 *J*	1.45 *J*	11%	0.725	7.1%	81%
1,2,3,4,7,8-HxCDF	2.30 *J*	2.09 *J*	2.28 *J*	2.40 *J*	8.8%	0.240	2.3%	--
1,2,3,6,7,8-HxCDF	1.22 *J*	1.07 *J*	1.13 *J*	1.65 *J*	38%	0.165	1.6%	--
2,3,4,6,7,8-HxCDF	1.08 *J*	1.06 *J*	1.21 *J*	1.21 *J*	9.8%	0.121	1.2%	--
1,2,3,7,8,9-HxCDF	0.607 *J*	0.535 *J*	0.571 *U*	0.599 *J*	7.2%	0.0599	0.6%	--
1,2,3,4,6,7,8-HpCDF	28.2	29.8	27.5	29.0	3.8%	0.290	2.8%	--
1,2,3,4,7,8,9-HpCDF	1.31 *J*	1.69 *J*	1.53 *J*	1.47 *J*	9.1%	0.0147	0.1%	--
OCDF	60.3	62.7	59.0	62.5	4.2%	0.00625	0.1%	--
TEQ (pg/g)						**10.2**		
PCBs								
PCB-77	--	--	--	7.62	--	0.00076	--	--
PCB-81	--	--	--	2.75 *U*[b]	--	0.00028	--	--
PCB-105	--	--	--	49.5	--	0.00495	--	--
PCB-114	--	--	--	2.75 *U*[b]	--	0.00138	--	--
PCB-106/118	--	--	--	129	--	0.0129	--	--
PCB-123	--	--	--	2.94	--	0.00029	--	--
PCB-126	--	--	--	2.75 *U*[b]	--	0.275	--	--
PCB-156	--	--	--	16.3	--	0.00815	--	--
PCB-157	--	--	--	4.48	--	0.00224	--	--
PCB-167	--	--	--	7.68	--	7.7E-05	--	--
PCB-169	--	--	--	2.75 *U*[b]	--	0.0275	--	--
PCB-189	--	--	--	2.75 *U*[b]	--	0.00028	--	--
TEQ (pg/g)						**0.33**		
Total TEQ (pg/g)						**10.56**		

Table 4. (cont.)

Sample ID: / Date:		Soil THT02769/Diet Blend (Test Article #2) 8/4/2004					
		Pre-Dosing Analysis					
Analyte	WHO TEF	Bottom Concentration (pg/g)	Middle Concentration (pg/g)	Top Concentration (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	% of Expected Concentration
PCDDs/Fs							
2,3,7,8-TCDD	1	0.308 *J*	0.217 *U*[a]	0.258 *U*[a]	0.261 *U*[a]	17%	--
1,2,3,7,8-PeCDD	1	0.280 *J*	0.282 *U*[a]	0.240 *U*[a]	0.267 *U*[a]	8.9%	--
1,2,3,4,7,8-HxCDD	0.1	0.307 *U*	0.214 *J*	0.226 *J*	0.249 *J*	20%	--
1,2,3,6,7,8-HxCDD	0.1	1.33 *J*	1.21 *J*	1.34 *J*	1.29 *J*	5.6%	--
1,2,3,7,8,9-HxCDD	0.1	0.493 *J*	0.440 *J*	0.474 *J*	0.469 *J*	5.7%	--
1,2,3,4,6,7,8-HpCDD	0.01	24.7	23.3	26.0	24.7	5.5%	--
OCDD	0.0001	245	223 *B*	255 *B*	241 *B*	6.8%	--
2,3,7,8-TCDF	0.1	77.2	79.5	88.4	81.7	7.2%	76%
1,2,3,7,8-PeCDF	0.05	50.6	47.8	52.3	50.2	4.5%	93%
2,3,4,7,8-PeCDF	0.5	43.7	41.2	45.5	43.5	5.0%	98%
1,2,3,4,7,8-HxCDF	0.1	35.4	32.1 *B*	34.5 *B*	34.0 *B*	5.0%	95%
1,2,3,6,7,8-HxCDF	0.1	9.48	7.33 *B,D*	7.79 *B*	8.20 *B*	14%	100%
2,3,4,6,7,8-HxCDF	0.1	4.70	4.23	4.56	4.50	5.4%	--
1,2,3,7,8,9-HxCDF	0.1	6.79	6.07	6.47	6.44	5.6%	--
1,2,3,4,6,7,8-HpCDF	0.01	37.8	32.8 *B*	35.7 *B*	35.4 *B*	7.1%	--
1,2,3,4,7,8,9-HpCDF	0.01	3.52	2.99	3.36	3.29	8.3%	--
OCDF	0.0001	70.4	60.8	68.4	66.5	7.6%	--
TEQ (pg/g)							
PCBs							
PCB-77	0.0001	--	5.04	--	5.04	--	--
PCB-81	0.0001	--	2.71 *U*[b]	--	2.71 *U*[b]	--	--
PCB-105	0.0001	--	33.8	--	33.8	--	--
PCB-114	0.0005	--	3.47	--	3.47	--	--
PCB-106/118	0.0001	--	101	--	101	--	--
PCB-123	0.0001	--	2.71 *U*[b]	--	2.71 *U*[b]	--	--
PCB-126	0.1	--	2.71 *U*[b]	--	2.71 *U*[b]	--	--
PCB-156	0.0005	--	12.2	--	12.2	--	--
PCB-157	0.0005	--	3.32	--	3.32	--	--
PCB-167	0.00001	--	6.41	--	6.41	--	--
PCB-169	0.01	--	2.71 *U*[b]	--	2.71 *U*[b]	--	--
PCB-189	0.0001	--	2.71 *U*[b]	--	2.71 *U*[b]	--	--
TEQ (pg/g)							
Total TEQ (pg/g)							

Table 4. (cont.)

Sample ID:	Soil THT02769/Diet Blend (Test Article #2)							
Date:	8/4/2004							
	Post-Dosing Analysis			Pre- and Post-Dosing Analysis				
Analyte	Concentration Rep 1 (pg/g)	Concentration Rep 2 (pg/g)	Concentration Rep 3 (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	TEQ (pg/g)	% of TEQ	% of Expected Concentration
PCDDs/Fs								
2,3,7,8-TCDD	0.330 *J*	0.532 *U*	0.284 *U*[a]	0.322 *U*	34%	0.322	0.8%	--
1,2,3,7,8-PeCDD	0.264 *U*[a]	0.293 *U*[a]	0.371 *J*	0.288 *U*	15%	0.288	0.7%	--
1,2,3,4,7,8-HxCDD	0.482 *U*	0.510 *U*	0.442 *U*	0.364 *U*	36%	0.0364	0.1%	--
1,2,3,6,7,8-HxCDD	0.991 *J*	1.09 *J*	0.954 *J*	1.15 *J*	14%	0.115	0.3%	--
1,2,3,7,8,9-HxCDD	0.631 *U*	0.468 *J*	0.836 *U*	0.557 *J*	27%	0.0557	0.1%	--
1,2,3,4,6,7,8-HpCDD	22.5	22.6	23.2	23.7	5.8%	0.237	0.6%	--
OCDD	235	230	231	237	4.9%	0.0237	0.1%	--
2,3,7,8-TCDF	83.9	87.2	86.1	83.7	5.3%	8.37	21%	78%
1,2,3,7,8-PeCDF	51.7	52.0	51.4	51.0	3.3%	2.55	6.4%	95%
2,3,4,7,8-PeCDF	44.1	44.6	44.4	43.9	3.3%	22.0	55%	99%
1,2,3,4,7,8-HxCDF	33.8	35.2	34.0	34.2	3.5%	3.42	8.6%	95%
1,2,3,6,7,8-HxCDF	8.29	8.73	9.08	8.45	9.5%	0.845	2.1%	103%
2,3,4,6,7,8-HxCDF	4.65 *J*	4.82 *J*	4.86 *J*	4.64	4.9%	0.464	1.2%	--
1,2,3,7,8,9-HxCDF	6.45	7.43	6.78	6.67	6.9%	0.667	1.7%	--
1,2,3,4,6,7,8-HpCDF	34.7	35.9	35.7	35.4	4.6%	0.354	0.9%	--
1,2,3,4,7,8,9-HpCDF	3.41 *J*	3.62 *J*	3.76 *J*	3.44	7.7%	0.0344	0.1%	--
OCDF	73.5	74.6	73.0	70.1	7.3%	0.00701	0.02%	--
TEQ (pg/g)						**39.7**		
PCBs								
PCB-77	--	--	--	5.04	--	0.000504	--	--
PCB-81	--	--	--	2.71 *U*[b]	--	0.000271	--	--
PCB-105	--	--	--	33.8	--	0.00338	--	--
PCB-114	--	--	--	3.47	--	0.00174	--	--
PCB-106/118	--	--	--	101	--	0.0101	--	--
PCB-123	--	--	--	2.71 *U*[b]	--	0.000271	--	--
PCB-126	--	--	--	2.71 *U*[b]	--	0.271	--	--
PCB-156	--	--	--	12.2	--	0.00610	--	--
PCB-157	--	--	--	3.32	--	0.00166	--	--
PCB-167	--	--	--	6.41	--	6.41E-05	--	--
PCB-169	--	--	--	2.71 *U*[b]	--	0.0271	--	--
PCB-189	--	--	--	2.71 *U*[b]	--	0.000271	--	--
TEQ (pg/g)						**0.32**		
Total TEQ (pg/g)						**40.1**		

Table 4. (cont.)

Sample ID: / Date:		Acetone Reference Mixture/Feed Blend (Test Article #3) 8/4/2004					
		Pre-Dosing Analysis					
Analyte	WHO TEF	Bottom Concentration (pg/g)	Middle Concentration (pg/g)	Top Concentration (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	% of Expected Concentration
PCDDs/Fs							
2,3,7,8-TCDD	1	5.56	5.30	5.44	5.43	2.4%	83%
1,2,3,7,8-PeCDD	1	3.29	3.38	3.47	3.38	2.7%	101%
1,2,3,4,7,8-HxCDD	0.1	0.0566 *U*	0.0629 *U*	0.0962 *U*	0.0719 *U*	30%	--
1,2,3,6,7,8-HxCDD	0.1	4.37	4.23	4.49	4.36	3.0%	118%
1,2,3,7,8,9-HxCDD	0.1	0.222 *J*	0.218 *J*	0.219 *J*	0.220 *J*	0.9%	--
1,2,3,4,6,7,8-HpCDD	0.01	55.1	54.9	55.9	55.3	1.0%	95%
OCDD	0.0001	8.66 *B*	8.54 *B*	8.99 *B*	8.73 *B*	2.7%	--
2,3,7,8-TCDF	0.1	0.0834 *J*	0.0934 *J*	0.0910 *J*	0.0893 *J*	5.8%	--
1,2,3,7,8-PeCDF	0.05	0.0533 *U*	0.0454 *U*	0.0414 *U*	0.0467 *U*	13%	--
2,3,4,7,8-PeCDF	0.5	1.87 *J*	1.82 *J*	1.87 *J*	1.85 *J*	1.6%	104%
1,2,3,4,7,8-HxCDF	0.1	0.0235 *U*	0.0244 *U*	0.0298 *U*	0.0259 *U*	13%	--
1,2,3,6,7,8-HxCDF	0.1	0.0251 *U*	0.0233 *U*	0.0297 *U*	0.0260 *U*	13%	--
2,3,4,6,7,8-HxCDF	0.1	0.0277 *U*	0.0265 *U*	0.0331 *U*	0.0291 *U*	12%	--
1,2,3,7,8,9-HxCDF	0.1	0.0363 *U*	0.0381 *U*	0.0435 *U*	0.0393 *U*	9.5%	--
1,2,3,4,6,7,8-HpCDF	0.01	0.115 *J,B*	0.0805 *J,B*	0.156 *U*	0.117 *J*	32%	--
1,2,3,4,7,8,9-HpCDF	0.01	0.0776 *U*	0.0469 *U*	0.168 *U*	0.0975 *U*	65%	--
OCDF	0.0001	0.167 *J*	0.156 *U*[a]	0.168 *J*	0.164 *J*	4.1%	--
TEQ (pg/g)							
PCBs							
PCB-77	0.0001	--	3.44	--	3.44	--	--
PCB-81	0.0001	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
PCB-105	0.0001	--	31.1	--	31.1	--	--
PCB-114	0.0005	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
PCB-106/118	0.0001	--	91.6	--	91.6	--	--
PCB-123	0.0001	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
PCB-126	0.1	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
PCB-156	0.0005	--	10.8	--	10.8	--	--
PCB-157	0.0005	--	3.07	--	3.07	--	--
PCB-167	0.00001	--	5.50	--	5.50	--	--
PCB-169	0.01	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
PCB-189	0.0001	--	2.90 *U*[b]	--	2.90 *U*[b]	--	--
TEQ (pg/g)							
Total TEQ (pg/g)							

Table 4. (cont.)

Sample ID:	Acetone Reference Mixture/Feed Blend (Test Article #3)							
Date:	8/4/2004							
	Post-Dosing Analysis			Pre- and Post-Dosing Analysis				
Analyte	Concentration Rep 1 (pg/g)	Concentration Rep 2 (pg/g)	Concentration Rep 3 (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	TEQ (pg/g)	% of TEQ	% of Expected Concentration
PCDDs/Fs								
2,3,7,8-TCDD	5.64	5.67	5.63	5.54	2.6%	5.54	50%	84%
1,2,3,7,8-PeCDD	3.57 *J*	3.47 *J*	3.83 *J*	3.50	5.3%	3.50	31%	105%
1,2,3,4,7,8-HxCDD	0.646 *U*	0.580 *U*	0.272 *U*	0.286 *U*	93.2%	0.0286	0.3%	--
1,2,3,6,7,8-HxCDD	4.65 *J*	4.58 *J*	4.63 *J*	4.49	3.7%	0.449	4.0%	121%
1,2,3,7,8,9-HxCDD	0.688 *U*	0.474 *U*	0.691 *U*	0.419	55.4%	0.0419	0.4%	--
1,2,3,4,6,7,8-HpCDD	56.7	55.1	55.7	55.6	1.2%	0.556	5.0%	95%
OCDD	8.22 *J*	8.76 *J*	9.07 *J*	8.71	3.6%	0.000871	0.008%	--
2,3,7,8-TCDF	0.365 *U*	0.440 *U*	0.155 *J*	0.205 *J*	76.8%	0.0205	0.2%	--
1,2,3,7,8-PeCDF	0.380 *U*	0.445 *U*	0.509 *U*	0.246 *U*	90.3%	0.0123	0.1%	--
2,3,4,7,8-PeCDF	1.81 *J*	2.11 *J*	1.98 *J*	1.91 *J*	6.0%	0.955	8.6%	107%
1,2,3,4,7,8-HxCDF	0.139 *U*	0.129 *U*	0.0958 *U*	0.0736 *U*	73.7%	0.00736	0.1%	--
1,2,3,6,7,8-HxCDF	0.0898 *U*	0.129 *U*	0.0961 *U*	0.0655 *U*	69.1%	0.00655	0.1%	--
2,3,4,6,7,8-HxCDF	0.121 *U*	0.137 *U*	0.105 *U*	0.0751 *U*	68.5%	0.00751	0.1%	--
1,2,3,7,8,9-HxCDF	0.104 *U*	0.185 *U*	0.142 *U*	0.0915 *U*	68.5%	0.00915	0.1%	--
1,2,3,4,6,7,8-HpCDF	0.212 *U*	0.236 *U*	0.246 *U*	0.174 *U*	38.9%	0.00174	0.0%	--
1,2,3,4,7,8,9-HpCDF	0.116 *U*	0.154 *U*	0.236 *U*	0.133 *U*	51.0%	0.00133	0.0%	--
OCDF	0.737 *U*	1.27 *U*	0.577 *U*	0.513 *U*	87.0%	5.13E-05	0.0%	--
TEQ (pg/g)						**11.1**		
PCBs								
PCB-77	--	--	--	3.44	--	0.000344	--	--
PCB-81	--	--	--	2.90 *U*[b]	--	0.00029	--	--
PCB-105	--	--	--	31.1	--	0.00311	--	--
PCB-114	--	--	--	2.90 *U*[b]	--	0.00145	--	--
PCB-106/118	--	--	--	91.6	--	0.00916	--	--
PCB-123	--	--	--	2.90 *U*[b]	--	0.00029	--	--
PCB-126	--	--	--	2.90 *U*[b]	--	0.290	--	--
PCB-156	--	--	--	10.8	--	0.0054	--	--
PCB-157	--	--	--	3.07	--	0.00154	--	--
PCB-167	--	--	--	5.50	--	0.000055	--	--
PCB-169	--	--	--	2.90 *U*[b]	--	0.029	--	--
PCB-189	--	--	--	2.90 *U*[b]	--	0.00029	--	--
TEQ (pg/g)						**0.34**		
Total TEQ (pg/g)						**11.5**		

Note: *B* – This compound was also detected in the method blank.
D – The amount reported is the maximum possible concentration due to possible chlorinated diphenylether interference.
J – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor
Highlighting indicates the five congeners in each sample that contribute most to the total TEQ
If more than half of the results for a chemical were qualified with a *B*, *D*, or *J*, then the associated mean concentration was also qualifi

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).
[b] Nondetect reported to the reporting limit.

Table 5. Analytical results for reference mixtures used in rat study

Compound	Initial Concentration (µg/mL)	Amount Spiked (µg/L)	Target Concentration (ng/mL)	Measured Concentration, Pre-Dosing (ng/mL)	Relative Percent Difference[a]	Measured Concentration, Post-Dosing (ng/mL)	Average Measured Concentration[b] (ng/mL)	Coefficient of Variability[c] (%)
Acetone Reference Mixture								
2,3,7,8-TCDD	--	--	0.625	0.664	6.1%	--	--	--
1,2,3,7,8-PeCDD	--	--	0.318	0.346	8.4%	--	--	--
1,2,3,6,7,8-HxCDD	--	--	0.349	0.492	34%	--	--	--
1,2,3,4,6,7,8-HpCDD	--	--	5.54	6.15	10%	--	--	--
2,3,4,7,8-PeCDD	--	--	0.172	0.178	3.4%	--	--	--
Gavage Reference Mixture No. 1 (Alta ID: 040812A)								
2,3,7,8-TCDD	5.0	60.4	0.151	0.142	6.1%	0.114	0.128	15%
1,2,3,7,8-PeCDD	5.0	30.8	0.077	0.079	2.6%	0.0690	0.0740	10%
1,2,3,6,7,8-HxCDD	5.0	33.8	0.084	0.122	37%	0.0901	0.106	21%
1,2,3,4,6,7,8-HpCDD	5.0	536.6	1.342	1.475	9.4%	1.18	1.33	16%
2,3,4,7,8-PeCDF	5.0	16.6	0.042	0.039	7.4%	0.0404	0.0397	2.5%
Gavage Reference Mixture No. 2 (Alta ID: 040812B)								
2,3,7,8-TCDF	50	98.9	2.473	2.655	7.1%	2.04	2.35	19%
1,2,3,7,8-PeCDF	50	49.5	1.238	1.185	4.4%	1.16	1.17	1.5%
2,3,4,7,8-PeCDF	50	40.6	1.015	0.963	5.3%	0.945	0.954	1.3%
1,2,3,4,7,8-HxCDF	5.0	330.8	0.827	0.806	2.6%	0.809	0.808	0.3%
1,2,3,6,7,8-HxCDF	5.0	75.2	0.188	0.214	13%	0.210	0.212	1.3%

[a] The relative percent difference (RPD) between the target and pre-dosing measured concentrations is calculated as the absolute value of the difference divided by the average of the target and pre-dosing measured concentrations.

[b] Average of pre- and post-dosing measured concentrations.

[c] Coefficient of variability between pre- and post-dosing measured concentrations.

Table 6. Analytical results for reference mixtures used in swine study

Compound	Initial Concentration (µg/mL)	Amount Used (µg/L)	Target Concentration (ng/mL)	Measured Concentration, Pre-Dosing (ng/mL)	Relative Percent Difference[a]	Measured Concentration, Post-Dosing (ng/mL)	Average Measured Concentration[b] (ng/mL)	Coefficient of Variability[c] (%)
Swine Reference Oil Mixture No. 1 (Alta ID: 040922A)								
2,3,7,8-TCDD	5.0	131.40	0.328	0.332	1.2%	0.446	0.389	21%
1,2,3,7,8-PeCDD	5.0	66.80	0.167	0.145	14%	0.208	0.177	25%
1,2,3,6,7,8-HxCDD	5.0	73.60	0.184	0.194	5.3%	0.270	0.232	23%
1,2,3,4,6,7,8-HpCDD	50	116.66	2.916	2.385	20%	3.58	2.98	28%
2,3,4,7,8-PeCDF	5.0	36.00	0.090	0.0840	6.9%	0.112	0.0980	20%
Swine Reference Oil Mixture No. 2 (Alta ID:040922B)								
2,3,7,8-TCDF	50	215.00	5.375	4.36	21%	5.44	4.90	16%
1,2,3,7,8-PeCDF	50	107.60	2.690	2.63	2.3%	3.24	2.94	15%
2,3,4,7,8-PeCDF	50	88.26	2.206	2.26	2.2%	2.75	2.50	14%
1,2,3,4,7,8-HxCDF	50	71.94	1.798	1.86	3.1%	2.12	1.99	9.4%
1,2,3,6,7,8-HxCDF	50	16.36	0.409	0.452	10%	0.528	0.490	11%

[a] The relative percent difference (RPD) between the target and pre-dosing measured concentrations is calculated as the absolute value of the difference divided by the average of the target and pre-dosing measured concentrations.

[b] Average of pre- and post-dosing measured concentrations.

[c] Coefficient of variability between pre- and post-dosing measured concentrations.

Table 7. Dose groups and test materials used in the rat pilot study

Dose Group	Test Material Name/ID	Description
1	Gavage Reference Mixture No. 1 (Alta ID: 040812A)	Oral gavage (Midland soil match in corn oil/acetone)
2	Gavage Reference Mixture No. 2 (Alta ID: 040812B)	Oral gavage (Tittabawassee River flood plain soil match in corn oil/acetone)
3	Test Article #1 (soil CC-S-27 in diet)	Midland soil blended with diet
4	Test Article #2 (soil THT02769 in diet)	Tittabawassee River flood plain soil blended with diet
5	Test Article #3 (acetone reference mixture 040728A in diet)	Feed control (Midland soil reference mixture blended with diet)

Table 8. Dose groups and test materials used in the swine pilot study

Dose Group	Test Material Name/ID	Description
1	Swine Reference Mixture No. 1 (Alta ID: 040922A)	Corn oil/acetone in gel capsules (4 mL/day)
2	Swine Reference Mixture No. 2 (Alta ID: 040922B)	Corn oil/acetone in gel capsules (4 mL /day)
3	Midland Soil (CC-S-27)	Midland soil (10 g/day)
4	Tittibawassee River flood plain soil (THT02769)	Tittibawassee River flood plain soil (10 g/day)

Table 9. Average daily doses administered to rats

	WHO TEF	Number of Animals per Group	Soil/Feed Mixture Average Daily Dose (ng/kg bw/day) Mean	S.D.	TEQ	Reference Corn Oil Gavage Average Daily Dose (ng/kg bw/day) Mean	S.D.	TEQ	Reference Feed Average Daily Dose (ng/kg bw/day) Mean	S.D.	TEQ
Midland Soil		10[a]									
2,3,7,8-TCDD	1		0.302	0.017	0.302	0.511	0.014	0.511	0.352	0.024	0.352
1,2,3,7,8-PeCDD	1		0.172	0.0096	0.172	0.295	0.0081	0.295	0.222	0.015	0.222
1,2,3,6,7,8-HxCDD	0.1		0.247	0.014	0.0247	0.423	0.012	0.0423	0.285	0.019	0.0285
1,2,3,4,6,7,8-HpCDD	0.01		4.82	0.27	0.0482	5.31	0.14	0.0531	3.53	0.24	0.0353
2,3,4,7,8-PeCDF	0.5		0.100	0.0056	0.0498	0.158	0.0043	0.0792	0.121	0.0081	0.0607
Total Mean TEQ Dose:			--	--	**0.597**	--	--	**0.981**	--	--	**0.699**
Tittabawassee River Flood Plain Soil		10[a,b]									
2,3,7,8-TCDF	0.1		6.43	0.37	0.643	8.84	1.7	0.884	--	--	--
1,2,3,7,8-PeCDF	0.05		3.92	0.23	0.196	4.40	0.84	0.220	--	--	--
2,3,4,7,8-PeCDF	0.5		3.37	0.20	1.69	3.59	0.68	1.79	--	--	--
1,2,3,4,7,8-HxCDF	0.01		2.63	0.15	0.0263	3.04	0.58	0.0304	--	--	--
1,2,3,6,7,8-HxCDF	0.01		0.649	0.038	0.0065	0.798	0.15	0.0080	--	--	--
Total Mean TEQ Dose:			--	--	**2.56**	--	--	**2.94**	--	--	--

Notes:

WHO TEF – World Health Organization Toxicity Equivalence Factor
S.D. – Standard deviation
TEQ – Toxicity Equivalence Concentration

[a] Tissue samples from rats were grouped into pairs for each analysis to acheive adequate sample mass, resulting in a sample size of 5 for each tissue analysis.

[b] Two rats from the Tittabawassee River flood plain soil corn oil gavage reference group (Group 2) died early and were excluded from calculations of average daily dose and RBA estimates.

Table 10. Summary of EROD and MROD liver microsomal activity data

		Liver Microsomal Activities (pmol/mg/min)				
	N	Minimum	Maximum	Mean	S.D.	p-value[a]
Rat						
EROD						
Midland Soil (Group 3)	5	63	99	83	14	--
Midland Reference Oil (Group 1)	5	116	257	169	53	**0.0194**
Midland Reference Feed (Group 5)	5	121	153	140	15	**0.0002**
Tittabawassee River Flood Plain Soil (Group 4)	5	261	361	319	39	--
Tittabawassee River Flood Plain Soil Reference Oil (Group 2)	4	407	486	444	34	**0.0015**
MROD						
Midland Soil (Group 3)	5	81	120	101	16	--
Midland Reference Oil (Group 1)	5	95	121	108	9.2	0.4006
Midland Reference Feed (Group 5)	5	96	139	122	17	0.0824
Tittabawassee River Flood Plain Soil (Group 4)	5	139	198	168	28	--
Tittabawassee River Flood Plain Soil Reference Oil (Group 2)	4	69	209	163	64	0.8779
Swine						
EROD						
Midland Soil (Group 3)	5	20	27	25	3	--
Midland Reference Oil (Group 1)	5	4	44	25	16	0.9567
Tittabawassee River Flood Plain Soil (Group 4)	4	15	47	28	14	--
Tittabawassee River Flood Plain Soil Reference Oil (Group 2)	5	32	39	35	3.1	0.3729
MROD						
Midland Soil (Group 3)	5	84	138	114	24	--
Midland Reference Oil (Group 1)	5	40	148	95	53	0.4867
Tittabawassee River Flood Plain Soil (Group 4)	4	82	131	97	23	--
Tittabawassee River Flood Plain Soil Reference Oil (Group 2)	5	84	169	123	39	0.2779

Notes: EROD – ethoxyresorufin O-deethylase
MROD – methoxyresorufin O-deethylase
S.D. – standard deviation

[a] Reference groups compared to corresponding soil groups using standard t-tests; p-values reported are unadjusted. Bolded values indicate a significant difference. Comparisons using Wilcox non-parametric test provided identical conclusions.

Table 11. Sensitivity of analytical limits for the rat pilot study

Dosing Group/ Chemical	Liver Number of Analyses	Liver Results Below DL (U)	Liver Results Below EMPC (Um)	Liver Results Below LCL (J)	Adipose Number of Analyses	Adipose Results Below DL (U)	Adipose Results Below EMPC (Um)	Adipose Results Below LCL (J)
Midland Soil (Group 3)								
2,3,7,8-TCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
1,2,3,6,7,8-HxCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
1,2,3,4,6,7,8-HpCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
All chemicals	**25**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**25**	**0 (0%)**	**0 (0%)**	**15 (60%)**
Midland Gavage Oil Reference (Group 1)								
2,3,7,8-TCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,4,6,7,8-HpCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
All chemicals	**25**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**25**	**0 (0%)**	**0 (0%)**	**5 (20%)**
Midland Soil Reference (Group 5)								
2,3,7,8-TCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	4 (80%)
1,2,3,4,6,7,8-HpCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
All chemicals	**25**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**25**	**0 (0%)**	**0 (0%)**	**9 (36%)**
Tittabawassee River Flood Plain Soil (Group 4)								
2,3,7,8-TCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,4,7,8-HxCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	5 (100%)
All chemicals	**25**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**25**	**0 (0%)**	**0 (0%)**	**5 (20%)**
Tittabawassee River Flood Plain Soil Reference (Group 2)[a]								
2,3,7,8-TCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
1,2,3,4,7,8-HxCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
All chemicals	**20**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**20**	**0 (0%)**	**0 (0%)**	**0 (0%)**

Notes:

DL – detection limit (sample specific)
EMPC – estimated maximum possible concentration
LCL – lower calibration limit of the analytical instrument
U – not detected at the sample-specific detection limit
Um – not detected at the EMPC
J – amount detected is below the LCL

[a] Summary values exclude results for the pair of rats that died before the end of the study (Rats #24 and 29).

Table 12. Summary of relative bioavailability estimates for the rat study

	Fraction of Administered Dose Retained									RBA Estimates					
	Liver			Adipose			Liver + Adipose			Liver		Adipose		Liver + Adipose	
Analyte	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
Midland Soil (Group 3)															
2,3,7,8-TCDD	0.042	0.003	7%	0.120	0.016	14%	0.162	0.017	11%						
1,2,3,7,8-PeCDD	0.093	0.006	7%	0.113	0.016	14%	0.206	0.016	8%						
1,2,3,6,7,8-HxCDD	0.166	0.012	7%	0.065	0.008	12%	0.230	0.016	7%						
1,2,3,4,6,7,8-HpCDD	0.089	0.006	7%	0.015	0.002	13%	0.104	0.007	6%						
2,3,4,7,8-PeCDF	0.273	0.017	6%	0.042	0.006	15%	0.315	0.018	6%						
Midland Reference Feed (Group 5)										**Soil vs. Reference Feed**					
2,3,7,8-TCDD	0.110	0.012	11%	0.263	0.030	12%	0.373	0.042	11%	38%	13%	46%	18%	43%	16%
1,2,3,7,8-PeCDD	0.191	0.018	9%	0.182	0.022	12%	0.373	0.039	10%	48%	12%	62%	19%	55%	13%
1,2,3,6,7,8-HxCDD	0.279	0.022	8%	0.080	0.014	18%	0.359	0.033	9%	60%	11%	80%	22%	64%	11%
1,2,3,4,6,7,8-HpCDD	0.159	0.012	7%	0.021	0.003	14%	0.180	0.014	8%	56%	10%	72%	19%	58%	10%
2,3,4,7,8-PeCDF	0.560	0.046	8%	0.063	0.006	10%	0.623	0.051	8%	49%	10%	65%	18%	50%	10%
Midland Reference Gavage (Group 1)										**Soil vs. Reference Gavage**					
2,3,7,8-TCDD	0.139	0.009	7%	0.319	0.017	5%	0.458	0.020	4%	30%	9%	38%	15%	35%	12%
1,2,3,7,8-PeCDD	0.265	0.009	3%	0.250	0.016	6%	0.515	0.013	3%	35%	8%	45%	16%	40%	8%
1,2,3,6,7,8-HxCDD	0.376	0.015	4%	0.117	0.011	9%	0.493	0.014	3%	44%	8%	55%	15%	47%	7%
1,2,3,4,6,7,8-HpCDD	0.265	0.009	3%	0.041	0.005	13%	0.306	0.012	4%	34%	7%	36%	18%	34%	8%
2,3,4,7,8-PeCDF	0.710	0.027	4%	0.086	0.008	9%	0.796	0.022	3%	38%	7%	48%	18%	40%	6%
Tittabawassee River Flood Plain Soil (Group 4)															
2,3,7,8-TCDF	0.065	0.006	10%	0.049	0.010	19%	0.114	0.015	13%						
1,2,3,7,8-PeCDF	0.084	0.007	8%	0.032	0.005	15%	0.117	0.010	9%						
2,3,4,7,8-PeCDF	0.394	0.021	5%	0.031	0.004	12%	0.425	0.022	5%						
1,2,3,4,7,8-HxCDF	0.312	0.017	5%	0.029	0.003	9%	0.341	0.017	5%						
1,2,3,6,7,8-HxCDF	0.327	0.022	7%	0.028	0.003	9%	0.355	0.024	7%						
Tittabawassee River Flood Plain Soil Reference Gavage (Group 2)										**Soil vs. Reference Gavage**					
2,3,7,8-TCDF	0.072	0.004	5%	0.055	0.003	5%	0.127	0.006	5%	90%	11%	89%	20%	89%	14%
1,2,3,7,8-PeCDF	0.142	0.008	6%	0.060	0.007	11%	0.202	0.014	7%	59%	10%	54%	19%	58%	11%
2,3,4,7,8-PeCDF	0.750	0.036	5%	0.061	0.007	12%	0.811	0.040	5%	52%	7%	52%	17%	52%	7%
1,2,3,4,7,8-HxCDF	0.545	0.017	3%	0.055	0.008	14%	0.599	0.020	3%	57%	6%	54%	16%	57%	6%
1,2,3,6,7,8-HxCDF	0.582	0.032	6%	0.051	0.007	14%	0.633	0.034	5%	56%	9%	55%	17%	56%	9%

Notes: One outlier excluded from Group 4 for 1,2,3,6,7,8-HxCDF. See text for details

RBA – relative bioavailability, calculated as: Fraction of administered dose retained$_{\text{test material}}$ / Fraction of administered dose retained$_{\text{reference material}}$

S.D. – standard deviation

C.V. – coefficient of variability

For fraction of administered dose retained: C.V. = Standard Deviation / Mean

For RBA estimates: C.V. = $(CV_{soil}^{2} + CV_{reference}^{2})^{0.5}$

Table 13. Average daily doses administered to swine

	WHO TEF	Number of Animals per Group	Soil/Feed Mixture Average Daily Dose (ng/kg bw/day) Mean	S.D.	TEQ	Reference Corn Oil Average Daily Dose (ng/kg bw/day) Mean	S.D.	TEQ
Midland Soil		5						
2,3,7,8-TCDD	1		0.0699	0.0024	0.0699	0.0807	0.0038	0.0807
1,2,3,7,8-PeCDD	1		0.0356	0.0012	0.0356	0.0367	0.0017	0.0367
1,2,3,6,7,8-HxCDD	0.1		0.0391	0.0013	0.0039	0.0482	0.0023	0.0048
1,2,3,4,6,7,8-HpCDD	0.01		0.621	0.021	0.0062	0.619	0.029	0.0062
2,3,4,7,8-PeCDF	0.5		0.0192	0.0006	0.0096	0.0203	0.0010	0.0102
Tittabawassee River Flood Plain Soil		5[a]						
2,3,7,8-TCDF	0.1		1.12	0.045	0.112	1.08	0.036	0.108
1,2,3,7,8-PeCDF	0.05		0.561	0.023	0.0280	0.647	0.021	0.0324
2,3,4,7,8-PeCDF	0.5		0.460	0.018	0.230	0.550	0.018	0.275
1,2,3,4,7,8-HxCDF	0.01		0.375	0.015	0.0038	0.438	0.014	0.0044
1,2,3,6,7,8-HxCDF	0.01		0.0853	0.0034	0.0009	0.108	0.0036	0.0011

Notes:

WHO TEF – World Health Organization Toxicity Equivalence Factor
S.D. – Standard deviation
TEQ – Toxicity Equivalence Concentration

[a] One swine from Group 4 died early and was excluded from calculations of average daily dose and RBA estimates.

Table 14. Sensitivity of analytical limits for the swine pilot study

Dosing Group/ Chemical	Liver Number of Analyses	Liver Results Below DL (U)	Liver Results Below EMPC (Um)	Liver Results Below LCL (J)	Adipose Number of Analyses	Adipose Results Below DL (U)	Adipose Results Below EMPC (Um)	Adipose Results Below LCL (J)
Midland Soil (Group 3)								
2,3,7,8-TCDD	5	1 (20%)	0 (0%)	4 (80%)	5	0 (0%)	2 (40%)	3 (60%)
1,2,3,7,8-PeCDD	5	3 (60%)	1 (20%)	1 (20%)	5	0 (0%)	3 (60%)	2 (40%)
1,2,3,6,7,8-HxCDD	5	1 (20%)	3 (60%)	1 (20%)	5	1 (20%)	1 (20%)	3 (60%)
1,2,3,4,6,7,8-HpCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	5 (100%)	5	1 (20%)	3 (60%)	1 (20%)
All chemicals	**25**	**5 (20%)**	**4 (16%)**	**11 (44%)**	**25**	**2 (8%)**	**9 (36%)**	**9 (36%)**
Midland Oil Reference (Group 1)								
2,3,7,8-TCDD	5	0 (0%)	1 (20%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDD	5	0 (0%)	2 (40%)	3 (60%)	5	0 (0%)	0 (0%)	5 (100%)
1,2,3,6,7,8-HxCDD	5	0 (0%)	1 (20%)	4 (80%)	5	0 (0%)	0 (0%)	5 (100%)
1,2,3,4,6,7,8-HpCDD	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	5 (100%)	5	0 (0%)	0 (0%)	5 (100%)
All chemicals	**25**	**0 (0%)**	**4 (16%)**	**12 (48%)**	**25**	**0 (0%)**	**0 (0%)**	**15 (60%)**
Tittabawassee River Soil (Group 4)[a]								
2,3,7,8-TCDF	4	4 (100%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	1 (25%)
1,2,3,7,8-PeCDF	4	4 (100%)	0 (0%)	0 (0%)	4	0 (0%)	1 (25%)	3 (75%)
2,3,4,7,8-PeCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
1,2,3,4,7,8-HxCDF	4	0 (0%)	0 (0%)	0 (0%)	4	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDF	4	0 (0%)	0 (0%)	2 (50%)	4	0 (0%)	0 (0%)	4 (100%)
All chemicals	**20**	**8 (40%)**	**0 (0%)**	**2 (10%)**	**20**	**0 (0%)**	**1 (5%)**	**8 (40%)**
Tittabawassee River Oil Reference (Group 2)								
2,3,7,8-TCDF	5	0 (0%)	0 (0%)	1 (20%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,7,8-PeCDF	5	1 (20%)	3 (60%)	1 (20%)	5	0 (0%)	0 (0%)	5 (100%)
2,3,4,7,8-PeCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,4,7,8-HxCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	0 (0%)
1,2,3,6,7,8-HxCDF	5	0 (0%)	0 (0%)	0 (0%)	5	0 (0%)	0 (0%)	1 (20%)
All chemicals	**25**	**1 (4%)**	**3 (12%)**	**2 (8%)**	**25**	**0 (0%)**	**0 (0%)**	**6 (24%)**

Notes:

DL – detection limit (sample specific)
EMPC – estimated maximum possible concentration
LCL – lower calibration limit of the analytical instrument
U – not detected at the sample-specific detection limit
Um – not detected at the EMPC
J – amount detected is below the LCL

[a] Summary values exclude results for the swine that died before the end of the study (#444).

Table 15a. Summary of relative bioavailability estimates for the swine study (using 1/2 DL)

	Fraction of Administered Dose Retained									RBA Estimates					
	Liver			Adipose			Liver + Adipose			Liver		Adipose		Liver + Adipose	
Analyte	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
Midland Soil (Group 3)															
2,3,7,8-TCDD	0.0039	0.0014	35%	0.028	0.013	46%	0.032	0.013	41%						
1,2,3,7,8-PeCDD	0.0043	0.0023	55%	0.040	0.018	46%	0.044	0.018	40%						
1,2,3,6,7,8-HxCDD	0.0070	0.0037	54%	0.073	0.042	58%	0.080	0.043	54%						
1,2,3,4,6,7,8-HpCDD	0.0185	0.0063	34%	0.046	0.011	24%	0.064	0.016	24%						
2,3,4,7,8-PeCDF	0.0440	0.0121	27%	0.042	0.024	57%	0.086	0.025	29%						
Midland Reference Oil (Group 1)										**Soil vs. Reference Oil**					
2,3,7,8-TCDD	0.0102	0.0034	33%	0.165	0.016	10%	0.175	0.019	11%	38%	48%	17%	47%	18%	43%
1,2,3,7,8-PeCDD	0.0123	0.0043	35%	0.173	0.020	12%	0.185	0.018	10%	35%	65%	23%	47%	24%	41%
1,2,3,6,7,8-HxCDD	0.0194	0.0057	29%	0.188	0.021	11%	0.208	0.022	11%	36%	61%	39%	59%	38%	55%
1,2,3,4,6,7,8-HpCDD	0.0290	0.0080	27%	0.089	0.018	20%	0.118	0.024	21%	64%	44%	52%	31%	55%	32%
2,3,4,7,8-PeCDF	0.0956	0.0146	15%	0.175	0.016	9%	0.270	0.029	11%	46%	31%	24%	58%	32%	31%
Tittabawassee River Flood Plain Soil (Group 4)															
2,3,7,8-TCDF	1.2E-04	2.9E-05	25%	0.0026	4.8E-04	18%	0.003	4.6E-04	17%						
1,2,3,7,8-PeCDF	2.4E-04	2.7E-05	11%	0.0033	0.0015	45%	0.004	0.0015	42%						
2,3,4,7,8-PeCDF	0.0273	0.0011	4%	0.0419	0.0051	12%	0.069	0.0049	7%						
1,2,3,4,7,8-HxCDF	0.0233	0.0024	10%	0.0675	0.0055	8%	0.091	0.0059	6%						
1,2,3,6,7,8-HxCDF	0.0333	0.0019	6%	0.0646	0.0037	6%	0.098	0.0043	4%						
Tittabawassee River Flood Plain Reference Oil (Group 2)										**Soil vs. Reference Oil**					
2,3,7,8-TCDF	0.0005	1.5E-04	28%	0.0119	0.0024	20%	0.012	0.0024	19%	21%	38%	22%	27%	22%	26%
1,2,3,7,8-PeCDF	0.0003	9.7E-05	34%	0.0117	0.0020	17%	0.012	0.0021	18%	86%	36%	28%	48%	30%	46%
2,3,4,7,8-PeCDF	0.1038	0.0202	19%	0.1499	0.0268	18%	0.254	0.0286	11%	26%	20%	28%	22%	27%	13%
1,2,3,4,7,8-HxCDF	0.0686	0.0135	20%	0.1877	0.0241	13%	0.256	0.0251	10%	34%	22%	36%	15%	35%	12%
1,2,3,6,7,8-HxCDF	0.0951	0.0198	21%	0.1668	0.0209	13%	0.262	0.0206	8%	35%	22%	39%	14%	37%	9%

Notes:

RBA – relative bioavailability adjustment

RBA calculated as: Fraction of administered dose retained$_{\text{test material}}$ / Fraction of administered dose retained$_{\text{reference material}}$

S.D. – standard deviation

C.V. – coefficient of variability

For fraction of administered dose retained: C.V. = Standard Deviation / Mean

For RBA estimates: C.V. = $(CV_{soil}^{2} + CV_{reference}^{2})^{0.5}$

Table 15b. Summary of relative bioavailability estimates for the swine study (using DL)

	Fraction of Administered Dose Retained									RBA Estimates					
	Liver			Adipose			Liver + Adipose			Liver		Adipose		Liver + Adipose	
Analyte	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
Midland Soil (Group 3)															
2,3,7,8-TCDD	0.0042	0.0008	18%	0.034	0.006	18%	0.038	0.006	17%						
1,2,3,7,8-PeCDD	0.0069	0.0014	21%	0.057	0.010	18%	0.064	0.011	17%						
1,2,3,6,7,8-HxCDD	0.0113	0.0027	24%	0.084	0.029	35%	0.095	0.029	30%						
1,2,3,4,6,7,8-HpCDD	0.0185	0.0063	34%	0.046	0.011	24%	0.064	0.016	24%						
2,3,4,7,8-PeCDF	0.0440	0.0121	27%	0.067	0.014	20%	0.111	0.018	16%						
Midland Reference Oil (Group 1)										**Soil vs. Reference Oil**					
2,3,7,8-TCDD	0.0111	0.0016	15%	0.165	0.016	10%	0.176	0.017	10%	38%	23%	20%	20%	22%	20%
1,2,3,7,8-PeCDD	0.0153	0.0004	2%	0.173	0.020	12%	0.188	0.020	11%	45%	21%	33%	22%	34%	20%
1,2,3,6,7,8-HxCDD	0.0215	0.0029	13%	0.188	0.021	11%	0.210	0.023	11%	52%	28%	45%	36%	45%	32%
1,2,3,4,6,7,8-HpCDD	0.0290	0.0080	27%	0.089	0.018	20%	0.118	0.024	21%	64%	44%	52%	31%	55%	32%
2,3,4,7,8-PeCDF	0.0956	0.0146	15%	0.175	0.016	9%	0.270	0.029	11%	46%	31%	39%	22%	41%	19%
Tittabawassee River Flood Plain Soil (Group 4)															
2,3,7,8-TCDF	2.3E-04	5.8E-05	25%	0.0026	4.8E-04	18%	0.003	4.5E-04	16%						
1,2,3,7,8-PeCDF	4.9E-04	5.4E-05	11%	0.0036	0.0010	26%	0.004	0.0010	24%						
2,3,4,7,8-PeCDF	0.0273	0.0011	4%	0.0419	0.0051	12%	0.069	0.0049	7%						
1,2,3,4,7,8-HxCDF	0.0233	0.0024	10%	0.0675	0.0055	8%	0.091	0.0059	6%						
1,2,3,6,7,8-HxCDF	0.0333	0.0019	6%	0.0646	0.0037	6%	0.098	0.0043	4%						
Tittabawassee River Flood Plain Reference Oil (Group 2)										**Soil vs. Reference Oil**					
2,3,7,8-TCDF	0.0005	1.5E-04	28%	0.0119	0.0024	20%	0.012	0.0024	19%	42%	38%	22%	27%	23%	25%
1,2,3,7,8-PeCDF	0.0005	9.2E-05	19%	0.0117	0.0020	17%	0.012	0.0020	17%	102%	22%	31%	31%	34%	29%
2,3,4,7,8-PeCDF	0.1038	0.0202	19%	0.1499	0.0268	18%	0.254	0.0286	11%	26%	20%	28%	22%	27%	13%
1,2,3,4,7,8-HxCDF	0.0686	0.0135	20%	0.1877	0.0241	13%	0.256	0.0251	10%	34%	22%	36%	15%	35%	12%
1,2,3,6,7,8-HxCDF	0.0951	0.0198	21%	0.1668	0.0209	13%	0.262	0.0206	8%	35%	22%	39%	14%	37%	9%

Notes:

RBA – relative bioavailability adjustment

RBA calculated as: Fraction of administered dose retained$_{\text{test material}}$ / Fraction of administered dose retained$_{\text{reference material}}$

S.D. – standard deviation

C.V. – coefficient of variability

For fraction of administered dose retained: C.V. = Standard Deviation / Mean

For RBA estimates: C.V. = $(CV_{soil}^{2} + CV_{reference}^{2})^{0.5}$

Table 16. TEQ-weighted relative and absolute bioavailability estimates for two soils

Congener	Percent of Soil TEQ	Mean RBA[a]			Estimated Absolute Bioavailability[b]			Estimated Bioaccessibility[c] (*in vitro* assay)
		Rat	Swine ND=1/2 DL	Swine ND=DL	Rat	Swine ND=1/2 DL	Swine ND=DL	
Midland Soil								
2,3,7,8-TCDD	48.9%	0.35	0.18	0.22	0.28	0.15	0.18	0.17
1,2,3,7,8-PeCDD	24.9%	0.40	0.24	0.34	0.32	0.19	0.27	0.16
1,2,3,6,7,8-HxCDD	2.7%	0.47	0.38	0.45	0.37	0.31	0.36	0.18
1,2,3,4,6,7,8-HpCDD	4.3%	0.34	0.55	0.55	0.27	0.44	0.44	0.26
2,3,4,7,8-PeCDF	6.7%	0.40	0.32	0.41	0.32	0.25	0.33	0.18
TEQ-Weighted:		**0.37**	**0.23**	**0.29**	**0.30**	**0.19**	**0.23**	**0.17**
Tittabawassee River Flood Plain Soil								
2,3,7,8-TCDF	25.4%	0.89	0.22	0.23	0.72	0.18	0.18	--
1,2,3,7,8-PeCDF	6.3%	0.58	0.30	0.34	0.46	0.24	0.27	--
2,3,4,7,8-PeCDF	52.1%	0.52	0.27	0.27	0.42	0.22	0.22	--
1,2,3,4,7,8-HxCDF	8.5%	0.57	0.35	0.35	0.46	0.28	0.28	--
1,2,3,6,7,8-HxCDF[d]	1.9%	0.56	0.37	0.37	0.45	0.30	0.30	--
TEQ-Weighted:		**0.63**	**0.27**	**0.27**	**0.51**	**0.22**	**0.22**	--

[a] RBA estimates for soil compared to corn oil reference material based on liver plus adipose tissue measurements.

[b] Assuming an absolute availability from corn oil of 80%.

[c] As estimated for the Midland soil sample based on in vitro assay by Ruby et al. (2002)

[d] Outlier omitted from rat RBA estimate; see results section text for discussion.

Appendix A

Sampling and Analysis Plan—Soil Sampling for the Pilot Bioavailability Study

Final

Sampling and Analysis Plan
Soil Sampling for Pilot Bioavailability Study

Prepared for

The Dow Chemical Company

June 2004

CH2MHILL

Contents

Appendixes

Tables **Page**

Figures

Abbreviations and Acronyms

ATV	all-terrain vehicle
bgs	below ground surface
COC	chain of custody
Dow	The Dow Chemical Company
DPT	direct push technology
D&F	dioxins and furans
DQO	data quality objective
GIS	geographic information system
GPS	global positioning system
HS&E	Health, Safety, and Environment
HSP	health and safety plan
ID	identification
JHA	job hazard analysis
LTI	Limno-Tech Inc.
MDEQ	Michigan Department of Environmental Quality
MI-OSHA	Michigan Occupational Safety and Health Administration
MOCA	Midland Offsite Corrective Actions
MS/MSD	matrix spike/matrix spike duplicate
PCOI	potential contaminants of interest
ppt	part per trillion
QAPP	quality assurance project plan
RI	remedial investigation
SAP	sampling and analysis plan
site	Tittabawassee River study area
SOP	standard operating procedure
STAC	Safety Task Analysis Card
SWP	Safety Work Permit
USEPA	United States Environmental Protection Agency

1 Introduction

1.1 Background

Several previous investigations, conducted by the Michigan Department of Environmental Quality (MDEQ), have indicated that dioxins and furans may be present in sediment and soil of the Tittabawassee River and its floodplain. On June 12, 2003, MDEQ issued an Operating License to The Dow Chemical Company (Dow). A pilot bioavailability study is being performed to evaluate a study design to assess the oral absorption of dioxins and furans in Midland and the Tittabawassee River floodplain,. This SAP is being prepared for the collection of soil samples from areas within Midland and the Tittabawassee River Floodplain that may be used in the pilot bioavailability study.

1.2 Purpose and Objectives

The purpose and primary objective of this Sampling and Analysis Plan (SAP) is to collect surface soil samples that may be used in the Pilot Bioavailability Study. Samples will be collected in areas where previous sampling results have indicated that dioxins and furans may be present in the concentration range of 800 to 1,000 ppt TEQ.

1.3 Scope

The scope of the field effort described in this SAP includes surface soil sample collection within the Midland area and the Tittabawassee River Floodplain, refer to Figure 1-1. Exponent will coordinate the analysis of all samples collected during this SAP.

Sampling will be performed in accordance with the Field SOPs established for the Dow Midland Off-site Corrective Actions (MOCA) program, and the Dow MOCA *Quality Assurance Project Plan* (QAPP) (CH2M HILL 2004c).

1.4 Data Quality Objectives

Data quality objectives (DQOs) are both qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support the decision making process during project activities. The DQO process used for this project follows the USEPA *Guidance for the Data Quality Objectives Process (EPA QA/G-4)* document (USEPA, 2000) and uses the seven-step DQO development process identified in the QAPP. Table 1-1 presents the DQOs associated with the sampling activities in support of the pilot bioavailability study.

1.5 Project Team

The team members responsible for the effective execution of this SAP are identified by role in Table 1-2. The program management roles are further defined in the Dow MOCA *Program Management Plan* (CH2M HILL, 2004a).

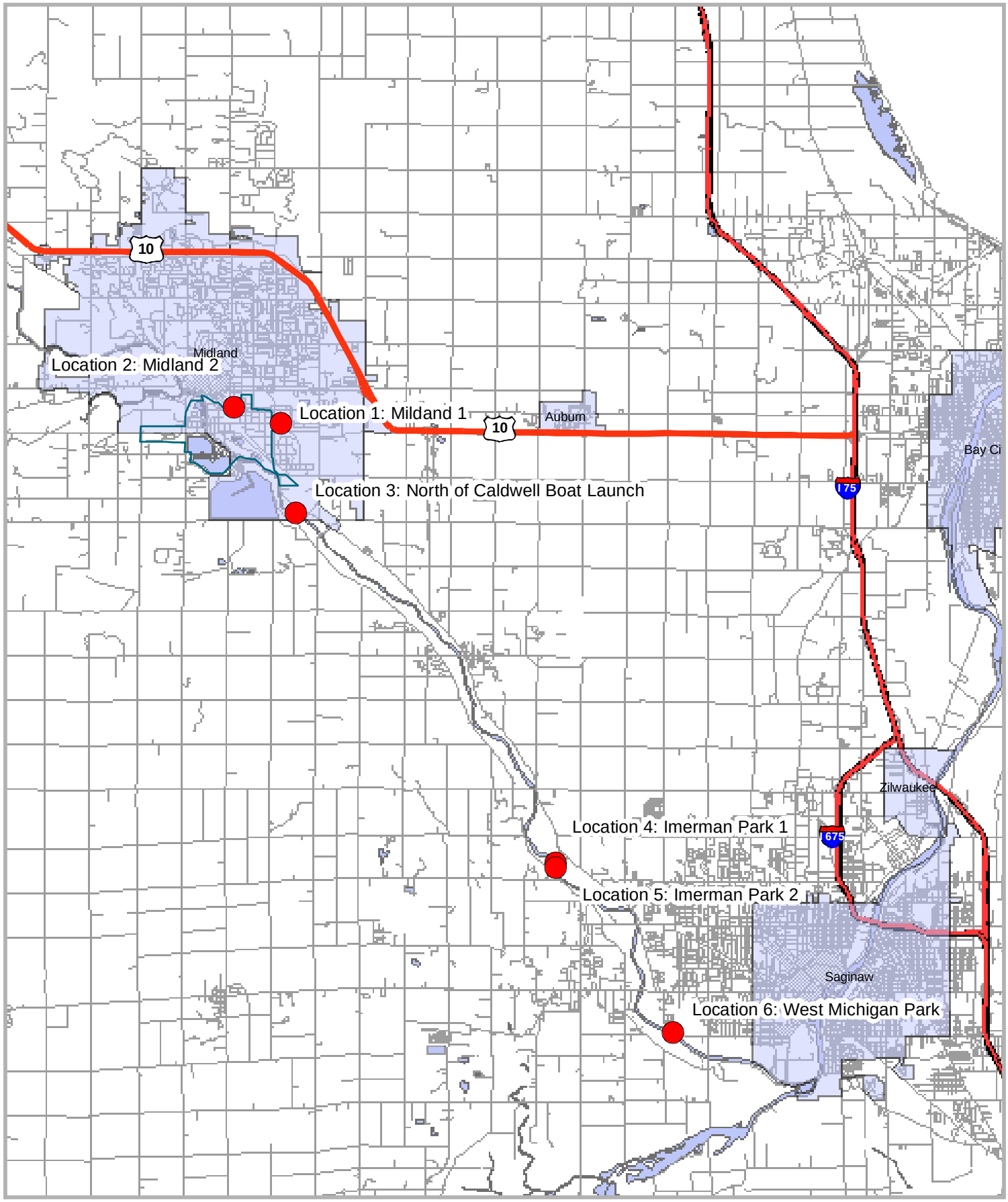


FIGURE 1-1
General Location of Sampling Points
Sampling and Analysis Plan for Ecological Risk Assessment Support Sampling
Dow Midland Offsite Corrective Actions Program

CH2MHILL

File Path: C:\dow\midland\GIS\MapDocs\0076.mxd, Computer: MKE40004344, Date: 06 18, 2004, User: RVANSLAM

TABLE 1-1
Data Quality Objectives
Pilot Bioavailability Study Support Sampling

State the Problem	Identify the Decisions	Identify Inputs to the Decisions	Define the Boundaries to the Study	Develop a Decision Rule	Specify Tolerable Limits on Decision Errors	Optimize the Design for Obtaining Data
Soil needs to be obtained with concentrations ideally ranging from 800 to 1,000 ppt TEQ of dioxins and furans (D&F) for the pilot bioavailability study.	What locations are likely to have D&F concentrations in the range needed for the pilot bioavailability study?	Surface soils from 0-0.1 ft. Midland area and 0-0.5ft the Titttabawassee River Floodplain.	Surface soils in Midland area and the Tittabawassee River Floodplain with expected D&F TEQ concentrations in the range of 800 to 1,000 ppt TEQ.	If the collected samples do not meet the requirements of Exponent, then additional samples may be collected.	Exponent will determine the tolerable limits on decision errors. Standard operating procedures for soil sampling will be followed to minimize human error.	One to two samples will be collected in the Midland area, and three to four samples will be collected in the Tittabawassee River Floodplain. These locations will be accessed through Dow-owned parcels or via public areas. A minimum of three gallons of soil will be collected per sample.

TABLE 1-2
ERA Support Sampling Project Team
Bioavailability Study Support Sampling

Responsibility	Individual	Affiliation	Contact Information
Senior Environmental Project Leader	Ben Baker	Dow	47 Building Midland, MI 48667 (989) 636-0787
Project Manager Leader/ Client Point-of-Contact	Gary Dyke	CH2M HILL	1111 Washington Street Midland, MI 48640 (989) 835-1187
Pilot Bioavailability Study	Mike Ruby	Exponent	(303) 444-7270
Project Manager	Eric Kroger	CH2M HILL	(937) 228-3180, ext. 207
Field Team Leader	Paul Arps	CH2M HILL	1111 Washington Street Midland, MI 48640 (989) 835-5132
Field Lead	Wayne Ekren	CH2M HILL	(517) 347-3138, ext.42
MOCA Health and Safety Manager	Lisa Martin	CH2M HILL	(816) 224-6311
GIS Manager	Randy Vanslambrouck	CH2M HILL	1111 Washington Street Midland, MI 48640 (989) 832-2608
Data Manager	Linda Crownover	CH2M HILL	(215) 563-4244, ext. 448
Project Chemist	Herb Kelly	CH2M HILL	(352) 335-5877, ext. 2572

2 Field Activities

The following provides some information necessary for the field team to locate the pre-selected sample areas. Each sample location was selected based on previous analytical data.

The soil sample locations will be on either Dow-owned property or in public parks. Access to the public parks will require access agreements. The sample locations are presented in Figure (2-1 through 2-5)

2.1 Access to Surface Soil Sample Locations

Before initiating fieldwork, the appropriate notifications must be made with the property owner at each location. Before entering Dow-owned property, contact Dow Midland Security (refer to Table 2.1). Additionally, the field lead should notify the property owner of the sampling activities the day before they are to commence.

2.1.1 Utility Clearances

Utility clearances are not necessary for the collection of shallow surface soil samples. However, if deemed necessary, the following service is available for identifying and locating underground utilities in Michigan:

Miss Dig System, Inc.
1-800-482-7171

The Miss Dig System should be contacted at least 3 business days prior to beginning any work requiring utility clearances. If questions arise in the field regarding utility clearances, the numbers of each utility owner are included in the Dow MOCA Program Health, Safety and Environment (HS&E) Plan (CH2M HILL, 2003).

2.1.2 Access Agreements

Imerman Park and West Michigan Park require access agreements in order to conduct the surface soil sampling. Access agreements will be secured at these two locations prior to sampling.

2.2 Sampling Procedures

Soil Sampling

Locate the sampling area in the field and verify the location by global positioning system (GPS). Figures 2-1 through 2-5 illustrate the sample locations.

After identifying the sampling location, vegetation/debris will be removed from the surface, taking care not to disturb underlying soil (refer to *Manual Soil Sampling Field SOP 2.1* [CH2M HILL, 2004b]). Only the top 0.1-ft of surface soil will be collected in the Midland area and the

top 0.5-ft will be collected in the Tittabawassee River Floodplain. The sample will be classified using the applicable portions of the *Soil Classification and Logging SOP 2.7*. The sample will be collected into the sample container (3 or 5 gallon bucket).

After collecting enough soil to meet the three-gallon requirement, GPS coordinates will be recorded from each location and documented in the field logbook. The sample location will also be photographed in accordance with the *Digital Camera Use and Documentation Procedures SOP 7.1*. Site restoration will consist of ground cover being placed over the sample location, returning it to its native condition.

2.3 Sample Containers, Preservation, and Holding Times

New 3 or 5 gallon plastic paint buckets will be used to contain the surface soil samples.

The activities associated with the sampling activities must be documented in field logbooks. The procedures and QC procedures for field logbook entries are located in the *Field SOPs* (CH2M HILL, 2004b) and QAPP (CH2M HILL, 2004c).

2.4 Field Quality Control

Field quality control sample collection is not necessary for this field event.FiF

2.5 Sample Identification

Sample identification numbers are listed in Appendix A (refer to *the Sample Identification Technical Memorandum*, CH2M HILL, 2004e).

2.6 Sample Handling and Chain of Custody

The procedures used for proper packaging, shipping, and documentation of samples being transported from the field to the Exponent for analysis are given in the *Sample Handling and Shipping Custody Procedures Field SOP 6.2* (CH2M HILL, 2004b). Due to the nature and use of the sample, the containers will not be placed on ice for shipping.

After samples are labeled and packaged, they will be shipped to Exponent, at the following address:

Attn: Mike Ruby
Exponent
4940 Pearl East Circle, Suite 300
Boulder, CO 80301
(303) 444-7270

2.7 Equipment Decontamination

- Personal decontamination procedures followed will be those provided in the Dow Program CH2M HILL Health, Safety and Environment Plan (HSEP; CH2M HILL, 2004).
- All soil sampling equipment will be decontaminated in accordance with the *Field Decontamination Procedures Field SOP* (CH2M HILL, 2004b).
- Excess soil, disposable sampling equipment, and decontamination materials and liquids will be disposed of in accordance to the *Handling and Disposal of Investigative-Derived Waste Field SOP* (CH2M HILL. 2004b).

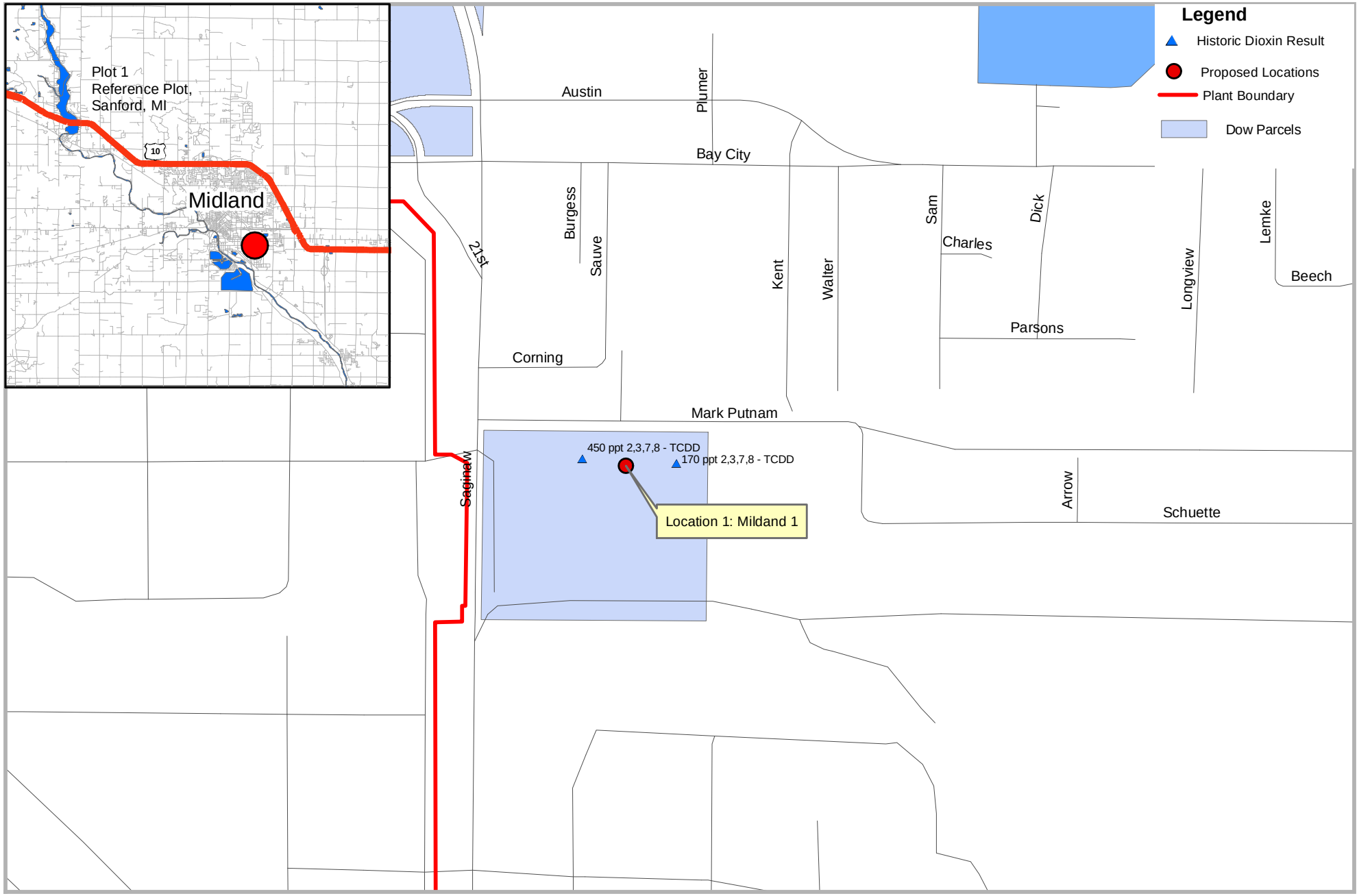


FIGURE 2-1
Location 1
Midland 1 - East of Plant
Sampling and Analysis Plan for Bioavailability Study Support Sampling
Dow Midland Offsite Corrective Actions Program

File Path: \dow\GIS\MapDocs\0065.mxd, Computer: MKE40004344, Date: 05 14, 2004, User: RVANSLAM

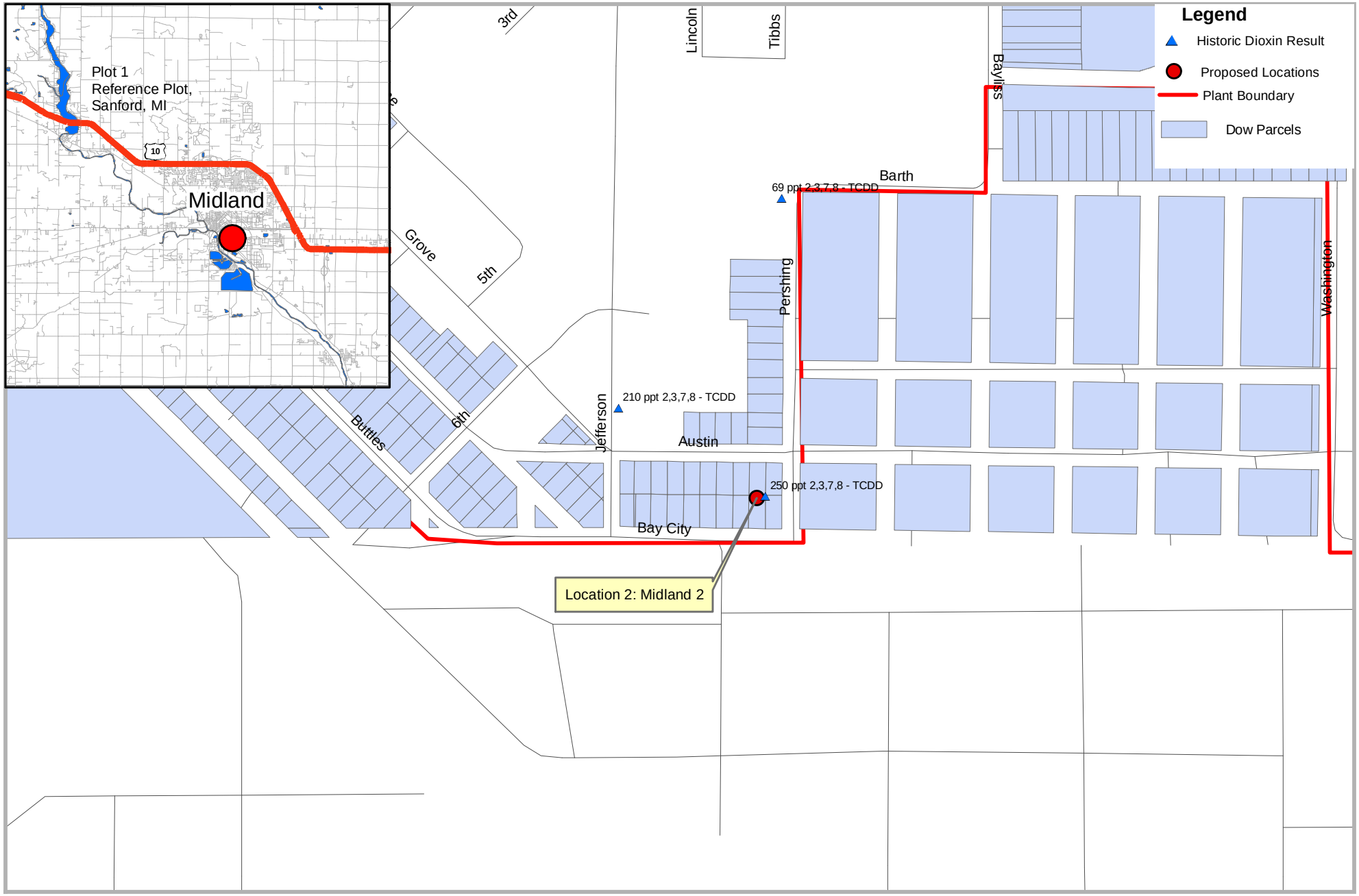


FIGURE 2-2
Location 2
Midland 2 - North of Plant
Sampling and Analysis Plan for Bioavailability Study Support Sampling
Dow Midland Offsite Corrective Actions Program

File Path: \dow\GIS\MapDocs\0065.mxd, Computer: MKE40004344, Date: 05 14, 2004, User: RVANSLAM

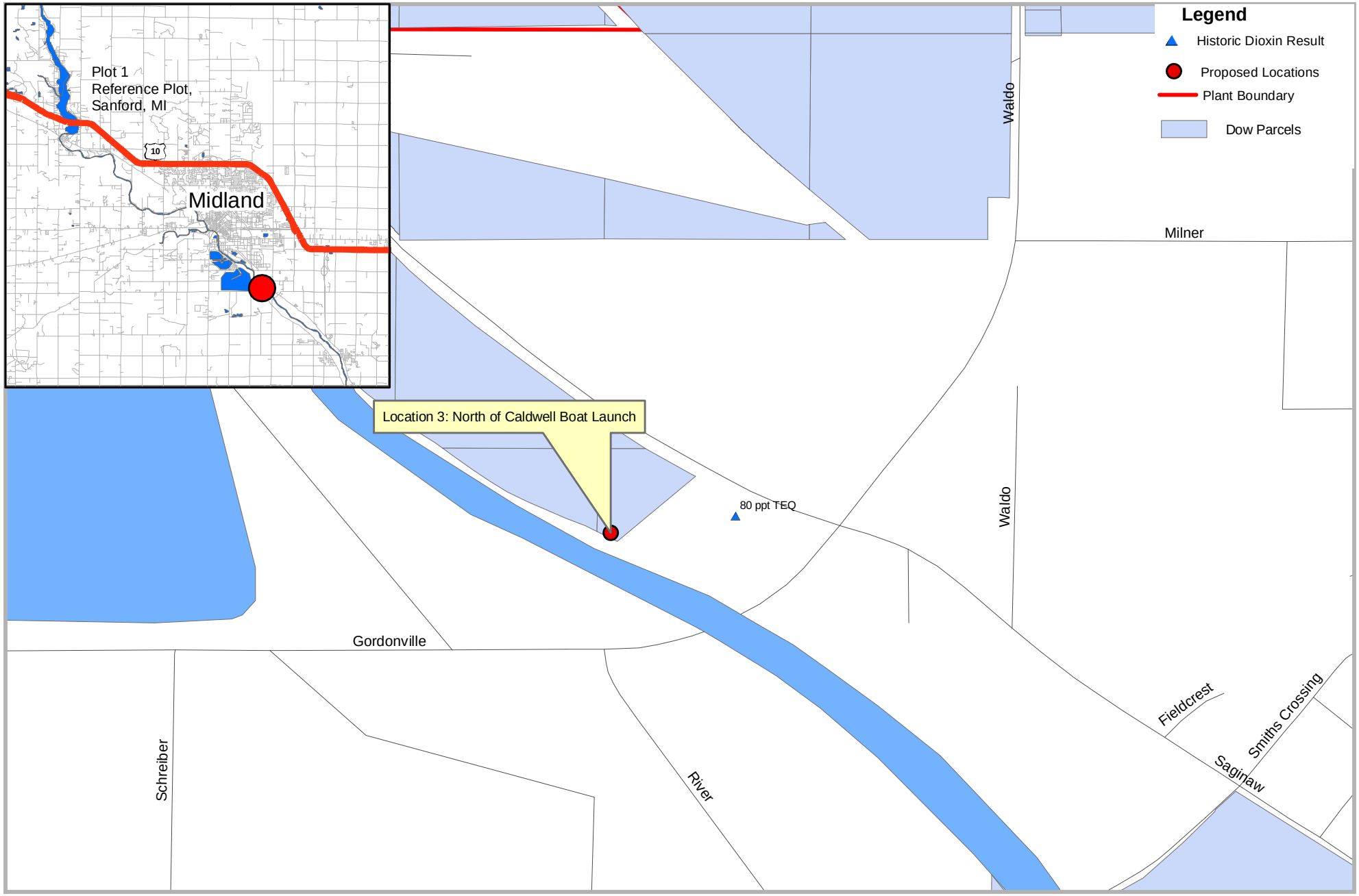


FIGURE 2-3
Location 3
North of Caldwell Boat Launch
Sampling and Analysis Plan for Bioavailability Study Support Sampling
Dow Midland Offsite Corrective Actions Program

File Path: \dow\GIS\MapDocs\0065.mxd, Computer: MKE40004344, Date: 05 14, 2004, User: RVANSLAM

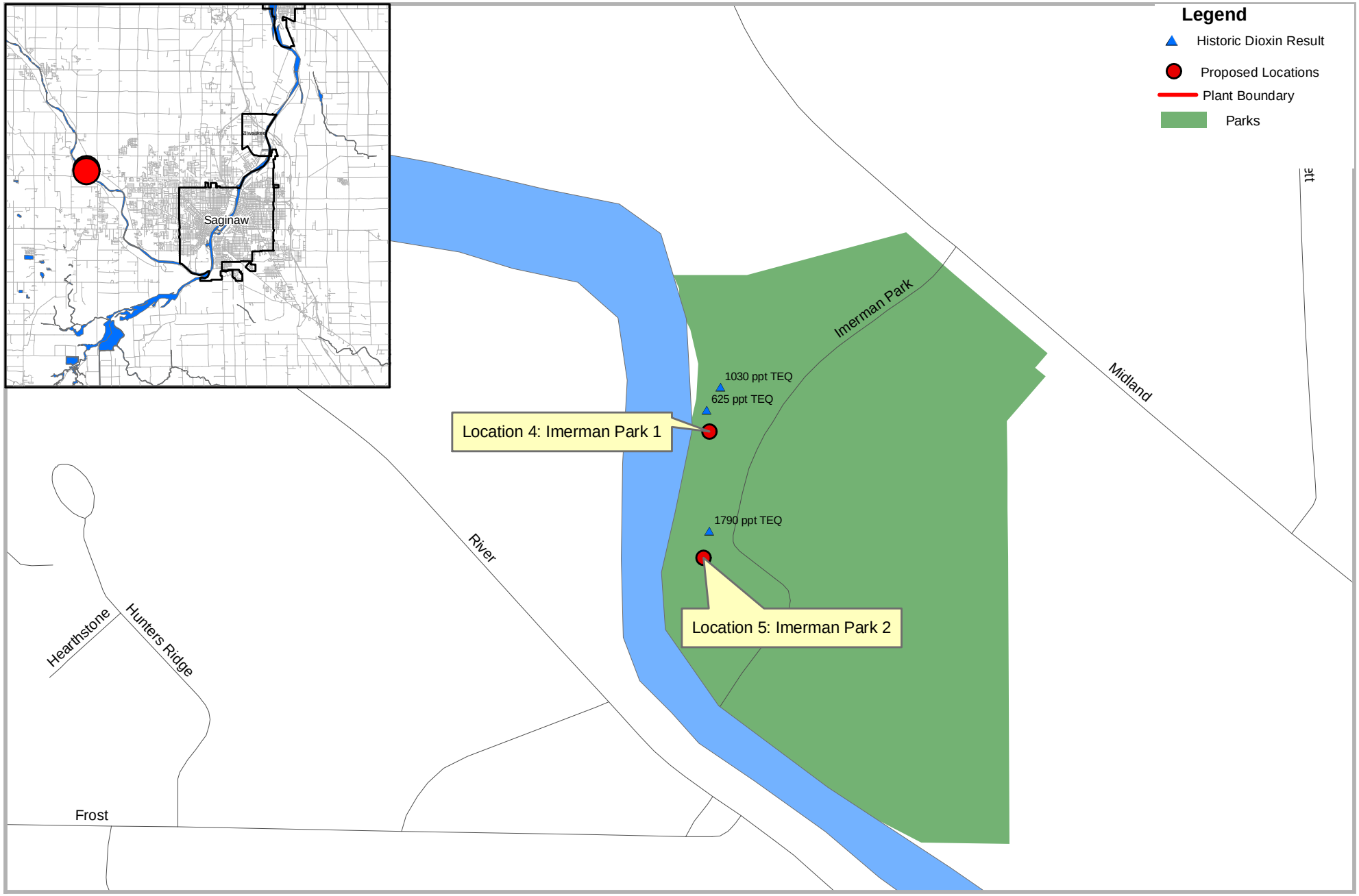


FIGURE 2-4
Location 4 & 5
Imerman Park 1 & Imerman Park 2
Sampling and Analysis Plan for Bioavailability Study Support Sampling
Dow Midland Offsite Corrective Actions Program

File Path: \dow\GIS\MapDocs\0065.mxd, Computer: MKE40004344, Date: 05 14, 2004, User: RVANSLAM

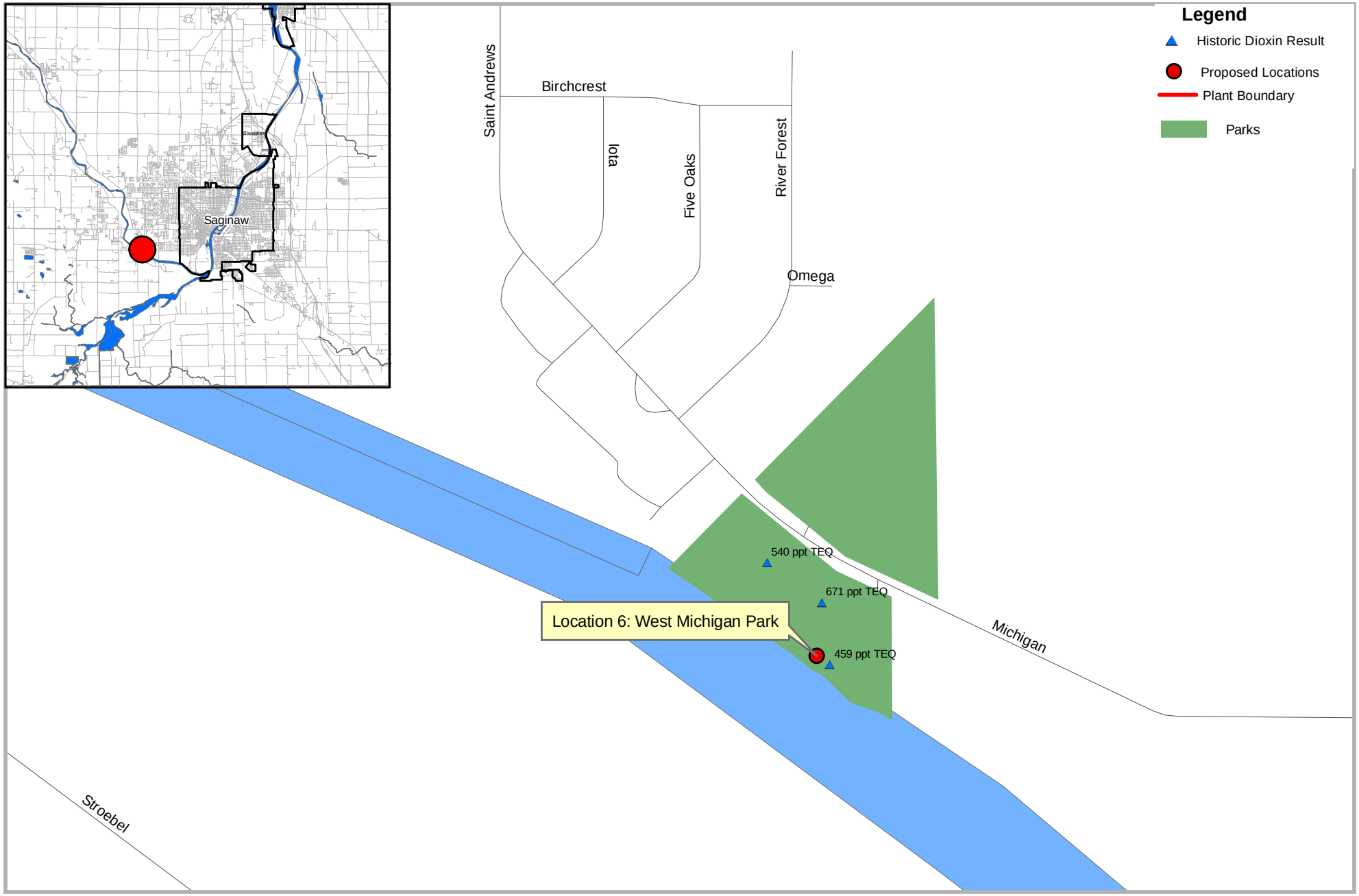


FIGURE 2-5
Location 6
West Michigan Park
Sampling and Analysis Plan for Bioavailability Study Support Sampling
Dow Midland Offsite Corrective Actions Program

File Path: \dow\GIS\MapDocs\0065.mxd, Computer: MKE40004344, Date: 05 14, 2004, User: RVANSLAM

3 Data Management and Validation

All data collected under this field effort will be managed in accordance with the Data Management Plan for Dow MOCA (CH2M HILL, 2004d).

Data validation is not anticipated as part of the data collection process. However if data validation is deemed necessary, all validation will be performed in accordance to the Dow MOCA program QAPP.

4 Health and Safety

Site Specific HS&E Plan Amendment

A Site-Specific Amendment to the HS&E Plan has been prepared for this project and has been approved by The Health and Safety Manager (HSM). It is included with this SAP as Appendix C. Prior to beginning fieldwork, Field Team members must read and sign the amendment, and follow its requirements.

5 Project Schedule

The surface soil collection is scheduled for June 18th. Based on that start date, the schedule will be as follows:

Activity	Anticipated Duration	Anticipated Start Date	Anticipated End Date
Work Planning, SAP Development, Contractor Procurement, Access Agreements	4 Days	June 14, 2004	June 17, 2004
Soil Sampling	1 Days	June 18, 2004	June 18, 2004

6 References

CH2M HILL. 2004. Dow Program CH2M HILL Health, Safety and Environment Plan. December

CH2M HILL. 2004a. *Dow MOCA Program Management Plan.*

CH2M HILL. 2004b. *Field SOPs.* April

CH2M HILL. 2004c. *Quality Assurance Project Plan (QAPP).* April

CH2M HILL. 2004d. *Dow MOCA Data Management Plan*. March

CH2M HILL. 2004e. *Sample Identification Technical Memorandum.* May

USEPA. 2000. Guidance for the Data Quality Objectives Process (EPA QA/G-4). EPA guidance document EPA/600/R-96/055. August.

Appendix A
Sample Station IDs

Appendix A

Identification of Samples Collected
Sampling and Analysis Plan
Soil Sampling for Bioavailability Study
Dow Midland Off-site Corrective Actions Program

BIOAVAILABILITY LOCATIONS:		SAMPLES COLLECTED FROM EACH BIOAVAILABILITY LOCATION			
Plot Name	**Plot Location**	**Station ID**	**Sample Media**	**Bottom Depth (ft)**	**Sample ID[1]**
Midland 1 East of Plant	Northing 13166306.89 Easting 765447.8698	MNE-02765	Soil[2]	0.1	mmddyy-SOI-02765-00.1
Midland 2 North of Plant	Northing 13160752.26 Easting 767341.0571	MNE-02766	Soil	0.1	mmddyy-SOI-02766-00.1
North of Caldwell Boat Launch	Northing 13168075.82 Easting 754803.287	MIC-02767	Soil	0.5	mmddyy-SOI-02767-00.5
Imerman Park 1	Northing 13198941.53 Easting 713309.9003	THT-02768	Soil	0.5	mmddyy-SOI-02768-00.5
Imerman Park 2	Northing 13198915.07 Easting 712735.9515	THT-02769	Soil	0.5	mmddyy-SOI-02769-00.5
West Michigan Park	Northing 13212823.69 Easting 693205.0275	SHL-02770	Soil	0.5	mmddyy-SOI-02770-00.5

Notes:

1. The "mmddyy" portion of the Sample ID will be replaced in the field with actual date of sample collection.
2. Soil samples will be collected at the surface. Samples will also be collected in accordance with the QAPP.

Appendix B

Site Specific HS&E Plan Amendment

Appendix B

Pilot Study Design: Oral Bioavailability of Dioxins/Furans in Midland and Tittabawassee River Flood Plain Soils

Pilot Study Design:
Oral Bioavailability of Dioxins/Furans in Midland and Tittabawassee River Flood Plain Soils

The overall objective of this pilot study is to evaluate two animal models (Sprague-Dawley rats and juvenile swine) for measuring the oral bioavailability of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), 2,3,4,7,8-pentachlorodibenzofuran (4-PeCDF), and the other dioxin/furan congeners of importance in soils from Midland, Michigan, and the Tittabawassee River flood plain. A test soil from each of these two areas will be studied, because the toxic equivalent (TEQ) for dioxins/furans in Midland soils is dominated by TCDD, while that of the Tittabawassee River flood-plain soils is dominated by furans (4-PeCDF in particular). Because the TCDD and 4-PeCDF may behave differently in these two animal models, a soil from each of these two areas will be evaluated in the pilot study. The results from this pilot study will be used to complete the design of a full-scale study of dioxin/furan bioavailability from soil.

Specific objectives of the pilot study include:

- Evaluate the feasibility of detecting dioxins/furans in the tissues of rats and swine dosed with soil from Midland and the Tittabawassee River flood plain
- Evaluate the proposed study design in rats and swine for measuring the relative bioavailability of dioxins/furans in soil
- Establish the absolute oral bioavailability of TCDD and 4-PeCDF from the control doses, so that results from the rat and swine models can be compared directly with each other
- Evaluate whether five animals per dose group will be an adequate number for the full study (note that for the rats in the pilot study, 10 animals will be used and the tissues from each pair of rats will be combined to provide 5 analytical samples).

The study in the rat model will be used to assess the oral bioavailability of dioxins/furans from soil relative to that from both rat feed and oral gavage doses. This is warranted because the cancer slope factor (CSF) for TCDD that was used to calculate a site-specific criterion for dioxins/furans in soil in Midland (Exponent 2002) is based on a study in which rats were dosed with TCDD in feed (see Kociba et al. 1978). Thus, if dioxins/furans in soil are less bioavailable than those in rat feed, an adjustment in the risk assessment is warranted to account for this difference. In addition, the rat studies will allow for comparison to the recent National Toxicology Program (NTP) chronic carcinogenesis bioassays, in which the rats were dosed by gavage.

The swine study will be conducted to evaluate the oral bioavailability of dioxins/furans from two Midland soils in an *in vivo* model that is more similar to humans than the rat, and will provide estimates of both absolute and relative bioavailability (relative to dioxins/furans dosed

in corn oil). The absolute bioavailability estimates in the swine and rats will allow for direct comparison between these two animal models (i.e., the same two soils will be dosed to both models, and estimates of absolute bioavailability from these soils will be obtained in both models).

This document presents the rationale for the pilot study design and discusses the basic study outline, including animal handling, dose preparation and delivery, tissue collection and analysis, data analysis, and reporting. Based on the results from this pilot study, a full-scale study of dioxin/furan bioavailability from soil will be designed, which will include preparation of formal study protocols, consistent with Good Laboratory Practice (GLP) guidelines.

Test Materials

Research has demonstrated that only the fine fraction of soil adheres to human hands and is subject to incidental ingestion. Hand-press trials have indicated that only particles less than approximately 200 μm adhere to the hands of children (Dugan and Inskip 1985). In keeping with this observation, studies of soil ingestion rates in children have found that soil particles in the 0- to 250-μm range are the primary source of ingested soil (Calabrese and Stanek 1996). For this reason, the U.S. Environmental Protection Agency (EPA) has used the <250-μm soil fraction for studies of oral lead bioavailability in humans (Maddaloni et al. 1998), and of lead and arsenic bioavailability in swine (Casteel et al. 1997a,b). Indeed, EPA has stated that "*it is critical to sieve the soil samples to <250 µm (60 mesh) to more closely represent the size of soil particles that would be expected to adhere to children's hands*" (U.S. EPA 1999), when conducting lead bioavailability studies. For these reasons, the <250-μm fraction of the test soils will be used for measurement of dioxin/furan bioavailability, because this is the fraction to which direct-contact exposure would most likely occur.

For the pilot study, two soils will be used—one from Midland and one from the Tittabawassee River flood plain. The Midland soil should have the maximum concentration of TCDD available (approx. 150–200 pg/g)to ensure detection of TCDD in the animal tissues. The Tittabawassee River flood-plain soil, in which the TEQ will be dominated by 4-PeCDF and other furans, should have a TEQ concentration just below 1,000 pg/g (the maximum soil concentration that can be used at the animal testing facility). The test soils will be analyzed for soil parameters (pH, total organic carbon [TOC], and particle size distribution [sand, silt, clay]), and for dioxin/furan content in duplicate, to ensure accurate characterization of the test-soil concentrations used in this study. The test soils will also be analyzed for polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), because the presence of these compounds could confound the results of certain measurements made during the pilot study (discussed below).

Study Design Considerations

Rat Model

The proposed study is designed to determine the relative oral bioavailability of dioxins/furans in soil (i.e., the bioavailability from soil relative to what would have been observed in the critical toxicity study). Because the Kociba et al. (1978) study is the basis for the current CSF for TCDD, the proposed study will employ the same dosing vehicle that was used in the Kociba study as the control dose (Kociba et al. dissolved TCDD in acetone, applied it to rat feed, and dosed the TCDD/rat feed mixture to rats). The relative bioavailability estimate would be directly applicable to human health risk assessment.

However, to compare the results in rats to those in swine, estimates of absolute bioavailability will also be necessary in rats. These data will be obtained by measuring the absolute bioavailability of TCDD and 4-PeCDF from a reference dose, and using this value to correct the relative bioavailability from soil to absolute bioavailability values. Because the distribution of TCDD-like compounds at low doses in the rat depends on the route of administration (Qiao and Riviere 2001), an i.v. dose cannot necessarily be used to establish the absolute bioavailability of an oral dose. Therefore, an oral gavage dose in oil, the absorption of which has been characterized previously in Sprague-Dawley rats (Rose et al. 1976), will be used as the reference dose, on the basis of which the absolute bioavailability from soil will be calculated.

The proposed study will rely on measurement of polychlorinated dibenzo-p-dioxins and furans (PCDDs/Fs) in liver and fat after 30 days of repeated dosing; therefore, it is critical to understand the disposition of these compounds to design an appropriate study. In the rat, several CYP-type mixed-function monooxygenase (MFO) enzymes can sequester TCDD and structurally similar compounds, such as PCBs and PAHs, in the liver. Of the MFO enzymes, CYP1A2 appears to bind TCDD most tightly. Therefore, ethoxyresorufin O-deethylase (EROD) and methoxyresorufin O-deethylase (MROD) assays will be used to measure CYP1A and CYP1A2 induction in the liver of rats exposed to dioxins/furans. If CYP1A2 is induced to a greater extent in the oral-soil versus oral-control dose groups, then it is reasonable to assume that TCDD sequestration may be occurring in the livers of these animals to a different extent. This would complicate the interpretation of tissue concentration data from the different dose groups. However, if the levels of induction between dose groups are negligible or similar, it can be assumed that TCDD is either not being sequestered, or is being sequestered to a similar extent, in both dose groups. In this case, relative bioavailability can be determined based on relative concentrations in liver tissue between different dose groups.

The minimum dose of TCDD for significant induction of these binding proteins in rats appears to be around 1–10 ng/kg/day (Abraham et al. 1988; Kociba et al. 1978; Leung et al. 1990). The highest concentration of TCDD in Midland soils collected for a previous study of dioxin bioaccessibility was 139 pg TCDD/g soil (Ruby et al. 2002), which would result in a dose of 160 pg TCDD/day (assuming 5% soil in the diet [Sprague-Dawley rats find food unpalatable at greater than 5% soil in feed], and 23 g of feed consumption/day [Freeman et al. 1992]). Because this dose is nearly an order of magnitude below the dose at which enzyme induction becomes important, hepatic sequestration of TCDD is unlikely to occur in the proposed rat

study. However, as discussed above, the activity of the hepatic enzyme CYP1A2 will be measured in the liver of each rat after dosing, to confirm this assumption.

The rats will be dosed with PCDDs/Fs in rat feed for 30 consecutive days to allow body burdens to approach steady state. Measurement of tissue concentrations close to steady-state conditions is less prone to error. The 30-day dosing period was selected as a reasonable length of time based on the observation that the elimination half-life for TCDD body burden in Sprague-Dawley rats averages about 19 days (Geyer et al. 2002). Thus, after 30 days of continuous dosing, TCDD body burdens should be at approximately 65% of steady state, which should be acceptable for conducting the proposed study.

The test soils used for this study must contain a sufficient concentration of PCDDs/Fs to ensure that detectable concentrations of these compounds are present in the rat tissues at the end of the study. The following calculation was performed to determine the minimum concentration of TCDD in the test soils required to ensure detectable tissue levels of TCDD. Assuming that the absolute oral bioavailability of TCDD in soil is 10% (a conservative assumption for the purposes of this calculation), and that the rats will retain 7% of the absorbed dose in their liver (determined using the PBPK model of Leung et al. 1990), a minimum concentration of approximately 10 pg TCDD/g soil would be required for detection of TCDD in liver tissue after 30 days of dosing (assuming 5% soil in feed, 23 g of feed consumption/day, a liver weight of 12 g [Shu et al. 1988], and a method detection limit of 0.2 pg TCDD/g liver tissue). Inclusion of a five-fold margin to ensure accurate quantitation of TCDD would result in a minimum soil concentration of 50 pg TCDD/g soil. However, for the pilot study, the maximum available concentration of TCDD in soil will be used, because the Midland soils contain far lower concentrations of TCDD than have been used in previous *in vivo* studies (Ruby et al. 2002), and it is critical that TCDD be detectable in post-dosing animal tissues for the pilot study to succeed. The Tittabawassee River flood-plain soil will have a TEQ concentration approximately three times that of the Midland soil (approx. 1,000 pg/g), so detection of absorbed furans in the rat tissues should not be a problem.

A study of background concentrations of PCDDs/Fs in the liver and fat of Sprague-Dawley rats due to diet was conducted recently (Ruby et al. 2004) and indicated negligible concentrations of PCDDs/Fs. TCDD concentrations in all samples of liver and fat were below the detection limit (0.0594 pg/g). Concentrations of 4-PeCDF were non-detect (0.0907 pg/g) in the rat fat and were 1.42 pg/g (mean) in the rat livers. Given that dosing a rat with soil containing 50 pg TCDD/g soil for 30 days should result in a liver concentration of approximately 1.0 pg TCDD/g liver (based on the calculation cited above), the background concentrations of TCDD in the rat livers should not pose a problem for this study (i.e., the inter-animal and analytical variability associated with the absorbed dose should be detectable over the background concentrations in the animals). A similar calculation suggests that the concentration of 4-PeCDF detected in rat livers should not pose a problem for this study. However, concentrations of PCDDs/Fs in the rat chow used during the pilot study will be measured to ensure that background concentrations due to diet are not increasing.

Swine Model

The swine study is designed to determine the oral bioavailability of dioxins/furans in soil in a model that bears greater similarity to humans than do rats. The swine data could also be used to adjust the modeled human exposures to PCDDs/Fs in soil that were used to calculate the site-specific criterion for dioxins/furans in soil in Midland, Michigan (Exponent 2002). This would be accomplished by comparing the uptake of dioxins/furans from soil to that from corn oil spiked with the same compounds, to determine the relative bioavailability of the dioxins/furans from soil. The relative bioavailability estimate would be directly applicable to human health risk assessment. This value would then be adjusted for the uptake of TCDD from the corn oil matrix in swine, based on literature values for humans, to obtain an absolute bioavailability value. The absolute bioavailability values for TCDD from the test soil can then be compared to the equivalent value developed in the rat model.

The proposed study will rely on measurement of PCDDs/Fs in liver and fat after 30 consecutive days of dosing. As discussed above, in the rat, the concentration of TCDD that can be attained in the liver is dose dependent and controlled by the induction of one or more hepatic binding proteins. The minimum dose of TCDD in rats that results in detectable, significant induction of these proteins appears to be around 1–10 ng/kg/day (Abraham et al. 1988; Kociba et al. 1978; Leung et al. 1990). Because very little is known about the pharmacokinetics of TCDD in swine, the minimum induction dose in swine was assumed to be similar to that in rats. The highest concentration of TCDD in Midland soils collected for a previous study of dioxin bioaccessibility was 139 pg TCDD/g soil (Ruby et al. 2002), which would result in a dose of 695 pg TCDD/day if a 5-g dose of soil were administered to each of the swine. Because this dose is below the range at which enzyme induction becomes important in rats, significant hepatic sequestration of TCDD is unlikely to occur in the swine study. However, as with the rat study, EROD and MROD activity in swine liver will be measured in all dosing groups to confirm this assumption.

The test soil used for this study must contain a sufficient concentration of dioxins/furans to ensure that detectable concentrations of these compounds are present in the swine tissues at the end of the study. The following calculation was performed to determine the minimum concentration of TCDD in the test soils required to ensure detectable tissue levels of TCDD. Assuming that the absolute oral bioavailability of TCDD in soil is 10% (a conservative assumption for the purposes of this calculation), and that the swine will retain 7% of the absorbed dose in their liver (determined using the PBPK model for rats of Leung et al. [1990], because no such model exists for swine), a minimum concentration of 2 pg TCDD/g soil would be required for detection of TCDD in liver tissue after 30 consecutive days of dosing at 5 g soil/day (assuming analysis of 10 g of liver tissue, and a method detection limit of 0.2 pg TCDD/g liver tissue). Inclusion of a five-fold margin to ensure accurate quantitation of TCDD would result in a minimum soil concentration of 9 pg TCDD/g soil. However, for the pilot study, the maximum available concentration of TCDD in soil will be used, because the Midland soils contain far lower concentrations of TCDD than have been used in previous *in vivo* studies (Ruby et al. 2002), and it is critical that TCDD be detectable in post-dosing animal tissues for the pilot study to succeed. The Tittabawassee River flood-plain soil will have a TEQ concentration approximately three times that of the Midland soil (approx. 1,000 pg/g), so detection of absorbed furans in the swine tissues should not be a problem.

A study of background concentrations of PCDDs/Fs in the liver and fat of juvenile swine due to diet was conducted recently (Ruby et al. 2004) and indicated negligible concentrations of PCDDs/Fs. TCDD and 4-PeCDF concentrations in all samples of liver and fat were below the detection limits (0.0594 pg/g and 0.0907 pg/g, respectively). Thus, the background concentrations of TCDD and 4-PeCDF in the swine livers and fat should not pose a problem for this study (i.e., the inter-animal and analytical variability associated with the absorbed dose should be detectable over the background concentrations in the animals). However, concentrations of PCDDs/Fs in the swine feed used during the pilot study will be measured to ensure that background concentrations due to diet are not increasing.

Test Species Selection and Rationale

Rat Model

Adult, female, Sprague-Dawley rats (4 months of age, approx. 250 g) will be used for this study. This rat model was selected because the dioxin cancer slope factor (CSF) currently in use by the Michigan Department of Environmental Quality (DEQ) was derived from a study in rats (Kociba et al. 1978), and the cancer slope factor presented in EPA's Dioxin Reassessment (U.S. EPA 2000) is based in part on the Kociba rat study. In addition, two previous bioavailability studies of TCDD from soil were conducted in rats (Lucier et al. 1986; Shu et al. 1988). All of the studies cited above used the Sprague-Dawley strain of rat. Female rats will be used, because the CSF in EPA's Dioxin Reassessment (U.S. EPA 2000) is based in part on a benchmark dose assessment of the female rat liver tumor data from Kociba et al. (1978; revised pathology from Goodman and Sauer 1992). All Sprague-Dawley rats will be obtained from Harlan (Indianapolis, Indiana), and maintained on Purina laboratory rodent diet 5001 (the same rodent diet used by Kociba et al. in 1978).

Swine Model

Intact, male juvenile swine (*Sus scrofa*) at 6 weeks of age, and weighing approximately 10 kg, will be used for this study. Swine will be obtained from Chinn Farms (Clarence, Mississippi) and will be fed a specially formulated diet (Ziegler Bros. Inc., Gardners, Pennsylvania) that has been determined to be low in PCDD/F concentrations (Ruby et al. 2004). Juvenile swine were selected as an appropriate surrogate for humans because of the similarity in gastrointestinal physiology between swine and humans. For example, feeding behavior, gastrointestinal anatomy, acid secretion, and the development of small-intestinal absorption mechanisms are all quite similar between swine and humans (Weis and LaVelle 1991). For these reasons, swine have been used as a surrogate for humans in the fields of pharmaceutical research (Dodds 1982) and nutrition (Miller and Ullrey 1987). Juvenile animals were selected, because absorption rates are frequently greater in younger animals, and this model is designed to predict uptake in the most sensitive subpopulation of concern (i.e., children). This test species has been used to assess the oral bioavailability of both lead and arsenic in soil (Casteel et al. 1997a,b), and the results from these studies have been used by EPA to develop relative bioavailability adjustments for human health risk assessments (U.S. EPA 1999; Kelley et al. 2002).

Pilot Study

Rat Study

For the pilot rat study, fifty 4-month-old female Sprague-Dawley rats will be obtained from Harlan and placed in individual stainless steel cages. The rats will be provided Purina laboratory rodent diet 5001 and de-ionized water *ad libitum.* Their health status will be monitored over a one-week quarantine period, and two days prior to dosing, healthy animals will be assigned randomly to test groups.

Ten rats will be used for each dose group, with the tissues from two animals combined to achieve sufficient tissue mass for analysis (i.e., there will be five analyses per dose group). There will be five dose groups in the pilot study: two soil, a feed control, and two oral gavage groups. For the soil dose groups, the two test soils will be blended with the rat chow at 5 wt. % and dosed for 30 days. For the feed control, a blend of dioxins/furans representative of the Midland test soil will be prepared in acetone, blended with rat chow, and dosed for 30 days (see Dose Preparation section below for details). The two oral gavage groups will be dosed with mixtures of dioxins/furans that deliver the same oral doses as the Midland and Tittabawassee soils, but the dioxins/furans will be in corn oil/acetone mixture (99:1; gavage volume of 1 mL); this group will also be dosed for 30 days. Triplicate splits of the soil/chow and feed control/chow mixtures will be tested for TCDD to ensure that homogeneous dosing mixtures have been prepared. Twenty-four hours after the last dose is administered, the animals will be weighed and terminated under anesthesia. Their livers (anticipated to be approx. 10 g) will be excised, blotted dry, and weighed. As much fatty tissue as possible (approx. 4–5 g) will be collected from each rat.

Immediately after sacrifice, the liver samples for the EROD and MROD assays will be collected (1-g samples) from the livers of each pair of rats (i.e., half the sample collected from each liver), snap-frozen, and sent to Michigan State University (MSU) for analysis. The pair of livers will then be frozen and shipped to Alta Analytical, where they will be homogenized together to create a sample of sufficient mass for the planned analyses. As much fatty tissue as possible will be collected from each animal, and combined into a single sample from two rats. The fat samples will be shipped (frozen) to Alta. At Alta, the liver and fat samples will be homogenized, and subsamples will be collected for analysis of lipid content and PCDDs/Fs. In addition, triplicate 25-g subsamples of each blended rodent diet will be collected and shipped to Alta for analysis of dioxins/furans to evaluate the stability of the blended diets during the 30-day dosing period.

The liver and fat samples generated during the pilot study will be analyzed by high-resolution gas chromatography/mass spectrometry (HR-GC/MS; EPA Method 8290) at Alta Analytical Laboratory, Inc. (Alta) in Eldorado Hills, California. Each tissue sample analyzed for dioxins/furans will also be analyzed for lipid content (EPA Method 8290) at Alta, to allow for lipid normalization of the tissue concentration data. Because co-planar PCB concentrations in the liver and fat of Sprague-Dawley rats were uniformly low in the background study (Ruby et al. 2004), only a single liver sample from each dose group will be analyzed for co-planar PCBs

during the pilot study. These samples will be analyzed by HR-GC/MS (EPA Method 1668) by Alta.

The rat livers from the pilot study will be tested to determine whether the CYP1A enzymes have been induced, using EROD and MROD assays, at MSU. If differential induction of CYP1A is observed between dose groups (e.g., oral-soil versus oral-control), then further investigations based on enzyme-specific assays, such as measurement of the protein (western blots) or determination of mRNA for the enzyme, may be applied to elucidate the pattern of MFO induction, and the potential effects on interpretation of the study data.

Rat carcasses from the pilot study will be placed in individual, labeled Ziploc® bags and archived (–80 °C) while the samples are analyzed, and will not be disposed of until the data have been reviewed and it has been determined that no further sampling of the rat carcasses is necessary.

The pilot study in rats will produce the following samples for analysis (Table 1):

- 1 rat-chow sample for PCDDs/Fs
- 18 rat-chow/soil and rat-chow/control homogeneity and stability samples for PCDD/Fs
- 25 liver samples for EROD and MROD assays
- 50 tissue samples (25 each of liver and fat) for lipid content
- 50 tissue samples (25 each liver and fat) for PCDDs/Fs
- 5 liver samples for analysis of co-planar PCBs.

Table 1. Analyses of samples from rats/swine for the pilot bioavailability study

Analysis	Test Soil	Feed	Liver	Fat
PCDDs/Fs (HR-GC/MS)	4	19/1[a]	25/20	25/20
Co-planar PCBs (HR-GC/MS)	2	1/1	5/4	--
Lipid content	--	7/1	25/20	25/20
EROD/MROD assay	--	--	25/20	--

[a] For the rats, a single feed sample will be analyzed for PCDDs/Fs, and triplicate samples of the soil/feed and control dose/feed mixtures will be analyzed to check for homogeneity (TCDD analysis only).

Swine Study

For the pilot swine study, 20 intact, male juvenile swine (*Sus scrofa*) at 6 weeks of age will be obtained from Chinn Farms and fed a specially formulated diet (Ziegler Bros. Inc.) that has been determined to be low in PCDDs/Fs (Ruby et al. 2004). Animals will be housed in stainless-steel pens for a one-week quarantine period prior to dosing. Their health status will be monitored periodically. Two days prior to dosing, healthy animals will be assigned randomly to test groups and placed in individual stainless-steel metabolism cages to acclimate. They will remain in these cages for the duration of the study.

Feeding will occur twice daily, in equal portions, and de-ionized water will be provided *ad libitum*. There will be four dose groups of swine: two soil and two corn oil groups (five swine per dose group). For the soil dose groups, the test soil (10 g/day) will be given as a divided dose using the feed-ball dosing method for 30 consecutive days (see Dose Preparation section below for details). For the corn oil administration groups, dosing will occur by placing the corn oil in gelatin capsules (1 mL/capsule) and embedding each capsule in a feed-ball (see Dose Preparation section below for details). Immediately after dosing, the animals will be given their standard ration of swine feed. Twelve hours after the final dose is administered, the animals will be weighed and terminated under anesthesia.

Immediately after sacrifice, each swine liver will be excised, blotted dry, and weighed. The liver samples for the EROD and MROD assays will be collected (three 1-g samples/liver), snap-frozen, and sent to MSU for analysis. The remainder of the liver will be frozen (–80 °C). The fatty tissue sample will consist of 50–100 g of fat from the abdominal cavity. The liver and fat samples will be shipped to Alta (frozen), where the samples will be homogenized, and subsamples will be collected for analysis of lipid content and PCDDs/Fs. In addition, a 50-g sample of the swine diet will be shipped to Alta for analysis of PCDDs/Fs and co-planar PCBs.

The liver and fat samples generated during the pilot study will be analyzed for PCDDs/Fs by HR-GC/MS (EPA Method 8290) at Alta. Each tissue sample analyzed for dioxins/furans will also be analyzed for lipid content (EPA Method 8290) at Alta, to allow for lipid normalization of the tissue concentration data. Because co-planar PCB concentrations in the liver and fat of juvenile swine were uniformly low in the background study (Ruby et al. 2004), only a single liver sample from each dose group will be analyzed for co-planar PCBs during the pilot study. These samples will be analyzed by HR-GC/MS (EPA Method 1668) at Alta.

The swine livers from the pilot study will be tested to determine whether the CYP1A2 enzyme has been induced, using EROD and MROD assays. If differential induction of CYP1A2 is observed among dose groups (e.g., oral-soil versus oral-control), further investigations based on enzyme-specific assays, such as measurement of the protein (western blots) or determination of mRNA for the enzyme, may be applied to elucidate the pattern of MFO induction and the potential effects on interpretation of the study data.

All swine carcasses from the pilot study will be archived (frozen) while the samples are analyzed, and will not be disposed of until the data have been reviewed and it has been determined that no further sampling of the swine carcasses is necessary.

This pilot study will produce the following samples for analysis (Table 1):

- 1 swine feed sample for analysis of PCDDs/Fs
- 20 liver samples for EROD and MROD assays
- 40 tissue samples (20 each of liver and fat) for lipid content
- 40 tissue samples (20 each of liver and fat) for PCDDs/Fs
- 4 liver samples for analysis of co-planar PCBs.

Dose Preparation and Administration

Rat Study

For the pilot study, test soils containing dioxins/furans (<250-μm size fraction) will be blended with the rat feed (5% w/w). Based on previous studies of this type, female Sprague-Dawley rats will consume approximately 23 g of this mixture per day (Freeman et al. 1992). The rats will be allowed to consume the soil/feed mixture *ad libitum*. The mass consumed by each rat will be recorded every second day (by weighing the remaining feed and calculating the mass consumed by difference), and the feed will be replenished. The mass of any spilled feed will be estimated by the laboratory technician and recorded. These data will be used to calculate the dose received by each rat.

The dosing material for the feed control group will be prepared by dissolving the appropriate concentrations of dioxins/furans in acetone and blending it thoroughly with the rat feed (i.e., the method used by Kociba et al. [1978]). The feed control dosing material will be matched to the Midland test soil, to the extent practicable. This will be accomplished by spiking the five dioxin/furan congeners that contribute the most to the total TEQ in the test soil into acetone, and applying the mixture to rat feed. For example, TCDD, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, 1,2,3,4,6,7,8-HpCDD, and 1,2,3,6,7,8-HxCDD account for over 81% of the total TEQ in the Midland soils used in the bioaccessibility study (Ruby et al. 2002). If the study soil shows this set of congeners, then the feed control material matched to that soil will be prepared using these five congeners at the appropriate ratios. The dose of TCDD and the other congeners delivered in the control feed will be prepared so that it is equal to the dose of TCDD delivered in the test soil. The rats will be allowed to consume the control material/feed mixture *ad libitum*. The mass consumed by each rat will be recorded every second day (by weighing the remaining feed and calculating the mass consumed by difference), and the feed will be replenished. The mass of any spilled feed will be estimated by the laboratory technician, and recorded. These data will be used to calculate the dose received by each rat.

The dosing material for the two gavage groups will be prepared by dissolving the appropriate concentrations of dioxins/furans in a corn oil/acetone (99:1) mixture. The gavage dosing materials will be matched to the Midland and Tittabawassee test soils, to the extent practicable. This will be accomplished by spiking the five dioxin/furan congeners that contribute the most to the total TEQ in the test soils, into the corn oil/acetone at the appropriate ratios. The doses of

TCDD, 4-PeCDF, and the other congeners delivered in the gavage doses, will be prepared so that they are equal to the doses delivered in the test soils. A gavage dose of 1 mL of the appropriate corn oil/acetone mixture will be given to each rat in the two gavage dose groups on a daily basis.

Both the soil/feed and control/feed mixtures will be checked for homogeneity prior to dosing by collecting three grab samples and testing these samples for dioxin/furan concentrations. These data will be used to establish doses administered in each of the blended feeds. Subsequent to the 30-day dosing period, triplicate 25-g subsamples of each blended rodent diet will be collected and shipped to Alta for analysis of dioxins/furans to evaluate the stability of the blended diets, and to confirm the doses administered in the blended feeds.

Swine Study

For the swine pilot study, the test-soil doses will be delivered by placing 1 g of the soil in the center of a 20-g moistened dough ball (Zeigler Bros. Swine Diet) and offering it to the swine. The swine will be fasted for two hours prior to dosing, because previous studies conducted in this animal model have indicated that a 2-hour fast will ensure eager acceptance of the 20-g dough ball containing the dose. Five dough balls (containing a total of 5 g of test soil) will be given each morning and afternoon, for a total dose of 10 g soil/day. Immediately after dosing, the animals will be given one-half their standard ration of swine feed. Dosing and feeding will continue twice daily for 30 consecutive days.

The dosing materials for the control groups will be prepared by dissolving the appropriate concentrations of PCDDs/Fs in a corn oil/acetone (99:1) mixture. The corn oil/acetone mixture will be prepared so that 2 mL of this mixture will deliver an equivalent dose to 5 g of the test soil to which it is matched. The corn oil solution will be placed in gel capsules (1 mL/capsule), and these will be embedded in the center of a 20-g ball of moistened swine feed. The feed ball will then be offered to the swine. The control dosing materials will be matched to the test soils, to the extent practicable. This will be accomplished by spiking the five dioxin/furan congeners that contribute the most to the total TEQ in the two test soils into corn oil. For example, TCDD, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, 1,2,3,4,6,7,8-HpCDD, and 1,2,3,6,7,8-HxCDD account for over 81% of the total TEQ in the Midland soils used in the bioaccessibility study (Ruby et al. 2002). If the Midland soil shows this congener profile, then the control material matched to this soil will be prepared using these five congeners at the appropriate ratios. The doses of TCDD, 4-PeCDF, and the other congeners delivered in the control doses will be prepared so that they are equal to the doses of these compounds delivered in the test soils. As with the soil dose groups, the control material will be dosed for 30 consecutive days.

Data Analysis

Statistical analyses will be conducted on the data from the pilot study to determine the number of rats and swine needed per dose group in the full study. This will be accomplished by calculating the sample size per group necessary to distinguish the mean soil-dosed tissue concentration from the mean background tissue concentration, and the mean soil-dosed tissue

concentration from the mean control-dosed tissue concentration. Both sample-size calculations will be done using a Type 1 error rate of 0.05 and a power of 0.80 (Type 2 error of 0.20). The number of rats and swine per dose group in the full study will be adjusted based on the larger of these two sample-size determinations. However, if the variance in the pilot study data is such that a reasonable difference cannot be demonstrated with sufficient power, even with a large number of rats or swine per dose group (i.e., >10), then other study parameters (e.g., soil concentration, dosing time, etc.) may have to be changed to increase the power of the study.

The results from the pilot study will also be used to calculate the relative bioavailability of TCDD and 4-PeCDF from the test soils, and associated confidence intervals. This will be accomplished by calculating the mean tissue concentrations of TCDD and 4-PeCDF from the soil and control doses, and the associated standard errors. The uncertainty in the ratio describing relative bioavailability (i.e., mean tissue concentration from soil dose/mean tissue concentration from control dose) will be calculated using a Monte Carlo simulation. The 5^{th} and 95^{th} percentile values from the simulated distribution of relative bioavailability values will be taken as the 90% confidence interval on the relative bioavailability.

Reporting

Once all of the *in vivo* and analytical work has been completed, a study report will be prepared. This report will include a description of the animal handling and dosing procedures, tissue collection, and methods of analysis. Analytical results will be provided in tabular and graphical format, and estimates of the absolute and relative bioavailability of dioxins/furans from the test soil in each of the two animal models will be presented.

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Appendix C

WIL Research Report: Preparation of Diets for a Dietary Exposure Study with Dioxin-Contaminated Soils in Rats

PROJECT TITLE

Preparation of Diets for a Dietary Exposure Study with Dioxin-Contaminated Soils in Rats

PROJECT NUMBER

WIL-518001

CONTRIBUTING SCIENTIST

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GENERAL CONSIDERATIONS

To my knowledge, there were no significant deviations from the intended scope of work or the Standard Operating Procedures of WIL Research Laboratories, Inc. that would be expected to affect the scientific integrity of this study.

_____ _____

Daniel W. Sved, Ph.D. Date
Director, Metabolism and
Analytical Chemistry

PREPARATION OF DIETS FOR A DIETARY EXPOSURE STUDY WITH DIOXIN-CONTAMINATED SOILS IN RATS

1. INTRODUCTION

WIL Research Laboratories, Inc. was subcontracted by Exponent, Inc. to prepare rodent diets containing 5% of Test Soil 1, 5% of Test Soil 2, or a dioxin reference mixture. Samples of the dietary admixes and the basal diet used were sent to Alta Analytical Laboratory for analysis. Dietary admixes and basal diet were shipped to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia.

2. TEST MATERIALS

The following materials were supplied to WIL Research Laboratories for use in preparing the dietary admixes.

A. Test Soil 1

Test Soil 1 was received from Exponent, Inc., Boulder, CO on July 29, 2004 and was assigned WIL Log No. 6256A. The material was labeled with the following information.

CC-S-27 (<250 µm – 2 of 4)
Tag No. 44090

B. Test Soil 2

Test Soil 2 was received from Exponent, Inc., Boulder, CO on July 29, 2004 and was assigned WIL Log No. 6257A. The material was labeled with the following information.

THT02769
Tag No. 57283
(IP2) Test Soil #2
<250 µm

C. Reference Mixture

The reference mixture was received from Alta Analytical Laboratory, El Dorado Hills, CA on August 3, 2004 and was assigned WIL Log No. 6261A. The material was labeled with the following information.

Feed Blending Reference Mixture 040728A
2378-TCDD 0.625 pg/µL

12378-PeCDD 0.3175 pg/µL
123678-HxCDD 0.349 pg/µL
1234678-HpCDD 5.54 pg/µL
23478-PeCDF 0.1715 pg/µL
EXP: 7/28/06

3. BASAL DIET

The basal diet used for this project was PMI International, LLC Certified Rodent LabDiet 5001 (meal). Lot number MAY 17 04 2 was used for the initial dietary admixes prepared on August 4, 2004. Lot number AUG 21 04 3 was used for the additional admix with Test Soil 1 on August 25, 2004; the remaining diet from this lot was shipped to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia.

4. MIXING PROCEDURE

A total batch size of 9.5 kg was prepared for each dietary admix. For the diets containing contaminated soil, 475 g of the appropriate test soil was weighed into a tared vessel. For the diet containing the reference mixture, 100 mL of the reference mixture was measured in a graduated cylinder (to deliver). For each pre-mixture, the test material was transferred to a Hobart mixer containing 1000 g of basal diet and the components mixed for 5 minutes with the speed setting on 1. The pre-mixtures were transferred to a V-blender along with the remaining amount of basal diet needed to achieve the total batch size (8025 g for the soils and 8500 g for the reference mixture). The components were mixed for 15 minutes using the intensifier bar for the first and last 5 minutes. After sample collection (see Section 5), the diet containing the reference mixture remained in an open container for approximately 24 hours to allow the acetone to evaporate.

Based on the analytical results of the dietary admix with Test Soil 1, a second batch of diet containing Test Soil 1 was prepared as previously described. The two dietary admixes with Test Soil 1 were distinguished by their preparation date and were also designated as Mix #1 and Mix #2.

5. SAMPLE COLLECTION AND SHIPMENT

Three samples (25 g each) of each dietary admix were collected into plastic ziplock-type bags. Samples were collected from the initial (bottom), middle, and last (top) portions of the admixes as they were discharged from the V-blender. Samples were shipped under ambient conditions to Alta Analytical Laboratory using an overnight courier. A sample (25 g) of each lot of basal diet used was also sent to Alta Analytical Laboratory.

6. SHIPMENT OF DIETARY ADMIXES

The dietary admixes were shipped under ambient conditions to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia using an overnight courier. Each diet was shipped in a separate container. Additionally, any remaining basal diet (lot number AUG 21 04 3) was also shipped.

7. DISPOSITION OF REMAINING TEST MATERIALS

Following shipment of the dietary admixes, all remaining test materials were returned to their respective suppliers.

Appendix D

Detailed Study Data

Table D-1. Rat feed intake during the pilot study

Rat #	Feed Intake (g) Thurs 2-Sep Study Day 2	Sat 4-Sep Study Day 4	Mon 6-Sep Study Day 6	Wed 8-Sep Study Day 8	Fri 10-Sep Study Day 10	Sun 12-Sep Study Day 12	Tues 14-Sep Study Day 14	Thurs 16-Sep Study Day 16	Sat 18-Sep Study Day 18	Mon 20-Sep Study Day 20	Wed 22-Sep Study Day 22	Fri 24-Sep Study Day 24	Sun 26-Sep Study Day 26	Tues 28-Sep Study Day 28	Thurs 30-Sep Study Day 30	Total	Paired Rats	Paired Mean Total Intake (g)
Group 1: Midland Reference Gavage																		
10	30.90	28.15	23.84	25.23	19.61	28.63	25.01	24.04	30.83	23.93	28.18	29.38	23.83	20.04	26.22	387.82	10 & 11	382.68
11	23.14	25.52	21.90	23.56	28.03	23.38	29.31	25.37	27.58	26.16	28.09	25.12	20.92	22.31	27.15	377.54		
12	39.23	35.42	42.91	42.86	44.10	44.71	38.78	38.07	39.28	37.59	44.18	44.95	46.53	47.87	41.38	627.86	12 & 13	489.16
13	34.11	26.53	25.79	27.22	16.28	17.30	19.95	16.80	22.72	19.03	22.88	23.96	22.69	27.97	27.23	350.46		
14	34.72	34.57	33.97	32.77	31.14	31.41	26.76	30.56	24.34	24.16	26.32	35.19	34.13	31.39	28.62	460.05	14 & 15	462.09
15	25.28	28.71	29.40	35.89	26.91	39.28	30.17	36.27	31.27	35.16	29.02	31.53	27.00	32.48	25.76	464.13		
16	21.41	25.78	25.34	21.71	28.05	24.21	28.13	22.22	29.29	23.60	31.88	28.19	29.24	28.60	27.22	394.87	16 & 17	368.95
17	26.05	25.42	23.85	25.74	19.61	23.33	21.49	21.64	27.42	18.17	23.20	21.56	22.15	23.60	19.79	343.02		
18	27.94	23.65	24.69	20.90	20.87	19.23	22.22	23.67	21.62	23.43	22.70	21.04	23.69	22.48	25.46	343.59	18 & 19	372.13
19	26.74	30.29	28.48	29.97	28.04	27.67	26.10	24.55	30.49	25.40	26.14	25.12	22.80	26.24	22.63	400.66		
Gp 1 Mean	**28.95**	**28.40**	**28.02**	**28.59**	**26.26**	**27.92**	**26.79**	**26.32**	**28.48**	**25.66**	**28.26**	**28.60**	**27.30**	**28.30**	**27.15**	**415.00**		
Group 2: Tittabawassee River Flood Plain Soil Reference Gavage																		
20	22.88	13.71	20.15	21.60	24.59	21.08	25.93	30.16	40.76	41.20	36.89	35.53	40.24	38.37	32.08	445.17	20 & 21	399.20
21	27.82	27.28	31.21	28.36	24.04	21.21	19.65	24.75	21.94	21.50	23.94	20.15	20.41	21.67	19.29	353.22		
22	29.60	29.26	30.13	34.56	27.20	22.51	26.48	23.93	27.89	29.63	28.45	27.77	32.20	36.31	32.45	438.37	22 & 23	421.99
23	24.25	24.87	20.96	28.95	30.10	28.13	30.90	24.14	28.44	24.21	23.53	25.74	29.35	26.16	35.87	405.60		
24	21.46	26.91	25.27	26.20	20.23	24.67	24.23	20.61	7.71	18.75						216.04	24 & 29[a]	177.51
25	25.24	22.37	24.36	22.87	25.40	21.85	28.26	20.02	24.08	19.93	22.57	22.55	23.56	40.00	23.60	366.66	25 & 26	384.53
26	30.49	28.22	24.26	26.25	26.60	22.94	26.26	25.24	27.41	25.03	25.33	27.46	25.84	33.39	27.68	402.40		
27	22.47	31.30	26.30	32.00	32.44	26.65	18.02	25.67	14.16	25.98	21.96	20.35	27.59	28.44	28.34	381.67	27 & 28	394.41
28	20.76	27.85	24.19	28.91	22.05	31.53	26.99	27.29	31.86	10.42	27.66	33.36	25.19	35.66	33.42	407.14		
29	25.27	10.58	9.71	19.98	21.89	20.20	22.69	8.66								138.98		
Gp 2 Mean	**25.02**	**24.24**	**23.65**	**26.97**	**25.45**	**24.08**	**24.94**	**23.05**	**24.92**	**24.07**	**26.29**	**26.61**	**28.05**	**32.50**	**29.09**	**400.03[b]**		
Group 3: Midland Soil																		
30	30.56	38.87	38.08	44.21	39.82	41.43	36.49	39.33	42.36	44.57	36.60	40.41	34.77	36.59	34.44	578.53	30 & 31	563.35
31	39.10	37.24	39.90	37.20	38.78	33.99	37.11	36.17	34.54	36.11	31.50	37.80	37.14	33.47	38.11	548.16		
32	36.12	36.55	34.18	35.06	32.80	35.39	35.67	34.40	34.73	30.88	34.07	31.88	33.64	31.64	32.45	509.46	32 & 33	477.20
33	32.25	25.78	33.07	27.88	32.97	31.02	30.42	29.23	28.27	30.80	23.82	33.78	29.62	28.73	27.29	444.93		
34	32.84	35.75	33.95	30.99	35.53	32.66	32.73	36.69	30.90	35.86	29.24	38.06	26.31	32.01	32.95	496.47	34 & 35	504.14
35	26.15	41.41	38.70	33.17	28.10	29.09	40.09	33.26	39.52	34.64	30.24	36.57	29.06	35.90	35.91	511.81		
36	39.49	35.41	29.82	31.03	32.66	34.49	35.37	36.16	33.43	34.56	34.13	30.65	34.55	28.48	34.12	504.35	36 & 37	531.42
37	36.63	39.21	40.25	35.46	38.74	34.92	38.50	41.27	34.23	40.31	32.55	39.04	34.05	34.04	39.29	558.49		
38	34.26	38.86	38.26	34.35	41.77	46.63	42.88	39.59	38.71	40.92	39.53	43.44	37.75	40.87	41.40	599.22	38 & 39	511.01
39	25.21	28.76	28.11	25.51	32.03	24.41	30.35	28.03	27.35	30.73	28.01	30.11	29.03	25.86	29.30	422.80		
Gp 3 Mean	**33.26**	**35.78**	**35.43**	**33.49**	**35.32**	**34.40**	**35.96**	**35.41**	**34.40**	**35.94**	**31.97**	**36.17**	**32.59**	**32.76**	**34.53**	**517.42**		

Table D-1. (cont.)

Rat #	Feed Intake (g) Thurs 2-Sep Study Day 2	Sat 4-Sep Study Day 4	Mon 6-Sep Study Day 6	Wed 8-Sep Study Day 8	Fri 10-Sep Study Day 10	Sun 12-Sep Study Day 12	Tues 14-Sep Study Day 14	Thurs 16-Sep Study Day 16	Sat 18-Sep Study Day 18	Mon 20-Sep Study Day 20	Wed 22-Sep Study Day 22	Fri 24-Sep Study Day 24	Sun 26-Sep Study Day 26	Tues 28-Sep Study Day 28	Thurs 30-Sep Study Day 30	Total	Paired Rats	Paired Mean Total Intake (g)
Group 4: Tittabawassee River Flood Plain Soil																		
40	33.65	38.66	38.54	37.87	37.20	40.83	36.78	39.07	36.72	32.06	36.74	32.79	35.99	34.23	32.17	543.30	40 & 41	548.74
41	37.68	39.97	33.45	33.61	36.88	37.23	40.41	36.59	37.15	40.03	33.15	38.88	33.63	38.95	36.56	554.17		
42	34.72	34.68	33.94	38.78	31.59	34.50	36.89	33.36	37.69	36.41	31.60	40.10	36.73	41.17	41.34	543.50	42 & 43	592.14
43	39.09	35.17	38.22	42.19	39.90	42.54	38.35	43.78	42.75	45.48	44.79	44.82	48.00	47.68	48.02	640.78		
44	37.23	40.66	43.65	36.40	41.92	39.89	38.90	35.37	35.39	34.73	38.78	44.24	43.07	44.75	49.00	603.98	44 & 45	564.56
45	30.89	39.13	34.44	34.12	37.36	33.95	33.26	38.18	34.51	34.46	35.15	35.28	33.99	37.69	32.73	525.14		
46	40.21	41.18	29.44	44.50	45.50	46.00	47.00	48.00	48.00	48.00	48.50	48.75	48.00	48.00	46.00	677.08	46 & 47	605.22
47	34.96	35.32	37.96	35.42	32.30	37.10	37.10	36.86	37.14	34.75	35.46	41.09	29.18	36.85	31.87	533.36		
48	36.75	40.65	31.87	42.85	42.97	43.18	44.73	44.45	42.96	43.00	34.60	39.95	47.50	47.82	40.84	624.12	48 & 49	586.04
49	35.47	37.30	40.20	37.29	38.02	35.71	39.78	37.57	39.46	38.19	34.44	34.59	33.87	34.93	31.14	547.96		
Gp 4 Mean	**36.07**	**38.27**	**36.17**	**38.30**	**38.36**	**39.09**	**39.32**	**39.32**	**39.18**	**38.71**	**37.32**	**40.05**	**39.00**	**41.21**	**38.97**	**579.34**		
Group 5: Midland Reference Feed																		
50	31.91	31.27	30.33	33.24	28.81	28.36	32.27	29.80	30.46	31.79	23.50	35.61	23.50	32.51	29.66	453.02	50 & 51	486.41
51	36.16	41.06	32.11	34.77	34.23	30.11	35.33	30.97	33.72	33.23	30.45	34.85	37.93	38.21	36.66	519.79		
52	28.55	30.22	29.66	28.18	31.03	28.31	27.99	31.11	26.75	29.63	27.68	30.88	28.73	28.47	28.48	435.67	52 & 53	503.40
53	34.50	39.97	37.68	36.08	35.70	37.65	34.52	38.91	40.09	39.56	39.02	43.45	37.95	42.10	33.95	571.13		
54	31.67	34.30	30.25	33.36	26.60	30.32	28.30	31.22	34.17	39.81	39.59	42.06	39.73	29.99	29.85	501.22	54 & 55	481.49
55	29.69	34.22	26.23	30.10	27.07	29.25	28.93	43.18	27.96	31.09	30.39	33.48	26.60	32.13	31.44	461.76		
56	29.63	34.17	32.59	27.61	30.16	24.50	26.73	24.75	29.92	30.44	30.50	30.91	30.41	30.55	32.33	445.20	56 & 57	457.32
57	29.89	33.99	31.46	31.77	36.82	28.83	31.96	30.81	27.27	30.38	28.62	32.45	31.74	29.40	34.05	469.44		
58	34.65	35.41	33.90	33.40	31.98	18.27	25.06	22.12	27.21	20.79	30.70	29.42	26.57	35.66	25.55	430.69	58 & 59	446.53
59	31.01	38.09	27.75	32.29	29.45	31.78	28.00	33.90	28.05	30.72	30.90	34.32	26.06	33.73	26.32	462.37		
Gp 5 Mean	**31.77**	**35.27**	**31.20**	**32.08**	**31.19**	**28.74**	**29.91**	**31.68**	**30.56**	**31.74**	**31.14**	**34.74**	**30.92**	**33.28**	**30.83**	**475.03**		

Note: Rats were offered 50 g of feed every 2 days.

[a] Rats #29 and #24 were sacrificed after 15 and 20 days of dosing, respectively, due to persistent problems with administering the gavage dose.

[b] Mean excludes the rat-pair who were sacrificed early.

Table D-2. Rat body weights during the pilot study

Rat #	Body Weight (g) Wed 25-Aug Study Day -6	Sun 29-Aug Study Day -2	Fri 3-Sep Study Day 3	Fri 10-Sep Study Day 10	Fri 17-Sep Study Day 17	Fri 24-Sep Study Day 24	Thurs 30-Sep Study Day 30[a]	Paired Rats	Body Weight (g) Mean Rat Pair Day -2 to 30	Terminal Rat Pair Study Day 30
Group 1: Midland Reference Gavage										
10	227.32	246.74	258.92	251.80	266.22	282.71	269.57	10 & 11	252.37	256.46
11	229.82	238.80	238.90	240.84	242.45	248.09	243.34			
12	226.01	242.66	245.58	259.82	258.01	277.81	288.96	12 & 13	262.33	281.82
13	229.22	258.70	259.02	259.66	257.20	265.83	274.68			
14	219.83	236.64	240.49	243.53	241.81	252.26	254.91	14 & 15	245.17	250.93
15	228.14	235.91	240.85	241.91	252.76	253.98	246.94			
16	228.16	243.27	240.50	244.33	241.37	254.86	257.21	16 & 17	246.37	254.55
17	218.67	233.56	239.90	244.61	249.99	254.95	251.89			
18	228.96	239.78	238.06	239.44	244.73	249.92	249.19	18 & 19	247.63	249.86
19	230.51	240.52	247.95	257.30	256.59	257.55	250.53			
Grp 1 Mean	**226.66**	**241.66**	**245.02**	**248.32**	**251.11**	**259.80**	**258.72**	**Grp 1 Mean**		**258.72**
Group 2: Tittabawassee River Flood Plain Soil Reference Gavage										
20	220.95	227.82	228.82	235.86	237.27	242.49	241.92	20 & 21	241.04	247.42
21	215.93	229.15	238.31	250.70	250.24	256.93	252.91			
22	216.30	232.21	240.34	245.98	248.71	257.53	254.62	22 & 23	244.28	252.49
23	222.97	233.76	234.67	238.12	242.19	252.85	250.35			
24	219.39	238.29	238.52	245.57	232.51	dead	dead	24 & 29[b]	241.20	235.56
25	223.76	236.98	241.36	252.20	253.43	263.57	247.84	25 & 26	251.07	253.67
26	220.20	240.19	245.25	251.37	258.07	263.12	259.50			
27	226.74	234.89	244.43	266.72	248.68	263.82	267.74	27 & 28	244.09	251.25
28	225.60	232.88	236.09	226.65	233.36	239.07	234.75			
29	232.55	251.32	241.08	238.61	dead	dead	dead			
Grp 2 Mean	**222.44**	**235.75**	**238.89**	**245.18**	**244.94**	**254.92**	**251.20**	**Grp 2 Mean[c]**	**245.12**	**251.20**
Group 3: Midland Soil										
30	224.12	234.36	238.46	235.65	243.17	251.54	247.03	30 & 31	256.46	271.69
31	226.45	249.07	256.49	268.64	275.24	281.48	296.35			
32	223.26	239.38	240.67	249.19	256.64	260.05	269.55	32 & 33	244.42	257.19
33	216.93	228.26	227.48	233.10	237.93	245.91	244.83			
34	229.36	244.44	252.32	260.91	265.09	273.68	275.34	34 & 35	259.73	269.76
35	235.12	255.84	252.18	250.47	260.22	262.11	264.18			
36	226.34	246.22	256.72	247.32	249.44	253.71	253.92	36 & 37	246.55	252.98
37	218.35	231.69	234.07	240.16	241.81	251.51	252.03			
38	217.60	240.04	247.90	254.77	262.18	269.07	267.45	38 & 39	248.39	258.44
39	217.80	229.49	232.51	239.83	238.69	249.30	249.42			
Grp 3 Mean	**223.53**	**239.88**	**243.88**	**248.00**	**253.04**	**259.84**	**262.01**	**Grp 3 Mean**		**262.01**
Group 4: Tittabawassee River Flood Plain Soil										
40	220.50	230.42	242.09	252.31	256.30	255.30	259.90	40 & 41	251.24	259.24
41	229.74	244.26	251.25	249.37	252.92	262.17	258.57			
42	220.20	237.93	244.79	248.40	255.40	269.29	280.21	42 & 43	251.77	274.75
43	210.02	230.84	237.51	241.39	250.97	255.27	269.29			
44	237.98	247.10	258.64	270.70	270.68	277.48	281.41	44 & 45	263.97	277.66
45	219.99	242.52	247.50	259.93	263.70	274.05	273.90			
46	217.86	236.47	242.25	244.96	256.07	256.43	251.95	46 & 47	250.95	258.63
47	219.88	234.70	241.04	247.78	259.45	274.94	265.31			
48	218.96	236.69	240.94	242.03	245.77	251.14	253.08	48 & 49	241.30	248.76
49	213.48	227.81	230.45	235.76	239.15	248.33	244.44			
Grp 4 Mean	**220.86**	**236.87**	**243.65**	**249.26**	**255.04**	**262.44**	**263.81**	**Grp 4 Mean**		**263.81**

Table D-2. (cont.)

Rat #	Body Weight (g) Wed 25-Aug Study Day -6	Sun 29-Aug Study Day -2	Fri 3-Sep Study Day 3	Fri 10-Sep Study Day 10	Fri 17-Sep Study Day 17	Fri 24-Sep Study Day 24	Thurs 30-Sep Study Day 30[a]	Paired Rats	Body Weight (g) Mean Rat Pair Day -2 to 30	Terminal Rat Pair Study Day 30
Group 5: Midland Reference Feed										
50	221.21	234.91	240.96	247.44	247.89	255.09	250.36	50 & 51	254.29	268.32
51	226.42	243.77	253.09	259.16	262.19	270.40	286.27			
52	216.44	226.50	231.82	241.35	245.22	254.67	253.28	52 & 53	238.93	250.18
53	217.16	226.77	224.07	237.05	239.51	239.90	247.07			
54	226.09	234.14	240.47	247.37	254.51	268.93	259.72	54 & 55	252.63	257.96
55	236.74	248.40	250.35	254.48	257.48	259.46	256.20			
56	218.55	231.66	237.84	236.25	237.59	246.56	250.95	56 & 57	247.91	259.44
57	220.33	240.30	244.43	251.31	253.39	276.68	267.92			
58	249.56	247.41	258.25	267.36	262.41	263.04	260.69	58 & 59	253.43	255.36
59	223.14	238.72	241.52	245.88	248.78	257.05	250.03			
Grp 5 Mean	**225.56**	**237.26**	**242.28**	**248.77**	**250.90**	**259.18**	**258.25**	**Grp 5 Mean**		**258.25**

[a] Weight after death.

[b] Rats #29 and #24 were sacrificed after 15 and 20 days of dosing, respectively, due to persistent problems with administering the gavage dose

[c] Mean excludes the rat-pair who were sacrificed early.

Table D-3. Rat necropsy liver and fat sample weights

Rat #	Liver Weight (g)	Abdominal Fat Sample Weight (g)	Paired Rats	Liver Weight Average (by pair) (g)	Abdominal Fat Sample Weight (by pair, sum) (g)
Group 1: Midland Reference Gavage					
10	10.26	3.84	10 & 11	8.95	8.33
11	7.63	4.49			
12	9.87	4.32	12 & 13	9.60	7.44
13	9.33	3.12			
14	9.45	4.46	14 & 15	9.00	8.32
15	8.54	3.86			
16	8.09	3.76	16 & 17	8.35	8.31
17	8.60	4.55			
18	8.55	4.12	18 & 19	8.31	9.09
19	8.07	4.97			
Gp 1 Mean	**8.84**	**4.15**			
Group 2: Tittabawassee River Flood Plain Soil Reference Gavage					
20	8.09	4.09	20 & 21	8.44	8.66
21	8.78	4.57			
22	9.23	4.93	22 & 23	8.67	10.76
23	8.11	5.83			
24	9.44 [a]	1.02 [a]	24 & 29	8.97	3.88
25	7.33	3.06	25 & 26	8.26	7.27
26	9.18	4.21			
27	9.18	6.67	27 & 28	8.54	10.94
28	7.89	4.27			
29	8.50 [b]	2.86 [b]			
Gp 2 Mean	**8.57**	**4.15**			
Group 3: Midland Soil					
30	7.95	3.04	30 & 31	9.68	9.61
31	11.40	6.57			
32	9.08	4.94	32 & 33	8.50	8.35
33	7.91	3.41			
34	9.63	4.96	34 & 35	9.68	9.63
35	9.73	4.67			
36	9.08	3.92	36 & 37	9.21	7.37
37	9.34	3.45			
38	9.73	4.56	38 & 39	9.18	8.56
39	8.63	4.00			
Gp 3 Mean	**9.25**	**4.35**			
Group 4: Tittabawassee River Flood Plain Soil					
40	9.31	4.77	40 & 41	9.11	8.21
41	8.91	3.44			
42	11.13	4.87	42 & 43	10.76	10.33
43	10.39	5.46			
44	9.90	4.57	44 & 45	9.79	7.26
45	9.68	2.69			
46	7.51	4.04	46 & 47	8.31	7.96
47	9.10	3.92			
48	8.59	3.41	48 & 49	8.49	6.69
49	8.38	3.28			
Gp 4 Mean	**9.29**	**4.05**			

Table D-3. (cont.)

Rat #	Liver Weight (g)	Abdominal Fat Sample Weight (g)	Paired Rats	Liver Weight Average (by pair) (g)	Abdominal Fat Sample Weight (by pair, sum) (g)
Group 5: Midland Reference Feed					
50	9.26	3.41	50 & 51	9.64	8.94
51	10.02	5.53			
52	8.62	4.01	52 & 53	8.39	8.96
53	8.16	4.95			
54	9.69	4.40	54 & 55	9.29	7.66
55	8.88	3.26			
56	9.52	3.81	56 & 57	9.70	8.10
57	9.87	4.29			
58	9.44	3.89	58 & 59	9.25	8.29
59	9.05	4.40			
Gp 5 Mean	**9.25**	**4.20**			

Notes:

Liver was weighed, EROD/MROD sample cut out, remainder wrapped in foil and placed on dry ice.
For fat samples, samplers tried to get 4–5 g from same areas on all rats. Fat samples were weighed, wrapped in foil, and placed on dry ice

[a] Sample was taken on 9/20/04 before study termination.

[b] Sample was taken on 9/16/04 before study termination.

Table D-4. Rat liver microsomal EROD and MROD activities

Group	Entrix Sample ID	Exponent ID	EROD (pmol/mg/min)	MROD (pmol/mg/min)
1	ERL-1	10 & 11	257.5	120.6
1	ERL-2	12 & 13	168.4	111.9
1	ERL-3	14 & 15	115.8	95.4
1	ERL-4	16 & 17	151.2	104.9
1	ERL-5	18 & 19	153.1	108.6
2	ERL-6	20 & 21	486.1	196.5
2	ERL-7	22 & 23	430.0	176.2
2	ERL-26	24[a]	489.4	101.1
2	ERL-8	25 & 26	406.6	68.6
2	ERL-9	27 & 28	455.3	209.1
3	ERL-10	30 & 31	99.1	93.0
3	ERL-11	32 & 33	75.7	95.3
3	ERL-12	34 & 35	84.4	119.6
3	ERL-13	36 & 37	91.4	115.6
3	ERL-15	38 & 39	62.5	80.9
4	ERL-16	40 & 41	261.1	148.3
4	ERL-17	42 & 43	319.0	139.3
4	ERL-18	44 & 45	307.2	198.3
4	ERL-19	46 & 47	346.8	154.3
4	ERL-20	48 & 49	361.5	198.0
5	ERL-21	50 & 51	152.5	120.0
5	ERL-22	52 & 53	151.9	139.1
5	ERL-23	54 & 55	128.3	117.7
5	ERL-24	56 & 57	146.7	136.8
5	ERL-25	58 & 59	120.9	96.2

Note: All assays conducted as outlined in SOP250 MSU-ATL SOP 250 version 1
Sample #29 was not analyzed due to ampule breakage and loss of sample in transit.

[a] Results excluded from analyses because this animal was sacrificed before end of study.

Table D-5. Tissue concentrations, doses, and RBA calculations for the rat pilot study: Midland soil

	Midland Soil (Group 3)											
	Soil CC-S-27/ Diet Blend (Test Article #1)						Using Mean BW					
Analyte	Mean Conc. (pg/g)	% of TEQ (in soil)	Group 3 Rat IDs	Total Feed Intake (g)	Mean BW (g)	Terminal BW (g)	Total Dose (pg/g BW)	Avg. Daily Dose (pg/g BW/d)	Avg. Daily Dose S.D.	Total Dose (pg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)
2,3,7,8-TCDD	4.40	48.9%	Grp 3 Mean	517.42	251.11	262.01	9.07	0.302	0.017	2,277		
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	Grp 3 Mean	517.42	251.11	262.01	5.15	0.172	0.010	1,294		
1,2,3,6,7,8-HxCDD	3.59	2.7%	Grp 3 Mean	517.42	251.11	262.01	7.40	0.247	0.014	1,858		
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	Grp 3 Mean	517.42	251.11	262.01	145	4.822	0.271	36,323		
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	Grp 3 Mean	517.42	251.11	262.01	2.99	0.100	0.006	750		
2,3,7,8-TCDD	4.40	48.9%	30 & 31	563.35	256.46	271.69	9.67	0.322		2,479	9.68	9.81
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	30 & 31	563.35	256.46	271.69	5.49	0.183		1,408	9.68	12.6
1,2,3,6,7,8-HxCDD	3.59	2.7%	30 & 31	563.35	256.46	271.69	7.89	0.263		2,022	9.68	32.0
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	30 & 31	563.35	256.46	271.69	154	5.140		39,547	9.68	335
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	30 & 31	563.35	256.46	271.69	3.19	0.106		817	9.68	21.1
2,3,7,8-TCDD	4.40	48.9%	32 & 33	477.20	244.42	257.19	8.59	0.286		2,100	8.50	11.3
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	32 & 33	477.20	244.42	257.19	4.88	0.163		1,193	8.50	14.0
1,2,3,6,7,8-HxCDD	3.59	2.7%	32 & 33	477.20	244.42	257.19	7.01	0.234		1,713	8.50	37.3
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	32 & 33	477.20	244.42	257.19	137	4.569		33,499	8.50	387
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	32 & 33	477.20	244.42	257.19	2.83	0.094		692	8.50	24.1
2,3,7,8-TCDD	4.40	48.9%	34 & 35	504.14	259.73	269.76	8.54	0.285		2,218	9.68	9.35
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	34 & 35	504.14	259.73	269.76	4.85	0.162		1,260	9.68	11.1
1,2,3,6,7,8-HxCDD	3.59	2.7%	34 & 35	504.14	259.73	269.76	6.97	0.232		1,810	9.68	29.7
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	34 & 35	504.14	259.73	269.76	136	4.542		35,391	9.68	318
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	34 & 35	504.14	259.73	269.76	2.81	0.094		731	9.68	20.1
2,3,7,8-TCDD	4.40	48.9%	36 & 37	531.42	246.55	252.98	9.48	0.316		2,338	9.21	10.8
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	36 & 37	531.42	246.55	252.98	5.39	0.180		1,329	9.21	13.7
1,2,3,6,7,8-HxCDD	3.59	2.7%	36 & 37	531.42	246.55	252.98	7.74	0.258		1,908	9.21	34.2
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	36 & 37	531.42	246.55	252.98	151	5.044		37,306	9.21	363
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	36 & 37	531.42	246.55	252.98	3.13	0.104		771	9.21	22.8
2,3,7,8-TCDD	4.40	48.9%	38 & 39	511.01	248.39	258.44	9.05	0.302		2,248	9.18	10.7
1,2,3,7,8-PeCDD	2.50 *J*	24.9%	38 & 39	511.01	248.39	258.44	5.14	0.171		1,278	9.18	13.4
1,2,3,6,7,8-HxCDD	3.59	2.7%	38 & 39	511.01	248.39	258.44	7.39	0.246		1,835	9.18	33.3
1,2,3,4,6,7,8-HpCDD	70.2	4.3%	38 & 39	511.01	248.39	258.44	144	4.814		35,873	9.18	347
2,3,4,7,8-PeCDF	1.45 *J*	6.7%	38 & 39	511.01	248.39	258.44	2.98	0.099		741	9.18	22.7

Table D-5. (cont.)

						Midland Soil (Group 3)						
			Using Terminal BW									
Analyte	WHO TEF (unitless)	Liver TEQ (pg/g)	Fat Weight Fraction (w_a) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	RBA Grp 3: Grp 1 Indiv: Grp Mean Using FR_{sum} (unitless)
2,3,7,8-TCDD	1					0.042	0.003	0.120	0.016	0.162	0.017	35%
1,2,3,7,8-PeCDD	1					0.093	0.006	0.113	0.016	0.206	0.016	40%
1,2,3,6,7,8-HxCDD	0.1					0.166	0.012	0.065	0.008	0.230	0.016	47%
1,2,3,4,6,7,8-HpCDD	0.01					0.089	0.006	0.015	0.002	0.104	0.007	34%
2,3,4,7,8-PeCDF	0.5					0.273	0.017	0.042	0.006	0.315	0.018	40%
2,3,7,8-TCDD	1	9.81	0.0707	19.21	12.7	0.038		0.098		0.137		0.298
1,2,3,7,8-PeCDD	1	12.6	0.0707	19.21	6.91 *J*	0.087		0.094		0.181		0.351
1,2,3,6,7,8-HxCDD	0.1	3.2	0.0707	19.21	5.83 *J*	0.153		0.055		0.209		0.423
1,2,3,4,6,7,8-HpCDD	0.01	3.35	0.0707	19.21	25.5	0.082		0.012		0.094		0.308
2,3,4,7,8-PeCDF	0.5	10.55	0.0707	19.21	1.57 *J*	0.250		0.037		0.287		0.360
2,3,7,8-TCDD	1	11.3	0.0678	17.44	14.4	0.046		0.120		0.165		0.361
1,2,3,7,8-PeCDD	1	14	0.0678	17.44	8.00 *J*	0.100		0.117		0.217		0.421
1,2,3,6,7,8-HxCDD	0.1	3.73	0.0678	17.44	6.67 *J*	0.185		0.068		0.253		0.513
1,2,3,4,6,7,8-HpCDD	0.01	3.87	0.0678	17.44	29.3	0.098		0.015		0.113		0.371
2,3,4,7,8-PeCDF	0.5	12.05	0.0678	17.44	1.63 *J*	0.296		0.041		0.337		0.423
2,3,7,8-TCDD	1	9.35	0.0703	18.97	16.9	0.041		0.145		0.185		0.404
1,2,3,7,8-PeCDD	1	11.1	0.0703	18.97	9.16 *J*	0.085		0.138		0.223		0.433
1,2,3,6,7,8-HxCDD	0.1	2.97	0.0703	18.97	7.22 *J*	0.159		0.076		0.235		0.475
1,2,3,4,6,7,8-HpCDD	0.01	3.18	0.0703	18.97	33.3	0.087		0.018		0.105		0.342
2,3,4,7,8-PeCDF	0.5	10.05	0.0703	18.97	2.01 *J*	0.266		0.052		0.318		0.400
2,3,7,8-TCDD	1	10.8	0.0670	16.94	16.1	0.043		0.117		0.159		0.347
1,2,3,7,8-PeCDD	1	13.7	0.0670	16.94	8.52 *J*	0.095		0.109		0.204		0.395
1,2,3,6,7,8-HxCDD	0.1	3.42	0.0670	16.94	7.34 *J*	0.165		0.065		0.230		0.467
1,2,3,4,6,7,8-HpCDD	0.01	3.63	0.0670	16.94	32.9	0.090		0.015		0.105		0.341
2,3,4,7,8-PeCDF	0.5	11.4	0.0670	16.94	1.77 *J*	0.273		0.039		0.311		0.391
2,3,7,8-TCDD	1	10.7	0.0681	17.59	15.3	0.044		0.120		0.163		0.356
1,2,3,7,8-PeCDD	1	13.4	0.0681	17.59	7.88 *J*	0.096		0.109		0.205		0.397
1,2,3,6,7,8-HxCDD	0.1	3.33	0.0681	17.59	6.10 *J*	0.167		0.058		0.225		0.456
1,2,3,4,6,7,8-HpCDD	0.01	3.47	0.0681	17.59	29.9	0.089		0.015		0.103		0.338
2,3,4,7,8-PeCDF	0.5	11.35	0.0681	17.59	1.62 *J*	0.281		0.038		0.320		0.401

Table D-5. (cont.)

	Midland Reference Feed (Group 5)										
	Acetone Mixture/ Feed Blend (Test Article #3)		Total			Using Mean BW				Liver	
	Mean Conc.	Group 5	Feed Intake	Mean BW	Terminal BW	Total Dose	Avg. Daily Dose	Avg. Daily Dose	Total Dose	Weight (mean)	Liver Conc.
Analyte	(pg/g)	Rat IDs	(g)	(g)	(g)	(pg/g BW)	(pg/g BW/d)	S.D.	(pg)	(g)	(pg/g)
2,3,7,8-TCDD	5.54	Grp 5 Mean	475.03	249.44	258.25	10.6	0.352	0.024	2,632		
1,2,3,7,8-PeCDD	3.50	Grp 5 Mean	475.03	249.44	258.25	6.67	0.222	0.015	1,663		
1,2,3,6,7,8-HxCDD	4.49	Grp 5 Mean	475.03	249.44	258.25	8.55	0.285	0.019	2,133		
1,2,3,4,6,7,8-HpCDD	55.6	Grp 5 Mean	475.03	249.44	258.25	106	3.533	0.236	26,412		
2,3,4,7,8-PeCDF	1.91 *J*	Grp 5 Mean	475.03	249.44	258.25	3.64	0.121	0.008	907		
2,3,7,8-TCDD	5.54	50 & 51	486.41	254.29	268.32	10.6	0.353		2,695	9.64	30.8
1,2,3,7,8-PeCDD	3.50	50 & 51	486.41	254.29	268.32	6.69	0.223		1,702	9.64	33.7
1,2,3,6,7,8-HxCDD	4.49	50 & 51	486.41	254.29	268.32	8.59	0.286		2,184	9.64	62.4
1,2,3,4,6,7,8-HpCDD	55.6	50 & 51	486.41	254.29	268.32	106	3.545		27,044	9.64	440
2,3,4,7,8-PeCDF	1.91 *J*	50 & 51	486.41	254.29	268.32	3.65	0.122		929	9.64	52.6
2,3,7,8-TCDD	5.54	52 & 53	503.40	238.93	250.18	11.7	0.389		2,789	8.39	29.7
1,2,3,7,8-PeCDD	3.50	52 & 53	503.40	238.93	250.18	7.37	0.246		1,762	8.39	33.6
1,2,3,6,7,8-HxCDD	4.49	52 & 53	503.40	238.93	250.18	9.46	0.315		2,260	8.39	65.6
1,2,3,4,6,7,8-HpCDD	55.6	52 & 53	503.40	238.93	250.18	117	3.905		27,989	8.39	467
2,3,4,7,8-PeCDF	1.91 *J*	52 & 53	503.40	238.93	250.18	4.02	0.134		961	8.39	56.1
2,3,7,8-TCDD	5.54	54 & 55	481.49	252.63	257.96	10.6	0.352		2,667	9.29	32.8
1,2,3,7,8-PeCDD	3.50	54 & 55	481.49	252.63	257.96	6.67	0.222		1,685	9.29	36.2
1,2,3,6,7,8-HxCDD	4.49	54 & 55	481.49	252.63	257.96	8.56	0.285		2,162	9.29	68.1
1,2,3,4,6,7,8-HpCDD	55.6	54 & 55	481.49	252.63	257.96	106	3.532		26,771	9.29	470
2,3,4,7,8-PeCDF	1.91 *J*	54 & 55	481.49	252.63	257.96	3.64	0.121		920	9.29	55.8
2,3,7,8-TCDD	5.54	56 & 57	457.32	247.91	259.44	10.2	0.341		2,534	9.70	31.0
1,2,3,7,8-PeCDD	3.50	56 & 57	457.32	247.91	259.44	6.46	0.215		1,601	9.70	33.9
1,2,3,6,7,8-HxCDD	4.49	56 & 57	457.32	247.91	259.44	8.28	0.276		2,053	9.70	63.2
1,2,3,4,6,7,8-HpCDD	55.6	56 & 57	457.32	247.91	259.44	103	3.419		25,427	9.70	449
2,3,4,7,8-PeCDF	1.91 *J*	56 & 57	457.32	247.91	259.44	3.52	0.117		873	9.70	55.1
2,3,7,8-TCDD	5.54	58 & 59	446.53	253.43	255.36	9.8	0.325		2,474	9.25	32.0
1,2,3,7,8-PeCDD	3.50	58 & 59	446.53	253.43	255.36	6.17	0.206		1,563	9.25	33.7
1,2,3,6,7,8-HxCDD	4.49	58 & 59	446.53	253.43	255.36	7.91	0.264		2,005	9.25	61.3
1,2,3,4,6,7,8-HpCDD	55.6	58 & 59	446.53	253.43	255.36	98	3.265		24,827	9.25	437
2,3,4,7,8-PeCDF	1.91 *J*	58 & 59	446.53	253.43	255.36	3.37	0.112		853	9.25	54.2

Table D-5. (cont.)

	Midland Reference Feed (Group 5)										
			Using Terminal BW			Fraction Retained in Liver		Fraction Retained in Fat		Fraction Retained Liver+Fat	
Analyte	WHO TEF (unitless)	Liver TEQ (pg/g)	Fat Weight Fraction (w_a) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	FR_{liver} (unitless)	FR_{liver} S.D.	FR_{fat} (unitless)	FR_{fat} S.D.	FR_{sum} (unitless)	FR_{sum} S.D.
2,3,7,8-TCDD	1					0.110	0.012	0.263	0.030	0.373	0.042
1,2,3,7,8-PeCDD	1					0.191	0.018	0.182	0.022	0.373	0.039
1,2,3,6,7,8-HxCDD	0.1					0.279	0.022	0.080	0.014	0.359	0.033
1,2,3,4,6,7,8-HpCDD	0.01					0.159	0.012	0.021	0.003	0.180	0.014
2,3,4,7,8-PeCDF	0.5					0.560	0.046	0.063	0.006	0.623	0.051
2,3,7,8-TCDD	1	30.8	0.0700	18.79	38.9	0.110		0.271		0.381	
1,2,3,7,8-PeCDD	1	33.7	0.0700	18.79	17.4	0.191		0.192		0.383	
1,2,3,6,7,8-HxCDD	0.1	6.24	0.0700	18.79	9.96 *J*	0.275		0.086		0.361	
1,2,3,4,6,7,8-HpCDD	0.01	4.4	0.0700	18.79	32.7	0.157		0.023		0.180	
2,3,4,7,8-PeCDF	0.5	26.3	0.0700	18.79	3.13 *J*	0.546		0.063		0.609	
2,3,7,8-TCDD	1	29.7	0.0664	16.62	35.6	0.089		0.212		0.301	
1,2,3,7,8-PeCDD	1	33.6	0.0664	16.62	15.4	0.160		0.145		0.305	
1,2,3,6,7,8-HxCDD	0.1	6.56	0.0664	16.62	7.95 *J*	0.244		0.058		0.302	
1,2,3,4,6,7,8-HpCDD	0.01	4.67	0.0664	16.62	27.1	0.140		0.016		0.156	
2,3,4,7,8-PeCDF	0.5	28.05	0.0664	16.62	3.22 *J*	0.490		0.056		0.545	
2,3,7,8-TCDD	1	32.8	0.0680	17.53	41.9	0.114		0.275		0.390	
1,2,3,7,8-PeCDD	1	36.2	0.0680	17.53	17.3	0.200		0.180		0.380	
1,2,3,6,7,8-HxCDD	0.1	6.81	0.0680	17.53	9.95 *J*	0.293		0.081		0.373	
1,2,3,4,6,7,8-HpCDD	0.01	4.7	0.0680	17.53	32.9	0.163		0.022		0.185	
2,3,4,7,8-PeCDF	0.5	27.9	0.0680	17.53	3.23 *J*	0.564		0.062		0.625	
2,3,7,8-TCDD	1	31	0.0683	17.71	37.5	0.119		0.262		0.381	
1,2,3,7,8-PeCDD	1	33.9	0.0683	17.71	17.1	0.205		0.189		0.395	
1,2,3,6,7,8-HxCDD	0.1	6.32	0.0683	17.71	9.09 *J*	0.299		0.078		0.377	
1,2,3,4,6,7,8-HpCDD	0.01	4.49	0.0683	17.71	29.4	0.171		0.020		0.192	
2,3,4,7,8-PeCDF	0.5	27.55	0.0683	17.71	3.13 *J*	0.612		0.063		0.675	
2,3,7,8-TCDD	1	32	0.0675	17.23	42.1	0.120		0.293		0.413	
1,2,3,7,8-PeCDD	1	33.7	0.0675	17.23	18.5	0.199		0.204		0.403	
1,2,3,6,7,8-HxCDD	0.1	6.13	0.0675	17.23	11.4	0.283		0.098		0.381	
1,2,3,4,6,7,8-HpCDD	0.01	4.37	0.0675	17.23	34.2	0.163		0.024		0.187	
2,3,4,7,8-PeCDF	0.5	27.1	0.0675	17.23	3.63 *J*	0.588		0.073		0.661	

Table D-5. (cont.)

	Midland Reference Gavage (Group 1)										
	Reference Mixture #1					Using Mean BW					
Analyte	Mean Conc. (ng/mL)	Group 1 Rat IDs	Total Gavage Volume (mL)	Mean BW (g)	Terminal BW (g)	Total Dose (pg/g BW)	Avg. Daily Dose (pg/g BW)	Avg. Daily Dose S.D.	Total Dose (pg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)
2,3,7,8-TCDD	0.128	Grp 1 Mean	30	250.77	258.72	15.3	0.511	0.014	3,840		
1,2,3,7,8-PeCDD	0.0740	Grp 1 Mean	30	250.77	258.72	8.85	0.295	0.008	2,220		
1,2,3,6,7,8-HxCDD	0.106	Grp 1 Mean	30	250.77	258.72	12.7	0.423	0.012	3,180		
1,2,3,4,6,7,8-HpCDD	1.33	Grp 1 Mean	30	250.77	258.72	159	5.307	0.145	39,900		
2,3,4,7,8-PeCDF	0.0397	Grp 1 Mean	30	250.77	258.72	4.75	0.158	0.004	1,191		
2,3,7,8-TCDD	0.128	10 & 11	30	252.37	256.46	15.2	0.507		3,840	8.95	59.7
1,2,3,7,8-PeCDD	0.0740	10 & 11	30	252.37	256.46	8.80	0.293		2,220	8.95	63.4
1,2,3,6,7,8-HxCDD	0.106	10 & 11	30	252.37	256.46	12.6	0.420		3,180	8.95	130
1,2,3,4,6,7,8-HpCDD	1.33	10 & 11	30	252.37	256.46	158	5.270		39,900	8.95	1,140
2,3,4,7,8-PeCDF	0.0397	10 & 11	30	252.37	256.46	4.72	0.157		1,191	8.95	90.1
2,3,7,8-TCDD	0.128	12 & 13	30	262.33	281.82	14.6	0.488		3,840	9.60	58.4
1,2,3,7,8-PeCDD	0.0740	12 & 13	30	262.33	281.82	8.46	0.282		2,220	9.60	62.6
1,2,3,6,7,8-HxCDD	0.106	12 & 13	30	262.33	281.82	12.1	0.404		3,180	9.60	130
1,2,3,4,6,7,8-HpCDD	1.33	12 & 13	30	262.33	281.82	152	5.070		39,900	9.60	1,160
2,3,4,7,8-PeCDF	0.0397	12 & 13	30	262.33	281.82	4.54	0.151		1,191	9.60	87.5
2,3,7,8-TCDD	0.128	14 & 15	30	245.17	250.93	15.7	0.522		3,840	9.00	62.4
1,2,3,7,8-PeCDD	0.0740	14 & 15	30	245.17	250.93	9.06	0.302		2,220	9.00	68.4
1,2,3,6,7,8-HxCDD	0.106	14 & 15	30	245.17	250.93	13.0	0.432		3,180	9.00	138
1,2,3,4,6,7,8-HpCDD	1.33	14 & 15	30	245.17	250.93	163	5.425		39,900	9.00	1,190
2,3,4,7,8-PeCDF	0.0397	14 & 15	30	245.17	250.93	4.86	0.162		1,191	9.00	98.6
2,3,7,8-TCDD	0.128	16 & 17	30	246.37	254.55	15.6	0.520		3,840	8.35	57.0
1,2,3,7,8-PeCDD	0.0740	16 & 17	30	246.37	254.55	9.01	0.300		2,220	8.35	69.3
1,2,3,6,7,8-HxCDD	0.106	16 & 17	30	246.37	254.55	12.9	0.430		3,180	8.35	137
1,2,3,4,6,7,8-HpCDD	1.33	16 & 17	30	246.37	254.55	162	5.398		39,900	8.35	1,260
2,3,4,7,8-PeCDF	0.0397	16 & 17	30	246.37	254.55	4.83	0.161		1,191	8.35	104
2,3,7,8-TCDD	0.128	18 & 19	30	247.63	249.86	15.5	0.517		3,840	8.31	65.4
1,2,3,7,8-PeCDD	0.0740	18 & 19	30	247.63	249.86	8.96	0.299		2,220	8.31	70.2
1,2,3,6,7,8-HxCDD	0.106	18 & 19	30	247.63	249.86	12.8	0.428		3,180	8.31	143
1,2,3,4,6,7,8-HpCDD	1.33	18 & 19	30	247.63	249.86	161	5.371		39,900	8.31	1,240
2,3,4,7,8-PeCDF	0.0397	18 & 19	30	247.63	249.86	4.81	0.160		1,191	8.31	99.4

Table D-5. (cont.)

	Midland Reference Gavage (Group 1)											
			Using Terminal BW									
Analyte	WHO TEF (unitless)	Liver TEQ (pg/g)	Fat Weight Fraction (w_a) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.
2,3,7,8-TCDD	1					0.139	0.009	0.319	0.017	0.458	0.020
1,2,3,7,8-PeCDD	1					0.265	0.009	0.250	0.016	0.515	0.013
1,2,3,6,7,8-HxCDD	0.1					0.376	0.015	0.117	0.011	0.493	0.014
1,2,3,4,6,7,8-HpCDD	0.01					0.265	0.009	0.041	0.005	0.306	0.012
2,3,4,7,8-PeCDF	0.5					0.710	0.027	0.086	0.008	0.796	0.022
2,3,7,8-TCDD	1	59.7	0.0677	17.36	72.5	0.139		0.328		0.467	
1,2,3,7,8-PeCDD	1	63.4	0.0677	17.36	33.6	0.256		0.263		0.518	
1,2,3,6,7,8-HxCDD	0.1	13	0.0677	17.36	21.8	0.366		0.119		0.485	
1,2,3,4,6,7,8-HpCDD	0.01	11.4	0.0677	17.36	93.1	0.256		0.040		0.296	
2,3,4,7,8-PeCDF	0.5	45.05	0.0677	17.36	6.75 *J*	0.677		0.098		0.775	
2,3,7,8-TCDD	1	58.4	0.0727	20.49	64.1	0.146		0.342		0.488	
1,2,3,7,8-PeCDD	1	62.6	0.0727	20.49	28.7	0.271		0.265		0.536	
1,2,3,6,7,8-HxCDD	0.1	13	0.0727	20.49	19.4	0.392		0.125		0.517	
1,2,3,4,6,7,8-HpCDD	0.01	11.6	0.0727	20.49	92.9	0.279		0.048		0.327	
2,3,4,7,8-PeCDF	0.5	43.75	0.0727	20.49	5.13 *J*	0.705		0.088		0.794	
2,3,7,8-TCDD	1	62.4	0.0666	16.71	70.9	0.146		0.308		0.455	
1,2,3,7,8-PeCDD	1	68.4	0.0666	16.71	30.0	0.277		0.226		0.503	
1,2,3,6,7,8-HxCDD	0.1	13.8	0.0666	16.71	19.0	0.391		0.100		0.490	
1,2,3,4,6,7,8-HpCDD	0.01	11.9	0.0666	16.71	80.1	0.268		0.034		0.302	
2,3,4,7,8-PeCDF	0.5	49.3	0.0666	16.71	5.48 *J*	0.745		0.077		0.822	
2,3,7,8-TCDD	1	57	0.0673	17.13	71.7	0.124		0.320		0.444	
1,2,3,7,8-PeCDD	1	69.3	0.0673	17.13	32.8	0.261		0.253		0.514	
1,2,3,6,7,8-HxCDD	0.1	13.7	0.0673	17.13	23.5	0.360		0.127		0.486	
1,2,3,4,6,7,8-HpCDD	0.01	12.6	0.0673	17.13	103	0.264		0.044		0.308	
2,3,4,7,8-PeCDF	0.5	52	0.0673	17.13	6.03 *J*	0.729		0.087		0.816	
2,3,7,8-TCDD	1	65.4	0.0664	16.58	68.7	0.142		0.297		0.438	
1,2,3,7,8-PeCDD	1	70.2	0.0664	16.58	32.5	0.263		0.243		0.506	
1,2,3,6,7,8-HxCDD	0.1	14.3	0.0664	16.58	22.0	0.374		0.115		0.488	
1,2,3,4,6,7,8-HpCDD	0.01	12.4	0.0664	16.58	96.0	0.258		0.040		0.298	
2,3,4,7,8-PeCDF	0.5	49.7	0.0664	16.58	5.83 *J*	0.694		0.081		0.775	

Table D-6. Tissue concentrations, doses, and RBA calculations for the rat pilot study: Tittabawassee River flood plain soil

	Tittabawassee River Flood Plain Soil (Group 4)											
	Soil THT02769/Diet Blend (Test Article #2)						Using Mean BW					
Analyte	Mean Conc. (pg/g)	% of TEQ in soil)	Group 4 Rat IDs	Total Feed Intake (g)	Mean BW (g)	Terminal BW (g)	Total Dose (pg/g BW)	Avg. Daily Dose (pg/g BW/d)	Avg. Daily Dose S.D.	Total Dose (pg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)
2,3,7,8-TCDF	83.7	25.4%	Grp 4 Mean	579.34	251.85	263.81	193	6.425	0.372	48,491		
1,2,3,7,8-PeCDF	51.0	6.3%	Grp 4 Mean	579.34	251.85	263.81	117	3.915	0.227	29,546		
2,3,4,7,8-PeCDF	43.9	52.1%	Grp 4 Mean	579.34	251.85	263.81	101	3.370	0.195	25,433		
1,2,3,4,7,8-HxCDF	34.2	8.5%	Grp 4 Mean	579.34	251.85	263.81	78.7	2.625	0.152	19,813		
1,2,3,6,7,8-HxCDF	8.45	1.9%	Grp 4 Mean	579.34	251.85	263.81	19.4	0.649	0.038	4,895		
1,2,3,6,7,8-HxCDF (excluding outlier)[a]												
2,3,7,8-TCDF	83.7	25.4%	40 & 41	548.74	251.24	259.24	183	6.094		45,929	9.11	316
1,2,3,7,8-PeCDF	51.0	6.3%	40 & 41	548.74	251.24	259.24	111	3.713		27,985	9.11	254
2,3,4,7,8-PeCDF	43.9	52.1%	40 & 41	548.74	251.24	259.24	95.9	3.196		24,089	9.11	1,050
1,2,3,4,7,8-HxCDF	34.2	8.5%	40 & 41	548.74	251.24	259.24	74.7	2.490		18,767	9.11	641
1,2,3,6,7,8-HxCDF	8.45	1.9%	40 & 41	548.74	251.24	259.24	18.5	0.615		4,637	9.11	161
2,3,7,8-TCDF	83.7	25.4%	42 & 43	592.14	251.77	274.75	197	6.562		49,562	10.76	333
1,2,3,7,8-PeCDF	51.0	6.3%	42 & 43	592.14	251.77	274.75	120	3.998		30,199	10.76	258
2,3,4,7,8-PeCDF	43.9	52.1%	42 & 43	592.14	251.77	274.75	103	3.442		25,995	10.76	944
1,2,3,4,7,8-HxCDF	34.2	8.5%	42 & 43	592.14	251.77	274.75	80.4	2.681		20,251	10.76	590
1,2,3,6,7,8-HxCDF	8.45	1.9%	42 & 43	592.14	251.77	274.75	19.9	0.662		5,004	10.76	151
2,3,7,8-TCDF	83.7	25.4%	44 & 45	564.56	263.97	277.66	179	5.967		47,254	9.79	342
1,2,3,7,8-PeCDF	51.0	6.3%	44 & 45	564.56	263.97	277.66	109	3.636		28,793	9.79	266
2,3,4,7,8-PeCDF	43.9	52.1%	44 & 45	564.56	263.97	277.66	93.9	3.130		24,784	9.79	1,080
1,2,3,4,7,8-HxCDF	34.2	8.5%	44 & 45	564.56	263.97	277.66	73.1	2.438		19,308	9.79	667
1,2,3,6,7,8-HxCDF	8.45	1.9%	44 & 45	564.56	263.97	277.66	18.1	0.602		4,771	9.79	175
2,3,7,8-TCDF	83.7	25.4%	46 & 47	605.22	250.95	258.63	202	6.729		50,657	8.31	360
1,2,3,7,8-PeCDF	51.0	6.3%	46 & 47	605.22	250.95	258.63	123	4.100		30,866	8.31	291
2,3,4,7,8-PeCDF	43.9	52.1%	46 & 47	605.22	250.95	258.63	106	3.529		26,569	8.31	1,190
1,2,3,4,7,8-HxCDF	34.2	8.5%	46 & 47	605.22	250.95	258.63	82.5	2.749		20,699	8.31	733
1,2,3,6,7,8-HxCDF	8.45	1.9%	46 & 47	605.22	250.95	258.63	20.4	0.679		5,114	8.31	697 [a]
2,3,7,8-TCDF	83.7	25.4%	48 & 49	586.04	241.30	248.76	203	6.776		49,052	8.49	341
1,2,3,7,8-PeCDF	51.0	6.3%	48 & 49	586.04	241.30	248.76	124	4.129		29,888	8.49	275
2,3,4,7,8-PeCDF	43.9	52.1%	48 & 49	586.04	241.30	248.76	107	3.554		25,727	8.49	1,160
1,2,3,4,7,8-HxCDF	34.2	8.5%	48 & 49	586.04	241.30	248.76	83.1	2.769		20,043	8.49	711
1,2,3,6,7,8-HxCDF	8.45	1.9%	48 & 49	586.04	241.30	248.76	20.5	0.684		4,952	8.49	180

Table D-6. (cont.)

	Tittabawassee River Flood Plain Soil (Group 4)											
			Using Terminal BW			Fraction		Fraction		Fraction		RBA
			Fat Weight			Retained		Retained		Retained		Grp 4: Grp 2
	WHO	Liver	Fraction	Fat	Fat	in Liver		in Fat		Liver+Fat		Indiv: Grp Mean
Analyte	TEF (unitless)	TEQ (pg/g)	(w_a) (unitless)	Weight (g)	Conc. (pg/g)	FR_{liver} (unitless)	FR_{liver} S.D.	FR_{fat} (unitless)	FR_{fat} S.D.	FR_{sum} (unitless)	FR_{sum} S.D.	Using FR_{sum} (unitless)
2,3,7,8-TCDF	0.1					0.065	0.006	0.049	0.010	0.114	0.015	89%
1,2,3,7,8-PeCDF	0.05					0.084	0.007	0.032	0.005	0.117	0.010	58%
2,3,4,7,8-PeCDF	0.5					0.394	0.021	0.031	0.004	0.425	0.022	52%
1,2,3,4,7,8-HxCDF	0.1					0.312	0.017	0.029	0.003	0.341	0.017	57%
1,2,3,6,7,8-HxCDF	0.1					0.488	0.361	0.028	0.003	0.516	0.362	82%
1,2,3,6,7,8-HxCDF (excluding outlier)[a]						0.327[a]	0.022[a]			0.355[a]	0.024[a]	56%[a]
2,3,7,8-TCDF	0.1	31.6	0.0682	17.69	132	0.063		0.051		0.114		0.894
1,2,3,7,8-PeCDF	0.05	12.7	0.0682	17.69	54.3	0.083		0.034		0.117		0.580
2,3,4,7,8-PeCDF	0.5	525	0.0682	17.69	45.1	0.397		0.033		0.430		0.530
1,2,3,4,7,8-HxCDF	0.1	64.1	0.0682	17.69	32.1	0.311		0.030		0.341		0.570
1,2,3,6,7,8-HxCDF	0.1	16.1	0.0682	17.69	7.73 *J*	0.316		0.029		0.346		0.547
2,3,7,8-TCDF	0.1	33.3	0.0713	19.59	140	0.072		0.055		0.128		1.005
1,2,3,7,8-PeCDF	0.05	12.9	0.0713	19.59	52.1	0.092		0.034		0.126		0.624
2,3,4,7,8-PeCDF	0.5	472	0.0713	19.59	41.3	0.391		0.031		0.422		0.520
1,2,3,4,7,8-HxCDF	0.1	59	0.0713	19.59	28.9	0.313		0.028		0.341		0.570
1,2,3,6,7,8-HxCDF	0.1	15.1	0.0713	19.59	6.51 *J*	0.325		0.025		0.350		0.554
2,3,7,8-TCDF	0.1	34.2	0.0719	19.96	133	0.071		0.056		0.127		1.000
1,2,3,7,8-PeCDF	0.05	13.3	0.0719	19.96	51.2	0.090		0.035		0.126		0.625
2,3,4,7,8-PeCDF	0.5	540	0.0719	19.96	42.7	0.427		0.034		0.461		0.568
1,2,3,4,7,8-HxCDF	0.1	66.7	0.0719	19.96	30.2	0.338		0.031		0.369		0.616
1,2,3,6,7,8-HxCDF	0.1	17.5	0.0719	19.96	7.22 *J*	0.359		0.030		0.389		0.615
2,3,7,8-TCDF	0.1	36	0.0681	17.61	141	0.059		0.049		0.108		0.851
1,2,3,7,8-PeCDF	0.05	14.55	0.0681	17.61	61.3	0.078		0.035		0.113		0.562
2,3,4,7,8-PeCDF	0.5	595	0.0681	17.61	50.2	0.372		0.033		0.405		0.500
1,2,3,4,7,8-HxCDF	0.1	73.3	0.0681	17.61	37.7	0.294		0.032		0.326		0.545
1,2,3,6,7,8-HxCDF	0.1	69.7	0.0681	17.61	8.64 *J*	1.133[a]		0.030		1.162[a]		1.837[a]
2,3,7,8-TCDF	0.1	34.1	0.0661	16.45	97.4	0.059		0.033		0.092		0.722
1,2,3,7,8-PeCDF	0.05	13.75	0.0661	16.45	43.2	0.078		0.024		0.102		0.505
2,3,4,7,8-PeCDF	0.5	580	0.0661	16.45	39.5	0.383		0.025		0.408		0.503
1,2,3,4,7,8-HxCDF	0.1	71.1	0.0661	16.45	31.2	0.301		0.026		0.327		0.545
1,2,3,6,7,8-HxCDF	0.1	18	0.0661	16.45	7.42 *J*	0.309		0.025		0.333		0.527

Table D-6. (cont.)

	Tittabawassee River Flood Plain Soil Reference Gavage (Group 2)										
	Reference Mixture #2					Using Mean BW					
Analyte	Mean Conc. (ng/mL)	Group 2 Rat IDs	Total Gavage Volume (mL)	Mean BW (g)	Terminal BW (g)	Total Dose (pg/g BW)	Avg. Daily Dose (pg/g BW/d)	Avg. Daily Dose S.D.	Total Dose (pg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)
2,3,7,8-TCDF	2.35	Grp 2 Mean	30 [b]	245.12 [b]	251.20 [b]	288	8.808	1.753	70,500		
1,2,3,7,8-PeCDF	1.17	Grp 2 Mean	30 [b]	245.12 [b]	251.20 [b]	143	4.385	0.873	35,100		
2,3,4,7,8-PeCDF	0.954	Grp 2 Mean	30 [b]	245.12 [b]	251.20 [b]	117	3.576	0.711	28,620		
1,2,3,4,7,8-HxCDF	0.808	Grp 2 Mean	30 [b]	245.12 [b]	251.20 [b]	98.9	3.029	0.603	24,240		
1,2,3,6,7,8-HxCDF	0.212	Grp 2 Mean	30 [b]	245.12 [b]	251.20 [b]	25.9	0.795	0.158	6,360		
1,2,3,6,7,8-HxCDF (excluding outlier)[a]											
2,3,7,8-TCDF	2.35	20 & 21	30	241.04	247.42	292	9.750		70,500	8.44	577
1,2,3,7,8-PeCDF	1.17	20 & 21	30	241.04	247.42	146	4.854		35,100	8.44	588
2,3,4,7,8-PeCDF	0.954	20 & 21	30	241.04	247.42	119	3.958		28,620	8.44	2,450
1,2,3,4,7,8-HxCDF	0.808	20 & 21	30	241.04	247.42	101	3.352		24,240	8.44	1,570
1,2,3,6,7,8-HxCDF	0.212	20 & 21	30	241.04	247.42	26.4	0.880		6,360	8.44	445
2,3,7,8-TCDF	2.35	22 & 23	30	244.28	252.49	289	9.620		70,500	8.67	556
1,2,3,7,8-PeCDF	1.17	22 & 23	30	244.28	252.49	144	4.790		35,100	8.67	530
2,3,4,7,8-PeCDF	0.954	22 & 23	30	244.28	252.49	117	3.905		28,620	8.67	2,370
1,2,3,4,7,8-HxCDF	0.808	22 & 23	30	244.28	252.49	99.2	3.308		24,240	8.67	1,470
1,2,3,6,7,8-HxCDF	0.212	22 & 23	30	244.28	252.49	26.0	0.868		6,360	8.67	399
2,3,7,8-TCDF	2.35	24 & 29	17.5 [b]	241.20 [b]	235.56 [b]	171	5.683		41,125	8.97	450
1,2,3,7,8-PeCDF	1.17	24 & 29	17.5 [b]	241.20 [b]	235.56 [b]	84.9	2.830		20,475	8.97	468
2,3,4,7,8-PeCDF	0.954	24 & 29	17.5 [b]	241.20 [b]	235.56 [b]	69.2	2.307		16,695	8.97	1,480
1,2,3,4,7,8-HxCDF	0.808	24 & 29	17.5 [b]	241.20 [b]	235.56 [b]	58.6	1.954		14,140	8.97	958
1,2,3,6,7,8-HxCDF	0.212	24 & 29	17.5 [b]	241.20 [b]	235.56 [b]	15.4	0.513		3,710	8.97	261
2,3,7,8-TCDF	2.35	25 & 26	30	251.07	253.67	281	9.360		70,500	8.26	632
1,2,3,7,8-PeCDF	1.17	25 & 26	30	251.07	253.67	140	4.660		35,100	8.26	633
2,3,4,7,8-PeCDF	0.954	25 & 26	30	251.07	253.67	114	3.800		28,620	8.26	2,670
1,2,3,4,7,8-HxCDF	0.808	25 & 26	30	251.07	253.67	96.5	3.218		24,240	8.26	1,580
1,2,3,6,7,8-HxCDF	0.212	25 & 26	30	251.07	253.67	25.3	0.844		6,360	8.26	441
2,3,7,8-TCDF	2.35	27 & 28	30	244.09	251.25	289	9.628		70,500	8.54	632
1,2,3,7,8-PeCDF	1.17	27 & 28	30	244.09	251.25	144	4.793		35,100	8.54	603
2,3,4,7,8-PeCDF	0.954	27 & 28	30	244.09	251.25	117	3.908		28,620	8.54	2,650
1,2,3,4,7,8-HxCDF	0.808	27 & 28	30	244.09	251.25	99.3	3.310		24,240	8.54	1,610
1,2,3,6,7,8-HxCDF	0.212	27 & 28	30	244.09	251.25	26.1	0.869		6,360	8.54	462

Table D-6. (cont.)

	Tittabawassee River Flood Plain Soil Reference Gavage (Group 2)										
			Using Terminal BW								
			Fat Weight			Fraction Retained		Fraction Retained		Fraction Retained	
	WHO	Liver	Fraction	Fat	Fat	in Liver[b]		in Fat[b]		Liver+Fat[b]	
Analyte	TEF (unitless)	TEQ (pg/g)	(w_a) (unitless)	Weight (g)	Conc. (pg/g)	FR_{liver} (unitless)	FR_{liver} S.D.	FR_{fat} (unitless)	FR_{fat} S.D.	FR_{sum} (unitless)	FR_{sum} S.D.
2,3,7,8-TCDF	0.1					0.072	0.004	0.055	0.003	0.127	0.006
1,2,3,7,8-PeCDF	0.05					0.142	0.008	0.060	0.007	0.202	0.014
2,3,4,7,8-PeCDF	0.5					0.750	0.036	0.061	0.007	0.811	0.040
1,2,3,4,7,8-HxCDF	0.1					0.545	0.017	0.055	0.008	0.599	0.020
1,2,3,6,7,8-HxCDF	0.1					0.582	0.032	0.051	0.007	0.633	0.034
1,2,3,6,7,8-HxCDF (excluding outlier)[a]											
2,3,7,8-TCDF	0.1	57.7	0.0659	16.30	233	0.069		0.054		0.123	
1,2,3,7,8-PeCDF	0.05	29.4	0.0659	16.30	129	0.141		0.060		0.201	
2,3,4,7,8-PeCDF	0.5	1225	0.0659	16.30	103	0.723		0.059		0.781	
1,2,3,4,7,8-HxCDF	0.1	157	0.0659	16.30	82.4	0.547		0.055		0.602	
1,2,3,6,7,8-HxCDF	0.1	44.5	0.0659	16.30	20.9	0.591		0.054		0.644	
2,3,7,8-TCDF	0.1	55.6	0.0669	16.89	219	0.068		0.052		0.121	
1,2,3,7,8-PeCDF	0.05	26.5	0.0669	16.89	110	0.131		0.053		0.184	
2,3,4,7,8-PeCDF	0.5	1185	0.0669	16.89	92.0	0.718		0.054		0.772	
1,2,3,4,7,8-HxCDF	0.1	147	0.0669	16.89	66.8	0.526		0.047		0.572	
1,2,3,6,7,8-HxCDF	0.1	39.9	0.0669	16.89	16.0	0.544		0.042		0.586	
2,3,7,8-TCDF	0.1	45	0.0635	14.96	264	0.098		0.096		0.194	
1,2,3,7,8-PeCDF	0.05	23.4	0.0635	14.96	119	0.205		0.087		0.292	
2,3,4,7,8-PeCDF	0.5	740	0.0635	14.96	69.6	0.795		0.062		0.858	
1,2,3,4,7,8-HxCDF	0.1	95.8	0.0635	14.96	50.8	0.608		0.054		0.661	
1,2,3,6,7,8-HxCDF	0.1	26.1	0.0635	14.96	13.2 *J*	0.631		0.053		0.684	
2,3,7,8-TCDF	0.1	63.2	0.0671	17.03	244	0.074		0.059		0.133	
1,2,3,7,8-PeCDF	0.05	31.65	0.0671	17.03	141	0.149		0.068		0.217	
2,3,4,7,8-PeCDF	0.5	1335	0.0671	17.03	119	0.771		0.071		0.841	
1,2,3,4,7,8-HxCDF	0.1	158	0.0671	17.03	91.9	0.538		0.065		0.603	
1,2,3,6,7,8-HxCDF	0.1	44.1	0.0671	17.03	22.1	0.573		0.059		0.632	
2,3,7,8-TCDF	0.1	63.2	0.0666	16.74	230	0.077		0.055		0.131	
1,2,3,7,8-PeCDF	0.05	30.15	0.0666	16.74	120	0.147		0.057		0.204	
2,3,4,7,8-PeCDF	0.5	1325	0.0666	16.74	100	0.791		0.058		0.849	
1,2,3,4,7,8-HxCDF	0.1	161	0.0666	16.74	75.8	0.567		0.052		0.620	
1,2,3,6,7,8-HxCDF	0.1	46.2	0.0666	16.74	18.2	0.620		0.048		0.668	

[a] Excluding outlier.

[b] Group means exclude results from rat pair (24 & 29), which were sacrificed early.

Table D-7. Swine body weights during the pilot study

	Body Weight (kg)											
Swine ID	Day -1 (10/4/04)	Day 2 (10/7/04)	Day 5 (10/10/04)	Day 8 (10/13/04)	Day 11 (10/16/04)	Day 14 (10/19/04)	Day 17 (10/22/04)	Day 21 (10/25/04)	Day 24 (10/29/04)	Day 27 (10/31/04)	Day 30 (11/3/04)	Avgerage Day -1 to 30
Group 1: Midland Reference Oil												
415	11.20	12.55	13.70	15.25	16.40	18.20	20.00	22.45	24.20	26.05	28.55	18.96
419	12.50	13.80	14.75	15.95	17.55	19.65	21.40	23.35	25.75	28.15	30.40	20.30
435	11.30	12.35	13.65	15.30	16.20	17.90	19.15	20.90	22.55	24.15	26.35	18.16
439	11.40	12.50	13.90	15.50	16.55	18.60	20.10	21.80	23.95	25.90	28.30	18.95
443	11.90	13.35	14.85	16.70	18.15	19.95	21.30	23.45	25.20	27.60	29.25	20.15
Grp 1 Mean	**11.66**	**12.91**	**14.17**	**15.74**	**16.97**	**18.86**	**20.39**	**22.39**	**24.33**	**26.37**	**28.57**	**19.31**
Group 2: Tittabawassee River Flood Plain Soil Reference Oil												
403	10.75	11.80	13.00	14.00	15.40	17.25	18.90	20.75	22.75	24.45	26.90	17.81
410	10.60	11.90	12.95	14.50	15.90	17.50	19.20	20.80	22.80	23.95	26.15	17.84
425	11.75	13.00	14.10	15.20	16.85	18.25	20.00	21.40	23.50	25.80	27.80	18.88
432	10.80	11.95	13.65	15.10	16.50	18.50	20.05	21.90	23.85	26.05	28.40	18.80
447	10.30	11.55	12.50	13.85	15.40	17.05	18.95	20.60	21.85	24.80	26.60	17.59
Grp 2 Mean	**10.84**	**12.04**	**13.24**	**14.53**	**16.01**	**17.71**	**19.42**	**21.09**	**22.95**	**25.01**	**27.17**	**18.18**
Group 3: Midland Soil												
405	10.30	11.45	13.00	14.35	16.15	17.85	19.75	21.40	23.10	25.50	27.85	18.25
407	11.65	13.00	14.45	16.15	17.60	19.40	21.40	23.65	25.05	27.30	29.25	19.90
417	10.45	12.00	13.30	15.00	16.35	17.95	19.75	21.30	23.20	25.40	27.60	18.39
418	11.50	12.70	14.10	15.40	16.80	18.20	19.60	21.75	23.05	25.05	26.75	18.63
436	11.05	12.35	13.75	15.05	16.50	18.05	19.95	21.75	24.10	26.30	28.50	18.85
Grp 3 Mean	**10.99**	**12.30**	**13.72**	**15.19**	**16.68**	**18.29**	**20.09**	**21.97**	**23.70**	**25.91**	**27.99**	**18.80**
Tittabawassee River Flood Plain Soil (Group 4)												
427	12.40	13.70	15.10	16.50	18.25	19.90	22.30	23.60	25.65	27.25	29.70	20.40
428	11.00	12.70	13.80	15.10	16.45	18.40	19.65	21.50	23.70	25.50	27.60	18.67
440	11.05	12.25	13.70	15.20	16.65	18.60	20.10	21.90	23.75	25.60	28.00	18.80
441	11.95	13.35	14.35	15.35	16.55	18.40	19.90	21.55	23.55	25.60	27.90	18.95
444	11.20	12.05	13.45	14.80	16.25	18.20	19.55	21.00	22.00			16.50[a]
Grp 4 Mean	**11.52**	**12.81**	**14.08**	**15.39**	**16.83**	**18.70**	**20.30**	**21.91**	**23.73**	**25.99**	**28.30**	**19.20[a]**
Body Composition Group												
401	11.90	13.30	14.40	15.95	17.30	18.85	20.35	22.05	23.90	25.75	28.05	19.25
402	11.00	12.50	13.85	15.65	16.85	18.95	20.85	22.75	24.90	27.30	29.65	19.48
413	12.30	13.10	14.45	15.75	17.55	19.30	20.90	23.30	25.35	27.95	31.30	20.11

[a] Swine #444 became ill and died early. Group means exclude results associated with this animal.

Table D-8. Swine necropsy liver and fat sample weights

Swine ID	Liver Weight (g)	Abdominal Fat Sample Weight (g)
Group 1: Midland Reference Oil		
415	594.8	50.40
419	754.6	54.60
435	500.8	46.58
439	660.8	64.56
443	655.7	55.47
Grp 1 Mean	**633.3**	**54.32**
Group 2: Tittabawassee River Flood Plain Soil Reference Oil		
403	621.4	38.90
410	568.5	52.75
425	560.1	53.80
432	572.7	53.72
447	601.0	50.66
Grp 2 Mean	**584.7**	**49.97**
Group 3: Midland Soil		
405	716.3	62.42
407	715.6	48.20
417	757.1	51.18
418	728.9	53.00
436	738.6	50.02
Grp 3 Mean	**731.3**	**52.96**
Tittabawassee River Flood Plain Soil (Group 4)		
427	566.9	50.77
428	656.1	48.17
440	795.7	50.89
441	646.0	47.74
444[a]	533.2	5.20
Grp 4 Mean	**666.2** [a]	**49.39** [a]

Notes:

Fat was taken from the abdominal cavity. Liver (gallbladder removed) was weighed and then sample for MROD was taken from 3 different areas in the liver, minced with a knife and scissors on a clean glass plate and packed into a 5ml cryovial and frozen in liquid N2. After this sample was taken, the liver was wrapped in foil, placed in a zipper-sealed freezer bag and frozen at -80 °C.

Fat was stripped from between the skin and the abdominal wall.

Fat removal was very time consuming. Pigs this age have little fat.

[a] Swine #444 became ill and died early. Group means exclude results associated with this animal.

Table D-9. Swine body composition data

Swine ID	Dead Weight (g)	Carcass Weight[a] (g)	Percent Dressed[b] (%)	Skin Weight (g)	Subcutaneous Fat Weight (g)	Seam Fat Weight (g)	Leaf Fat Weight (g)	Muscle Weight (g)	Total Fat Weight (g)	Percent Fat (%)	Percent Muscle (%)	Percent Skin (%)
401	28,770	21,092.4	73.31	1,528.3	1,229.0	140.6	62.3	11,157.4	1,431.9	6.79	52.90	7.25
402	28,770	22,453.2	78.04	1,684.8	1,274.7	268.0	77.6	12,940.4	1,620.3	7.22	57.63	7.50
413	31,020	22,680.0	73.11	1,697.4	1,086.7	253.7	69.8	12,475.6	1,410.2	6.22	55.01	7.48

[a] Weight after removing intestinal contents.

[b] Carcass weight as a percentage of dead weight.

Table D-10. Swine liver microsomal EROD and MROD activities

Group	Entrix Sample ID	Exponent Swine ID	EROD (pmol/mg/min)	MROD (pmol/mg/min)
1	ESL-5	415	26.1	143
1	ESL-8	419	37.4	106
1	ESL-13	435	3.91	39.8
1	ESL-15	439	14.9	41.1
1	ESL-18	443	43.9	147.6
2	ESL-1	403	31.5	103.4
2	ESL-4	410	33.0	161
2	ESL-9	425	38.3	169
2	ESL-12	432	34.6	83.8
2	ESL-20	447	38.5	96.7
3	ERL-2	405	27.3	83.7
3	ESL-3	407	19.8	93.8
3	ESL-6	417	24.4	132
3	ESL-7	418	26.9	138
3	ESL-14	436	25.7	124
4	ESL-10	427	28.0	87.0
4	ESL-11	428	21.2	87.0
4	ESL-16	440	15.3	81.6
4	ESL-17	441	47.1	130.5
4	ESL-19	444[a]	11.6	28.9

Note: All assays conducted as outlined in SOP250 MSU-ATL SOP 250 version 1

[a] Results excluded from analyses because this animal died before end of study.

Table D-11. Tissue concentrations, doses, and RBA calculations for the swine pilot study: Midland soil

	Midland Soil (Group 3)															
	Dow Corporate Center (CC-S-27)					Using Mean BW										
Analyte	Soil Mean Conc.[a] (pg/g)	% of TEQ	Soil Dose Daily Mass of Chemical (ng/day)	Pig ID	Total Dose (ng)	Average Daily Dose (ng/kg BW/d)	Average Daily Dose S.D.	Mean Body Weight (kg)	Terminal Body Weight (kg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)	Fat Weight Using term. BW (g)	Fat Conc. (pg/g)	WHO TEF (unitless)	Using 1/2 DL Liver TEQ (pg/g)	Using DL Liver TEQ (pg/g)
2,3,7,8-TCDD	131	49%	1.31	Grp 3 Mean	39.4	0.0699	0.0024	18.80	27.99	731.3		1,887		1		
1,2,3,7,8-PeCDD	66.9	25%	0.669	Grp 3 Mean	20.1	0.0356	0.0012	18.80	27.99	731.3		1,887		1		
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	Grp 3 Mean	22.1	0.0391	0.0013	18.80	27.99	731.3		1,887		0.1		
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	Grp 3 Mean	350	0.621	0.021	18.80	27.99	731.3		1,887		0.01		
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	Grp 3 Mean	10.8	0.0192	0.0006	18.80	27.99	731.3		1,887		0.5		
2,3,7,8-TCDD	131	49%	1.31	405	39.4	0.072		18.25	27.85	716.3	0.200 *J*	1,877	0.508 *Um*	1	0.200	0.200
1,2,3,7,8-PeCDD	66.9	25%	0.669	405	20.1	0.037		18.25	27.85	716.3	0.195 *U*	1,877	0.443 *Um*	1	0.098	0.195
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	405	22.1	0.040		18.25	27.85	716.3	0.401 *U*	1,877	0.500 *U*	0.1	0.020	0.040
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	405	350	0.639		18.25	27.85	716.3	5.17	1,877	5.62	0.01	0.052	0.052
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	405	10.8	0.020		18.25	27.85	716.3	0.425 *J*	1,877	0.390 *U*	0.5	0.213	0.213
2,3,7,8-TCDD	131	49%	1.31	407	39.4	0.066		19.90	29.25	715.6	0.224 *J*	1,971	0.638 *Um*	1	0.224	0.224
1,2,3,7,8-PeCDD	66.9	25%	0.669	407	20.1	0.034		19.90	29.25	715.6	0.232 *J*	1,971	0.611 *Um*	1	0.232	0.232
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	407	22.1	0.037		19.90	29.25	715.6	0.408 *J*	1,971	0.956 *J*	0.1	0.041	0.041
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	407	350	0.586		19.90	29.25	715.6	12.0	1,971	7.67	0.01	0.120	0.120
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	407	10.8	0.018		19.90	29.25	715.6	0.856 *J*	1,971	0.308 *Um*	0.5	0.428	0.428
2,3,7,8-TCDD	131	49%	1.31	417	39.4	0.071		18.39	27.60	757.1	0.174 *U*	1,860	0.773 *J*	1	0.087	0.174
1,2,3,7,8-PeCDD	66.9	25%	0.669	417	20.1	0.036		18.39	27.60	757.1	0.120 *U*	1,860	0.552 *J*	1	0.060	0.120
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	417	22.1	0.040		18.39	27.60	757.1	0.225 *Um*	1,860	0.833 *Um*	0.1	0.011	0.023
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	417	350	0.634		18.39	27.60	757.1	6.81	1,860	8.15	0.01	0.068	0.068
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	417	10.8	0.020		18.39	27.60	757.1	0.558 *J*	1,860	0.303 *Um*	0.5	0.279	0.279
2,3,7,8-TCDD	131	49%	1.31	418	39.4	0.071		18.63	26.75	728.9	0.284 *J*	1,803	0.805 *J*	1	0.284	0.284
1,2,3,7,8-PeCDD	66.9	25%	0.669	418	20.1	0.036		18.63	26.75	728.9	0.189 *U*	1,803	0.740 *J*	1	0.095	0.189
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	418	22.1	0.039		18.63	26.75	728.9	0.268 *Um*	1,803	1.39 *J*	0.1	0.013	0.027
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	418	350	0.626		18.63	26.75	728.9	8.46	1,803	11.4	0.01	0.085	0.085
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	418	10.8	0.019		18.63	26.75	728.9	0.600 *J*	1,803	0.504 *J*	0.5	0.300	0.300
2,3,7,8-TCDD	131	49%	1.31	436	39.4	0.070		18.85	28.50	738.6	0.248 *J*	1,921	0.814 *J*	1	0.248	0.248
1,2,3,7,8-PeCDD	66.9	25%	0.669	436	20.1	0.035		18.85	28.50	738.6	0.208 *Um*	1,921	0.677 *Um*	1	0.104	0.208
1,2,3,6,7,8-HxCDD	73.5	2.7%	0.735	436	22.1	0.039		18.85	28.50	738.6	0.402 *Um*	1,921	1.25 *J*	0.1	0.020	0.040
1,2,3,4,6,7,8-HpCDD	1,167	4.3%	11.7	436	350	0.619		18.85	28.50	738.6	11.9	1,921	9.81	0.01	0.119	0.119
2,3,4,7,8-PeCDF	36.1	6.7%	0.361	436	10.8	0.019		18.85	28.50	738.6	0.816 *J*	1,921	0.436 *Um*	0.5	0.408	0.408

Table D-11. (cont.)

	Midland Soil (Group 3)													
	Using 1/2 DL							Using DL						
Analyte	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	RBA Grp 3: Grp 1 Indiv: Grp Mean Using FR_{sum} (unitless)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	RBA Grp 3: Grp 1 Indiv: Grp Mean Using FR_{sum} (unitless)
2,3,7,8-TCDD	0.0039	0.0014	0.028	0.013	0.032	0.013	18%	0.0042	0.0008	0.034	0.006	0.038	0.006	22%
1,2,3,7,8-PeCDD	0.0043	0.0023	0.040	0.018	0.044	0.018	24%	0.0069	0.0014	0.057	0.010	0.064	0.011	34%
1,2,3,6,7,8-HxCDD	0.0070	0.0037	0.073	0.042	0.080	0.043	38%	0.0113	0.0027	0.084	0.029	0.095	0.029	45%
1,2,3,4,6,7,8-HpCDD	0.0185	0.0063	0.046	0.011	0.064	0.016	55%	0.0185	0.0063	0.046	0.011	0.064	0.016	55%
2,3,4,7,8-PeCDF	0.0440	0.0121	0.042	0.024	0.086	0.025	32%	0.0440	0.0121	0.067	0.014	0.111	0.018	41%
2,3,7,8-TCDD	0.0036		0.012		0.016		0.0898	0.0036		0.024		0.028		0.1580
1,2,3,7,8-PeCDD	0.0035		0.021		0.024		0.1308	0.0070		0.041		0.048		0.2573
1,2,3,6,7,8-HxCDD	0.0065		0.021		0.028		0.1338	0.0130		0.043		0.056		0.2649
1,2,3,4,6,7,8-HpCDD	0.0106		0.030		0.041		0.3457	0.0106		0.030		0.041		0.3457
2,3,4,7,8-PeCDF	0.0281		0.034		0.062		0.2293	0.0281		0.068		0.096		0.3544
2,3,7,8-TCDD	0.0041		0.016		0.020		0.1142	0.0041		0.032		0.036		0.2042
1,2,3,7,8-PeCDD	0.0083		0.030		0.038		0.2069	0.0083		0.060		0.068		0.3631
1,2,3,6,7,8-HxCDD	0.0132		0.085		0.099		0.4753	0.0132		0.085		0.099		0.4704
1,2,3,4,6,7,8-HpCDD	0.0245		0.043		0.068		0.5751	0.0245		0.043		0.068		0.5751
2,3,4,7,8-PeCDF	0.0566		0.028		0.085		0.3133	0.0566		0.056		0.113		0.4171
2,3,7,8-TCDD	0.0017		0.036		0.038		0.2177	0.0033		0.036		0.040		0.2260
1,2,3,7,8-PeCDD	0.0023		0.051		0.053		0.2887	0.0045		0.051		0.056		0.2961
1,2,3,6,7,8-HxCDD	0.0039		0.035		0.039		0.1878	0.0077		0.070		0.078		0.3717
1,2,3,4,6,7,8-HpCDD	0.0147		0.043		0.058		0.4928	0.0147		0.043		0.058		0.4928
2,3,4,7,8-PeCDF	0.0390		0.026		0.065		0.2408	0.0390		0.052		0.091		0.3372
2,3,7,8-TCDD	0.0053		0.037		0.042		0.2401	0.0053		0.037		0.042		0.2388
1,2,3,7,8-PeCDD	0.0034		0.067		0.070		0.3778	0.0069		0.067		0.073		0.3899
1,2,3,6,7,8-HxCDD	0.0044		0.114		0.118		0.5685	0.0089		0.114		0.123		0.5839
1,2,3,4,6,7,8-HpCDD	0.0176		0.059		0.076		0.6481	0.0176		0.059		0.076		0.6481
2,3,4,7,8-PeCDF	0.0404		0.084		0.124		0.4603	0.0404		0.084		0.124		0.4603
2,3,7,8-TCDD	0.0046		0.040		0.044		0.2529	0.0046		0.040		0.044		0.2516
1,2,3,7,8-PeCDD	0.0038		0.032		0.036		0.1958	0.0077		0.065		0.072		0.3852
1,2,3,6,7,8-HxCDD	0.0067		0.109		0.116		0.5567	0.0135		0.109		0.122		0.5831
1,2,3,4,6,7,8-HpCDD	0.0251		0.054		0.079		0.6703	0.0251		0.054		0.079		0.6703
2,3,4,7,8-PeCDF	0.0557		0.039		0.094		0.3493	0.0557		0.077		0.133		0.4925

Table D-11. (cont.)

	Midland Reference Oil (Group 1)														
					Using Mean BW										
Analyte	Mean Conc.[b] (ng/mL)	Total Volume Oil Mixture (mL)	Pig ID	Total Dose (ng)	Average Daily Dose (ng/kg BW/d)	Average Daily Dose S.D.	Mean Body Weight (kg)	Terminal Body Weight (kg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)	Fat Weight Using term. BW (g)	Fat Conc. (pg/g)	WHO TEF (unitless)	Using 1/2 DL Liver TEQ (pg/g)	Using DL Liver TEQ (pg/g)
2,3,7,8-TCDD	0.389	120	Grp 1 Mean	46.7	0.0807	0.0038	19.31	28.57	633.3		1,926		1		
1,2,3,7,8-PeCDD	0.177	120	Grp 1 Mean	21.2	0.0367	0.0017	19.31	28.57	633.3		1,926		1		
1,2,3,6,7,8-HxCDD	0.232	120	Grp 1 Mean	27.8	0.0482	0.0023	19.31	28.57	633.3		1,926		0.1		
1,2,3,4,6,7,8-HpCDD	2.98	120	Grp 1 Mean	358	0.619	0.029	19.31	28.57	633.3		1,926		0.01		
2,3,4,7,8-PeCDF	0.098	120	Grp 1 Mean	11.8	0.0203	0.0010	19.31	28.57	633.3		1,926		0.5		
2,3,7,8-TCDD	0.389	120	415	46.7	0.082		18.96	28.55	594.8	0.711 *Um*	1,924	3.53	1	0.356	0.711
1,2,3,7,8-PeCDD	0.177	120	415	21.2	0.037		18.96	28.55	594.8	0.553 *J*	1,924	1.71 *J*	1	0.553	0.553
1,2,3,6,7,8-HxCDD	0.232	120	415	27.8	0.049		18.96	28.55	594.8	0.993 *Um*	1,924	2.81 *J*	0.1	0.050	0.099
1,2,3,4,6,7,8-HpCDD	2.98	120	415	358	0.629		18.96	28.55	594.8	15.3	1,924	13.7	0.01	0.153	0.153
2,3,4,7,8-PeCDF	0.098	120	415	11.8	0.021		18.96	28.55	594.8	1.77 *J*	1,924	1.07 *J*	0.5	0.885	0.885
2,3,7,8-TCDD	0.389	120	419	46.7	0.077		20.30	30.40	754.6	0.839	2,049	4.04	1	0.839	0.839
1,2,3,7,8-PeCDD	0.177	120	419	21.2	0.035		20.30	30.40	754.6	0.427 *J*	2,049	1.67 *J*	1	0.427	0.427
1,2,3,6,7,8-HxCDD	0.232	120	419	27.8	0.046		20.30	30.40	754.6	0.629 *J*	2,049	2.36 *J*	0.1	0.063	0.063
1,2,3,4,6,7,8-HpCDD	2.98	120	419	358	0.587		20.30	30.40	754.6	9.69	2,049	15.5	0.01	0.097	0.097
2,3,4,7,8-PeCDF	0.098	120	419	11.8	0.019		20.30	30.40	754.6	1.24 *J*	2,049	0.979 *J*	0.5	0.620	0.620
2,3,7,8-TCDD	0.389	120	435	46.7	0.086		18.16	26.35	500.8	1.03	1,776	4.10	1	1.030	1.030
1,2,3,7,8-PeCDD	0.177	120	435	21.2	0.039		18.16	26.35	500.8	0.662 *J*	1,776	2.11 *J*	1	0.662	0.662
1,2,3,6,7,8-HxCDD	0.232	120	435	27.8	0.051		18.16	26.35	500.8	1.25 *J*	1,776	2.74 *J*	0.1	0.125	0.125
1,2,3,4,6,7,8-HpCDD	2.98	120	435	358	0.656		18.16	26.35	500.8	26.7	1,776	20.3	0.01	0.267	0.267
2,3,4,7,8-PeCDF	0.098	120	435	11.8	0.022		18.16	26.35	500.8	2.08 *J*	1,776	1.04 *J*	0.5	1.040	1.040
2,3,7,8-TCDD	0.389	120	439	46.7	0.082		18.95	28.30	660.8	0.797	1,907	4.54	1	0.797	0.797
1,2,3,7,8-PeCDD	0.177	120	439	21.2	0.037		18.95	28.30	660.8	0.475 *Um*	1,907	2.30 *J*	1	0.238	0.475
1,2,3,6,7,8-HxCDD	0.232	120	439	27.8	0.049		18.95	28.30	660.8	1.05 *J*	1,907	3.24 *J*	0.1	0.105	0.105
1,2,3,4,6,7,8-HpCDD	2.98	120	439	358	0.629		18.95	28.30	660.8	20.4	1,907	20.8	0.01	0.204	0.204
2,3,4,7,8-PeCDF	0.098	120	439	11.8	0.021		18.95	28.30	660.8	2.07 *J*	1,907	1.24 *J*	0.5	1.035	1.035
2,3,7,8-TCDD	0.389	120	443	46.7	0.077		20.15	29.25	655.7	0.754	1,971	3.82	1	0.754	0.754
1,2,3,7,8-PeCDD	0.177	120	443	21.2	0.035		20.15	29.25	655.7	0.508 *Um*	1,971	1.78 *J*	1	0.254	0.508
1,2,3,6,7,8-HxCDD	0.232	120	443	27.8	0.046		20.15	29.25	655.7	0.924 *J*	1,971	2.50 *J*	0.1	0.092	0.092
1,2,3,4,6,7,8-HpCDD	2.98	120	443	358	0.591		20.15	29.25	655.7	13.2	1,971	12.6	0.01	0.132	0.132
2,3,4,7,8-PeCDF	0.098	120	443	11.8	0.019		20.15	29.25	655.7	1.87 *J*	1,971	1.01 *J*	0.5	0.935	0.935

Table D-11. (cont.)

	Midland Reference Oil (Group 1)											
	Using 1/2 DL						Using DL					
Analyte	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.
2,3,7,8-TCDD	0.010	0.003	0.165	0.016	0.175	0.019	0.011	0.002	0.165	0.016	0.176	0.017
1,2,3,7,8-PeCDD	0.012	0.004	0.173	0.020	0.185	0.018	0.015	0.000	0.173	0.020	0.188	0.020
1,2,3,6,7,8-HxCDD	0.019	0.006	0.188	0.021	0.208	0.022	0.021	0.003	0.188	0.021	0.210	0.023
1,2,3,4,6,7,8-HpCDD	0.029	0.008	0.089	0.018	0.118	0.024	0.029	0.008	0.089	0.018	0.118	0.024
2,3,4,7,8-PeCDF	0.096	0.015	0.175	0.016	0.270	0.029	0.096	0.015	0.175	0.016	0.270	0.029
2,3,7,8-TCDD	0.005		0.146		0.150		0.009		0.146		0.155	
1,2,3,7,8-PeCDD	0.015		0.155		0.170		0.015		0.155		0.170	
1,2,3,6,7,8-HxCDD	0.011		0.194		0.205		0.021		0.194		0.215	
1,2,3,4,6,7,8-HpCDD	0.025		0.074		0.099		0.025		0.074		0.099	
2,3,4,7,8-PeCDF	0.090		0.175		0.265		0.090		0.175		0.265	
2,3,7,8-TCDD	0.014		0.177		0.191		0.014		0.177		0.191	
1,2,3,7,8-PeCDD	0.015		0.161		0.176		0.015		0.161		0.176	
1,2,3,6,7,8-HxCDD	0.017		0.174		0.191		0.017		0.174		0.191	
1,2,3,4,6,7,8-HpCDD	0.020		0.089		0.109		0.020		0.089		0.109	
2,3,4,7,8-PeCDF	0.080		0.171		0.250		0.080		0.171		0.250	
2,3,7,8-TCDD	0.011		0.156		0.167		0.011		0.156		0.167	
1,2,3,7,8-PeCDD	0.016		0.176		0.192		0.016		0.176		0.192	
1,2,3,6,7,8-HxCDD	0.022		0.175		0.197		0.022		0.175		0.197	
1,2,3,4,6,7,8-HpCDD	0.037		0.101		0.138		0.037		0.101		0.138	
2,3,4,7,8-PeCDF	0.089		0.157		0.246		0.089		0.157		0.246	
2,3,7,8-TCDD	0.011		0.186		0.197		0.011		0.186		0.197	
1,2,3,7,8-PeCDD	0.007		0.207		0.214		0.015		0.207		0.221	
1,2,3,6,7,8-HxCDD	0.025		0.222		0.247		0.025		0.222		0.247	
1,2,3,4,6,7,8-HpCDD	0.038		0.111		0.149		0.038		0.111		0.149	
2,3,4,7,8-PeCDF	0.116		0.201		0.317		0.116		0.201		0.317	
2,3,7,8-TCDD	0.011		0.161		0.172		0.011		0.161		0.172	
1,2,3,7,8-PeCDD	0.008		0.165		0.173		0.016		0.165		0.181	
1,2,3,6,7,8-HxCDD	0.022		0.177		0.199		0.022		0.177		0.199	
1,2,3,4,6,7,8-HpCDD	0.024		0.069		0.094		0.024		0.069		0.094	
2,3,4,7,8-PeCDF	0.104		0.169		0.274		0.104		0.169		0.274	

Note: One-half of the detection limit was used in calculations for non-detect concentrations.

[a] Average of triplicate samples.

[b] Average of duplicate analyses.

U – nondetect; value represents detection limit

Um – nondetect; value represents estimated maximum possible concentration (EMPC)

Table D-12. Tissue concentrations, doses, and RBA calculations for the swine pilot study: Tittabawassee River flood plain soil

	Tittabawassee River Flood Plain Soil (Group 4)																
	Imerman Park 2 (THT02769)					Using Mean BW											
Analyte	Soil Mean Conc.[a] (pg/g)	% of TEQ	Soil Dose Daily Mass of Chemical (ng/day)	Pig ID	Total Dose (ng)	Average Daily Dose (ng/kg BW/d)	Average Daily Dose S.D.	Mean Body Weight (kg)	Terminal Body Weight (kg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)	Fat Weight Using term BW (g)	Fat Conc. (pg/g)	WHO TEF (unitless)	Using 1/2 DL Liver TEQ (pg/g)	Using DL Liver TEQ (pg/g)
2,3,7,8-TCDF	2,150	25%	21.5	Grp 4 Mean	645	1.12	0.045	19.20 [b]	28.30 [b]	666.2 [b]		1,907		0.1		
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	Grp 4 Mean	323	0.561	0.023	19.20 [b]	28.30 [b]	666.2 [b]		1,907		0.05		
2,3,4,7,8-PeCDF	883	52%	8.83	Grp 4 Mean	265	0.460	0.018	19.20 [b]	28.30 [b]	666.2 [b]		1,907		0.5		
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	Grp 4 Mean	216	0.375	0.015	19.20 [b]	28.30 [b]	666.2 [b]		1,907		0.1		
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	Grp 4 Mean	49.1	0.0853	0.0034	19.20 [b]	28.30 [b]	666.2 [b]		1,907		0.1		
2,3,7,8-TCDF	2,150	25%	21.5	427	645	1.054		20.40	29.70	566.9	0.175 *U*	2,002	0.949	0.1	0.0088	0.0175
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	427	323	0.528		20.40	29.70	566.9	0.233 *U*	2,002	0.54 *J*	0.05	0.0058	0.0117
2,3,4,7,8-PeCDF	883	52%	8.83	427	265	0.433		20.40	29.70	566.9	12.3	2,002	4.91	0.5	6.1500	6.1500
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	427	216	0.353		20.40	29.70	566.9	8.38	2,002	6.49	0.1	0.8380	0.8380
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	427	49.1	0.080		20.40	29.70	566.9	2.79	2,002	1.46 *J*	0.1	0.2790	0.2790
2,3,7,8-TCDF	2,150	25%	21.5	428	640 [c]	1.151		18.67	27.60	656.1	0.221 *U*	1,860	0.983	0.1	0.0111	0.0221
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	428	320 [c]	0.576		18.67	27.60	656.1	0.259 *U*	1,860	0.834 *J*	0.05	0.0065	0.0130
2,3,4,7,8-PeCDF	883	52%	8.83	428	263 [c]	0.473		18.67	27.60	656.1	10.6	1,860	6.9	0.5	5.3000	5.3000
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	428	214 [c]	0.385		18.67	27.60	656.1	6.89	1,860	8.46	0.1	0.6890	0.6890
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	428	48.7 [c]	0.088		18.67	27.60	656.1	2.36 *J*	1,860	1.79 *J*	0.1	0.2360	0.2360
2,3,7,8-TCDF	2,150	25%	21.5	440	645	1.144		18.80	28.00	795.7	0.229 *U*	1,887	0.976	0.1	0.0115	0.0229
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	440	323	0.572		18.80	28.00	795.7	0.21 *U*	1,887	0.652 *J*	0.05	0.0053	0.0105
2,3,4,7,8-PeCDF	883	52%	8.83	440	265	0.470		18.80	28.00	795.7	9.15	1,887	5.94	0.5	4.5750	4.5750
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	440	216	0.383		18.80	28.00	795.7	6.42	1,887	7.79	0.1	0.6420	0.6420
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	440	49.1	0.087		18.80	28.00	795.7	2.06 *J*	1,887	1.69 *J*	0.1	0.2060	0.2060
2,3,7,8-TCDF	2,150	25%	21.5	441	645	1.135		18.95	27.90	646	0.27 *U*	1,880	0.665 *J*	0.1	0.0135	0.0270
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	441	323	0.568		18.95	27.90	646	0.242 *U*	1,880	0.439 *Um*	0.05	0.0061	0.0121
2,3,4,7,8-PeCDF	883	52%	8.83	441	265	0.466		18.95	27.90	646	11.8	1,880	5.54	0.5	5.9000	5.9000
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	441	216	0.380		18.95	27.90	646	8.85	1,880	7.81	0.1	0.8850	0.8850
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	441	49.1	0.086		18.95	27.90	646	2.73	1,880	1.71 *J*	0.1	0.2730	0.2730
2,3,7,8-TCDF	2,150	25%	21.5	444	<538 [d]			16.50	22.00	533.2	0.178 *U*	1,483	0.318 *U*	0.1	0.0089	0.0178
1,2,3,7,8-PeCDF	1,076	6.3%	10.8	444	<269 [d]			16.50	22.00	533.2	0.312 *U*	1,483	0.304 *U*	0.05	0.0078	0.0156
2,3,4,7,8-PeCDF	883	52%	8.83	444	<221 [d]			16.50	22.00	533.2	3.71	1,483	1.99 *Um*	0.5	1.8550	1.8550
1,2,3,4,7,8-HxCDF	719	8.5%	7.19	444	<180 [d]			16.50	22.00	533.2	1.78 *J*	1,483	2.54 *J*	0.1	0.1780	0.1780
1,2,3,6,7,8-HxCDF	164 *D*	1.9%	1.64	444	<40.9 [d]			16.50	22.00	533.2	0.574 *J*	1,483	0.599 *Um*	0.1	0.0574	0.0574

Table D-12. (cont.)

	Tittabawassee River Flood Plain Soil (Group 4)													
	Using 1/2 DL							Using DL						
Analyte	Fraction Retained in Liver[b] FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat[b] FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat[b] FR_{sum} (unitless)	FR_{sum} S.D.	RBA Grp 4 : Grp 2 Indiv: Grp Mean Using FR_{sum} (unitless)	Fraction Retained in Liver[b] FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat[b] FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat[b] FR_{sum} (unitless)	FR_{sum} S.D.	RBA Grp 4 : Grp 2 Indiv: Grp Mean Using FR_{sum} (unitless)
2,3,7,8-TCDF	0.0001	0.00003	0.0026	0.0005	0.0028	0.0005	22%	0.0002	0.00006	0.0026	0.0005	0.0029	0.0004	23%
1,2,3,7,8-PeCDF	0.0002	0.00003	0.0033	0.0015	0.0036	0.0015	30%	0.0005	0.00005	0.0036	0.0010	0.0041	0.0010	34%
2,3,4,7,8-PeCDF	0.0273	0.0011	0.0419	0.0051	0.0692	0.0049	27%	0.0273	0.0011	0.0419	0.0051	0.0692	0.0049	27%
1,2,3,4,7,8-HxCDF	0.0233	0.0024	0.0675	0.0055	0.0908	0.0059	35%	0.0233	0.0024	0.0675	0.0055	0.0908	0.0059	35%
1,2,3,6,7,8-HxCDF	0.0333	0.0019	0.0646	0.0037	0.0979	0.0043	37%	0.0333	0.0019	0.0646	0.0037	0.0979	0.0043	37%
2,3,7,8-TCDF	0.0001		0.0029		0.0030		0.2426	0.0002		0.0029		0.0031		0.2487
1,2,3,7,8-PeCDF	0.0002		0.0033		0.0036		0.2974	0.0004		0.0033		0.0038		0.3095
2,3,4,7,8-PeCDF	0.0263		0.0371		0.0635		0.2500	0.0263		0.0371		0.0635		0.2500
1,2,3,4,7,8-HxCDF	0.0220		0.0602		0.0822		0.3208	0.0220		0.0602		0.0822		0.3208
1,2,3,6,7,8-HxCDF	0.0322		0.0595		0.0917		0.3503	0.0322		0.0595		0.0917		0.3503
2,3,7,8-TCDF	0.0001		0.0029		0.0030		0.2383	0.0002		0.0029		0.0031		0.2474
1,2,3,7,8-PeCDF	0.0003		0.0048		0.0051		0.4275	0.0005		0.0048		0.0054		0.4425
2,3,4,7,8-PeCDF	0.0265		0.0488		0.0753		0.2967	0.0265		0.0488		0.0753		0.2967
1,2,3,4,7,8-HxCDF	0.0211		0.0735		0.0946		0.3691	0.0211		0.0735		0.0946		0.3691
1,2,3,6,7,8-HxCDF	0.0318		0.0683		0.1001		0.3822	0.0318		0.0683		0.1001		0.3822
2,3,7,8-TCDF	0.0001		0.0029		0.0030		0.2405	0.0003		0.0029		0.0031		0.2519
1,2,3,7,8-PeCDF	0.0003		0.0038		0.0041		0.3407	0.0005		0.0038		0.0043		0.3566
2,3,4,7,8-PeCDF	0.0275		0.0423		0.0698		0.2752	0.0275		0.0423		0.0698		0.2752
1,2,3,4,7,8-HxCDF	0.0237		0.0681		0.0918		0.3582	0.0237		0.0681		0.0918		0.3582
1,2,3,6,7,8-HxCDF	0.0334		0.0650		0.0983		0.3755	0.0334		0.0650		0.0983		0.3755
2,3,7,8-TCDF	0.0001		0.0019		0.0021		0.1665	0.0003		0.0019		0.0022		0.1773
1,2,3,7,8-PeCDF	0.0002		0.0013		0.0015		0.1273	0.0005		0.0026		0.0030		0.2505
2,3,4,7,8-PeCDF	0.0288		0.0393		0.0681		0.2685	0.0288		0.0393		0.0681		0.2685
1,2,3,4,7,8-HxCDF	0.0265		0.0681		0.0945		0.3690	0.0265		0.0681		0.0945		0.3690
1,2,3,6,7,8-HxCDF	0.0359		0.0655		0.1014		0.3872	0.0359		0.0655		0.1014		0.3872
2,3,7,8-TCDF	0.0001		0.0004		0.0005			0.0002		0.0009		0.0011		
1,2,3,7,8-PeCDF	0.0003		0.0008		0.0011			0.0006		0.0017		0.0023		
2,3,4,7,8-PeCDF	0.0090		0.0067		0.0157			0.0090		0.0134		0.0223		
1,2,3,4,7,8-HxCDF	0.0053		0.0209		0.0262			0.0053		0.0209		0.0262		
1,2,3,6,7,8-HxCDF	0.0075		0.0109		0.0183			0.0075		0.0217		0.0292		

Table D-12. (cont.)

	Tittabawassee River Flood Plain Reference Oil (Group 2)														
					Using Mean BW										
Analyte	Mean Conc.[e] (ng/mL)	Total Volume Oil Mixture (mL)	Pig ID	Total Dose (ng)	Average Daily Dose (ng/kg BW/d)	Average Daily Dose S.D.	Mean Body Weight (kg)	Terminal Body Weight (kg)	Liver Weight (mean) (g)	Liver Conc. (pg/g)	Fat Weight Using term BW (g)	Fat Conc. (pg/g)	WHO TEF (unitless)	Using 1/2 DL Liver TEQ (pg/g)	Using DL Liver TEQ (pg/g)
2,3,7,8-TCDF	4.90	120	Grp 2 Mean	588	1.08	0.036	18.18	27.17	584.7		1,831		0.1		
1,2,3,7,8-PeCDF	2.94	120	Grp 2 Mean	353	0.647	0.021	18.18	27.17	584.7		1,831		0.05		
2,3,4,7,8-PeCDF	2.50	120	Grp 2 Mean	300	0.550	0.018	18.18	27.17	584.7		1,831		0.5		
1,2,3,4,7,8-HxCDF	1.99	120	Grp 2 Mean	239	0.438	0.014	18.18	27.17	584.7		1,831		0.1		
1,2,3,6,7,8-HxCDF	0.490	120	Grp 2 Mean	58.8	0.108	0.0036	18.18	27.17	584.7		1,831		0.1		
2,3,7,8-TCDF	4.90	120	403	588	1.100		17.81	26.90	621.4	0.635	1,813	4.36	0.1	0.0635	0.0635
1,2,3,7,8-PeCDF	2.94	120	403	353	0.660		17.81	26.90	621.4	0.360 *Um*	1,813	2.48 *J*	0.05	0.009	0.018
2,3,4,7,8-PeCDF	2.50	120	403	300	0.561		17.81	26.90	621.4	55.6	1,813	27.4	0.5	27.8	27.8
1,2,3,4,7,8-HxCDF	1.99	120	403	239	0.447		17.81	26.90	621.4	28.1	1,813	26.6	0.1	2.81	2.81
1,2,3,6,7,8-HxCDF	0.490	120	403	58.8	0.110		17.81	26.90	621.4	9.35	1,813	5.89	0.1	0.935	0.935
2,3,7,8-TCDF	4.90	120	410	588	1.099		17.84	26.15	568.5	0.712	1,763	2.78	0.1	0.0712	0.0712
1,2,3,7,8-PeCDF	2.94	120	410	353	0.659		17.84	26.15	568.5	0.286 *Um*	1,763	1.74 *J*	0.05	0.00715	0.0143
2,3,4,7,8-PeCDF	2.50	120	410	300	0.561		17.84	26.15	568.5	70.0	1,763	20.1	0.5	35.0	35.0
1,2,3,4,7,8-HxCDF	1.99	120	410	239	0.446		17.84	26.15	568.5	37.1	1,763	21.9	0.1	3.71	3.71
1,2,3,6,7,8-HxCDF	0.490	120	410	58.8	0.110		17.84	26.15	568.5	12.9	1,763	4.57 *J*	0.1	1.29	1.29
2,3,7,8-TCDF	4.90	120	425	588	1.038		18.88	27.80	560.1	0.549	1,874	4.19	0.1	0.0549	0.0549
1,2,3,7,8-PeCDF	2.94	120	425	353	0.623		18.88	27.80	560.1	0.275 *J*	1,874	2.65 *J*	0.05	0.01375	0.01375
2,3,4,7,8-PeCDF	2.50	120	425	300	0.530		18.88	27.80	560.1	51.8	1,874	29.9	0.5	25.9	25.9
1,2,3,4,7,8-HxCDF	1.99	120	425	239	0.422		18.88	27.80	560.1	27.2	1,874	28	0.1	2.72	2.72
1,2,3,6,7,8-HxCDF	0.490	120	425	58.8	0.104		18.88	27.80	560.1	8.75	1,874	5.93	0.1	0.875	0.875
2,3,7,8-TCDF	4.90	120	432	588	1.043		18.80	28.40	572.7	0.577	1,914	4.28	0.1	0.0577	0.0577
1,2,3,7,8-PeCDF	2.94	120	432	353	0.626		18.80	28.40	572.7	0.241 *Um*	1,914	2.19 *J*	0.05	0.006025	0.01205
2,3,4,7,8-PeCDF	2.50	120	432	300	0.532		18.80	28.40	572.7	48.9	1,914	22.6	0.5	24.45	24.45
1,2,3,4,7,8-HxCDF	1.99	120	432	239	0.424		18.80	28.40	572.7	27.6	1,914	23.4	0.1	2.76	2.76
1,2,3,6,7,8-HxCDF	0.490	120	432	58.8	0.104		18.80	28.40	572.7	9.92	1,914	5.26	0.1	0.992	0.992
2,3,7,8-TCDF	4.90	120	447	588	1.114		17.59	26.60	601.0	0.298 *J*	1,793	3.44	0.1	0.0298	0.0298
1,2,3,7,8-PeCDF	2.94	120	447	353	0.669		17.59	26.60	601.0	0.274 *U*	1,793	2.15 *J*	0.05	0.00685	0.0137
2,3,4,7,8-PeCDF	2.50	120	447	300	0.569		17.59	26.60	601.0	40.6	1,793	22.6	0.5	20.3	20.3
1,2,3,4,7,8-HxCDF	1.99	120	447	239	0.453		17.59	26.60	601.0	20.5	1,793	22.3	0.1	2.05	2.05
1,2,3,6,7,8-HxCDF	0.490	120	447	58.8	0.111		17.59	26.60	601.0	7.04	1,793	5.09	0.1	0.704	0.704

Table D-12. (cont.)

	Tittabawassee River Flood Plain Reference Oil (Group 2)											
	Using 1/2 DL						Using DL					
Analyte	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.
2,3,7,8-TCDF	0.0005	0.0002	0.012	0.002	0.012	0.002	0.0005	0.0002	0.012	0.002	0.012	0.002
1,2,3,7,8-PeCDF	0.0003	0.0001	0.012	0.002	0.012	0.002	0.0005	0.0001	0.012	0.002	0.012	0.002
2,3,4,7,8-PeCDF	0.104	0.020	0.150	0.027	0.254	0.029	0.104	0.020	0.150	0.027	0.254	0.029
1,2,3,4,7,8-HxCDF	0.069	0.013	0.188	0.024	0.256	0.025	0.069	0.013	0.188	0.024	0.256	0.025
1,2,3,6,7,8-HxCDF	0.095	0.020	0.167	0.021	0.262	0.021	0.095	0.020	0.167	0.021	0.262	0.021
2,3,7,8-TCDF	0.0007		0.013		0.014		0.0007		0.013		0.014	
1,2,3,7,8-PeCDF	0.0003		0.013		0.013		0.0006		0.013		0.013	
2,3,4,7,8-PeCDF	0.115		0.166		0.281		0.1152		0.166		0.281	
1,2,3,4,7,8-HxCDF	0.073		0.202		0.275		0.0731		0.202		0.275	
1,2,3,6,7,8-HxCDF	0.099		0.182		0.280		0.0988		0.182		0.280	
2,3,7,8-TCDF	0.0007		0.008		0.009		0.0007		0.008		0.009	
1,2,3,7,8-PeCDF	0.0002		0.009		0.009		0.0005		0.009		0.009	
2,3,4,7,8-PeCDF	0.133		0.118		0.251		0.1327		0.118		0.251	
1,2,3,4,7,8-HxCDF	0.088		0.162		0.250		0.0883		0.162		0.250	
1,2,3,6,7,8-HxCDF	0.125		0.137		0.262		0.1247		0.137		0.262	
2,3,7,8-TCDF	0.0005		0.013		0.014		0.0005		0.013		0.014	
1,2,3,7,8-PeCDF	0.0004		0.014		0.015		0.0004		0.014		0.015	
2,3,4,7,8-PeCDF	0.097		0.187		0.283		0.0967		0.187		0.283	
1,2,3,4,7,8-HxCDF	0.064		0.220		0.283		0.0638		0.220		0.283	
1,2,3,6,7,8-HxCDF	0.083		0.189		0.272		0.0833		0.189		0.272	
2,3,7,8-TCDF	0.0006		0.014		0.014		0.0006		0.014		0.014	
1,2,3,7,8-PeCDF	0.0002		0.012		0.012		0.0004		0.012		0.012	
2,3,4,7,8-PeCDF	0.093		0.144		0.238		0.0934		0.144		0.238	
1,2,3,4,7,8-HxCDF	0.066		0.188		0.254		0.0662		0.188		0.254	
1,2,3,6,7,8-HxCDF	0.097		0.171		0.268		0.0966		0.171		0.268	
2,3,7,8-TCDF	0.0003		0.010		0.011		0.0003		0.010		0.011	
1,2,3,7,8-PeCDF	0.0002		0.011		0.011		0.0005		0.011		0.011	
2,3,4,7,8-PeCDF	0.081		0.135		0.216		0.0813		0.135		0.216	
1,2,3,4,7,8-HxCDF	0.052		0.167		0.219		0.0516		0.167		0.219	
1,2,3,6,7,8-HxCDF	0.072		0.155		0.227		0.0720		0.155		0.227	

(notes on following page)

Table D-12. (cont.)

Note: Calculations were performed using one-half the detection limit for non-detects.
U – nondetect; value represents detection limit
Um – nondetect; value represents estimated maximum possible concentration (EMPC)

[a] Average of triplicate samples.
[b] Excluding results from swine #444, who became sick and was found dead on Study Day 25
[c] Total dosed material received by Pig 428 was adjusted downward slightly per notes in log book.
[d] Swine 444 was offered a maximum of 25 doses (from Study Day 0–24). He did not eat all of the doses he was given because of illness. However, additional details of the total dosed material were not estimated because results associated with this animal were excluded from final calculations.
[e] Average of duplicate analyses.

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SUMMIT TOXICOLOGY

Follow-Up Study Report: Oral Bioavailability of Dioxins/Furans in Tittabawassee River Floodplain Soil

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Acronyms and Abbreviations

ANOVA	analysis of variance
CV	coefficient of variability
CYP1A1	cytochrome p-450 1A1
CYP1A2	cytochrome p-450 1A2
EROD	ethoxyresorufin O-deethylase
HR-GC/MS	high-resolution gas chromatography/mass spectrometry
1,4-HxCDF	1,2,3,4,7,8-hexachlorodibenzofuran
1,6-HxCDF	1,2,3,6,7,8-hexachlorodibenzofuran
MROD	methoxyresorufin O-deethylase
MSU	Michigan State University
NTP	National Toxicology Program
PCDD/F	polychlorinated dibenzo-*p*-dioxin/furan
1-PeCDF	1,2,3,7,8-pentachlorodibenzofuran
4-PeCDF	2,3,4,7,8-pentachlorodibenzofuran
RBA	relative bioavailability
RPD	relative percent difference
SOP	standard operating procedure
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
TCDF	2,3,7,8-tetrachlorodibenzofuran

Executive Summary

This report presents the results of a follow-up to the pilot bioavailability study of Midland and Tittabawassee River floodplain soils (Exponent 2005). The objective of this follow-up study was to repeat the pilot oral bioavailability study in rats, with study design modifications structured to allow an assessment of the possible impact of observed differential enzyme induction on the estimation of relative bioavailability of selected dioxins and furans of importance from a soil sample from the Tittabawassee River floodplain. This follow-up was motivated by the findings of the pilot study, which showed:

1. Statistically significant differences between RBA estimates derived from rats compared to swine, and
2. A markedly higher RBA estimate for TCDF than for the other congeners.

These differences were hypothesized to be due to the observed differential induction of hepatic EROD activity (a marker for CYP1A1 induction) between the rats dosed with soils and their respective dose-matched reference groups (matched on an *administered* dose basis), with higher enzyme activity observed in the reference-group rats compared to the rats in the respective soil groups. CYP1A1 is directly involved in the metabolism of TCDF, and its role in the metabolism of other furan congeners was unknown.

This follow-up study was conducted with the same floodplain soil sample as used in the pilot study (Table 1) and multiple oil reference groups, with administered doses of the five furan congeners that contribute most to the soil TEQ matched to 0.2, 0.5, and 0.8 times the administered dose in soil. The range of oil reference doses was selected with the goal of matching hepatic TEQ (i.e., the *absorbed* dose) and EROD activity between at least one oil reference group and the soil group. The test materials were administered daily to rats for 30 days, and at the end of the study, the fraction of the total administered dose of each congener remaining in the liver and adipose tissue of each study animal was quantified.

The specific research objectives of this study were to:

1. Evaluate hepatic EROD and MROD activity as a function of hepatic TEQ concentration in the tested dose range
2. Assess any dose dependency of the elimination rate for each congener by examining the fraction of administered dose retained across dose rates and as a function of EROD activity, MROD activity, and hepatic TEQ concentration
3. Base a revised RBA calculation on the oil reference group(s) that match the soil group on hepatic TEQ and EROD activity, and compare the results to the original pilot-study results for rats and swine.

The results of the follow-up study demonstrated:

1. A clear relationship between hepatic TEQ and both EROD and MROD activity in the liver of the study animals, although the effect of hepatic TEQ on EROD activity was stronger
2. A clear impact of both hepatic TEQ concentration on the fraction of administered dose retained in the animal tissues for four of the five compounds, and a strong effect of and hepatic EROD (but not MROD) activity on the retention of TCDF, but not the other compounds.

These findings indicate that calculation of relative bioavailability of compounds in the soil, compared to the same compounds administered in corn oil, requires the use of an oil reference group that is matched both on hepatic TEQ and on hepatic EROD activity. In this study, the oil reference groups given doses of 0.5 and 0.8 times that in the soil group provided adequate comparison groups for calculation of RBA.

Based on those oil reference groups, the RBA of each of the five predominant floodplain furan congeners was estimated. The estimated RBAs for all five congeners were between 55% and 65%, with a TEQ-weighted RBA estimate of 58% to 60% for the floodplain soil compared to the oil reference groups with matched hepatic TEQ and EROD activity. In comparison with the results of the pilot study:

- The RBA estimates were similar to those obtained in rats in the pilot-study phase for all congeners except TCDF. The marked elevation of apparent RBA of TCDF, compared to the other furan congeners, observed in the pilot study was not observed when the hepatic TEQ and EROD activity were matched between the oil reference group and the soil group.
- The RBA estimates obtained in the follow-up study using rats remained statistically significantly higher than those obtained using swine during the pilot study. The difference in RBA estimates between species may represent differences due to the mode of soil administration (soil mixed with feed in the rats vs. administration of soil in wrapped in dough balls for the swine) or may represent true species differences in bioavailability of the furan compounds in this soil.

The pilot study and the follow-up study were undertaken to demonstrate and test a methodology to evaluate relative bioavailability of dioxin and furan congeners in soils containing mixed dioxin and furan congeners. Based on the results of these two studies, it does appear possible to use the mass-balance approach envisioned here to assess the bioavailability of soils with these compounds in the concentration range relevant to the Midland and Tittabawassee River floodplain soil contamination. However, the follow-up study in rats demonstrated clear relationships between the elimination rate of four of the five tested congeners and hepatic TEQ and EROD activity in the tested dose ranges. Any further studies should take steps to match the reference and soil groups on these parameters, probably by using a range of oil reference dose groups at fractions of the total soil dose, as demonstrated in the follow-up study.

Another key conclusion is that there appear to be true species differences in relative oral bioavailability between rats and swine. Such species differences have been observed for other classes of compounds in soil. The relevant question is which species provides a more representative model of the human gastrointestinal tract, but an assessment of this question is beyond the scope of this report.

If further bioavailability testing of soils is conducted, several additional minor modifications to the study protocol could be made to provide additional relevant information or to reduce costs:

1. Consider addition of hepatic CYP1A2 protein determination. Hepatic sequestration of the furan congeners was dose-related, even over the relatively narrow dose range used in this study, and may indicate some induction of CYP1A2 protein, even though the changes in MROD activity observed in this study were very slight.

2. Use composite tissue samples from within each oil reference group to obtain a single hepatic and adipose tissue sample for HR/GC-MS analysis for each group. The variability in tissue concentrations within these groups was consistent and relatively minor between the pilot and follow-up study, and continued use of individual tissue analyses among animals in these dose groups is probably unnecessary.

3. Consider analysis only for a single furan congener from the floodplain soils. Use of the range of oil reference doses and resulting matching on hepatic TEQ and EROD activity produced very consistent bioavailability estimates across congeners. If only a single furan congener (probably 4-PeCDF) were used as a marker for bioavailability, this would reduce analytical costs but would still provide a reasonable surrogate for the other furan congeners.

Introduction

The objective of this follow-up study was to repeat the pilot rat oral bioavailability study (Exponent 2005), with certain study design modifications (Appendix A). These modifications are structured to allow an assessment of the possible impact of differential enzyme induction on the estimation of relative bioavailability of selected dioxins and furans of importance from a soil sample from the Tittabawassee River floodplain. This follow-up was motivated by the findings of the pilot study that showed statistically significant differences in hepatic ethoxyresorufin O-deethylase (EROD) activity (a marker for cytochrome P450 1A1 induction) between the rats dosed with soils and their respective reference groups (congener-matched administered doses), with higher enzyme activity observed in the reference-group rats compared to the rats in the respective soil groups.

The observed differences in EROD activity were likely due to a difference in absorbed dose of dioxin and furan (PCDD/F) compounds, which led to statistically significantly different hepatic TEQ concentrations. The higher EROD activity in the reference groups compared to the soil groups was likely due to higher liver TEQ concentrations achieved in the reference groups due to higher absorbed doses of PCDD/Fs, and the resulting increased hepatic EROD activity.

CYP1A1 is responsible for the metabolism of 2,3,7,8-TCDF in rats (Tai et al. 1993), and induction of CYP1A1 has been shown to strongly increase the hepatic metabolism rate for TCDF in rats (McKinley et al. 1993; Olson et al. 1994). 4-PeCDF also can induce its own metabolism due to induction of CYP1A enzymes (Brewster and Birnbaum 1987). Other compounds, including TCDD and 1-PeCDF, show decreased retention of administered dose with increasing dose in subchronic studies, suggesting autoinduction of metabolism, although the specific metabolic pathways have not been identified (DeVito et al. 1998; Diliberto et al. 2001; Jackson et al. 1998). The metabolic pathways for the other compounds that contribute substantially to the total TEQ in the Midland and Tittabawassee River floodplain soils have not been examined to date but may be influenced by CYP1A1 induction. Distribution and retention of PCDD/F congeners can also be influenced by induction of hepatic CYP1A2 protein, which acts as a binding protein for these congeners (Diliberto et al. 1999).

Because the method used to estimate relative bioavailability in this study relies on an assumption that the elimination rate (including elimination through metabolism and other clearance mechanisms) for each compound is the same in the soil and oil reference groups, demonstrated statistically significant differences in EROD activity (a marker for CYP1A1) among the groups may result in invalid estimates of relative bioavailability for any congener for which metabolism is mediated by CYP1A1. In the pilot study, estimates of relative bioavailability for many of the compounds in the study were statistically significantly different between the rats and the swine. The rats displayed different EROD activities in the soil and reference groups (while the swine did not); therefore, this factor may account for some of the observed differences in apparent relative bioavailability between the two species. Other factors related to differing tissue concentrations, including differential rates of passive elimination at different liver or body concentrations, could also confound the interpretation of the initial pilot study results. Therefore, the goal of this effort was to match *absorbed* doses (as opposed to

administered doses) of congeners for which inducible metabolism may be affecting the interpretation of the results from the pilot study. Dose levels for the oil reference groups were selected so as to 'bracket' the likely absorbed dose from soil.

This follow-up study was conducted with the same floodplain soil sample that was used in the pilot study (Table 1) and multiple oil reference groups, with administered doses of the five furan congeners that contribute most to the soil TEQ matched to 0.2, 0.5, and 0.8 times the administered dose in soil. The range of oil reference doses was selected with the goal of matching hepatic TEQ and EROD activity between at least one oil reference group and the soil group. This approach was used to address the following research objectives:

1. *Evaluate EROD/MROD activity as a function of hepatic TEQ.* EROD and methoxyresorufin O-deethylase (MROD) activities for all individual animals and dose groups will be plotted versus hepatic TEQ concentration. The hepatic concentration-response curves for EROD and MROD activity will be characterized. The oil reference group(s) that provide the closest match to the hepatic TEQ, EROD, and MROD activity of the soil group will be identified.

2. *Assess any dose dependency of elimination rate by congener.* Liver and adipose tissue concentration data from each animal in each of the three oil reference groups will be analyzed to estimate the fraction of total administered dose retained in the tissues at the end of the 30-day dosing period for each of the five target congeners. If there is no dose dependence of elimination rate for a given congener, the fraction of administered dose retained should be similar among all oil reference groups regardless of administered dose. If the fraction of administered dose retained decreases or increases with increasing administered dose, this would provide evidence that the elimination rate of this congener is dose dependent in the range of doses examined.

3. *Calculate RBA for the congeners in soil based on matched hepatic TEQ and EROD activity.* The relative bioavailability of the congeners in soil will be estimated using the same calculation procedures outlined in the pilot-study report. However, these calculations will be presented based only on the one or two oil reference group(s) with hepatic TEQ and EROD activities that are most similar to those of the soil group, as identified in step 1 above. The results will be compared to those obtained in the original pilot study for both rats and swine, to evaluate the consistency of results between trials and to assess whether the estimates based on rat as the experimental model, once adjusted for enzyme induction, become more consistent with the results obtained using swine.

Methods and Materials

In general, the methods used in this study are similar to those in the pilot study (Exponent 2005), with modifications as described in Appendix A. These methods are described below.

Dose Preparation and Administration

The test soil (sample THT02769, <250-μm size fraction) was blended with PMI Nutrition International, Rodent LabDiet® 5001 (meal) (5% w/w) at WIL Research Laboratories, Inc. (WIL) in Ashland, Ohio. The WIL report describing the diet blending is provided in Appendix B, and results for concentrations of PCDD/Fs in the Rodent LabDiet® batch used in this study are provided in Table 2. To accomplish the blending of soil into the rat diet, soil (250 g) and diet (1,000 g) were blended in a Hobart mixer for 5 minutes to create a diet pre-mixture. The pre-mixture was then blended with 3,750 g of diet in a V-blender to create the final 5,000-g diet batch. Diet homogeneity samples (100 g) were collected from the initial, middle, and final material that emerged from the V-blender; these samples were sent to Alta for analysis of PCDD/F concentrations. Results for the pre-dosing soil/diet mixture (Table 3) show that the five most important congeners were recovered with coefficients of variability (CVs) ranging from 6.7% to 11%. These measurements of blended diet PCDD/F concentrations and homogeneity were considered acceptable to proceed with the study.

The three gavage reference materials for the rat study were prepared in corn oil/acetone (99:1), and were designed to deliver dioxin/furan doses that would achieve administered daily doses equal to 0.2, 0.5, and 0.8 times the administered doses in the soil/feed mixture. To create these reference mixtures, the five dioxin/furan congeners that contribute most to TEQ in the soil sample were spiked into acetone (10 mL), and the concentrations of the five congeners in the spiked acetone were measured to confirm that analytical concentrations were close to target concentrations. Subsequently, 4 mL of this acetone was added to 396 mL of corn oil (Spectrum Chemicals & Laboratory Products, National Formulary [NF] grade; analysis of the corn oil indicated negligible dioxin/furan concentrations [Table 2]). The three corn-oil/acetone reference materials were then assayed for concentrations of the five target congeners (Table 4). Relative percent differences (RPDs) between target and pre-dosing measured concentrations ranged from 0.9% to 14%. These results were considered acceptable for use in the study. The gavage reference mixtures were stored in amber glass bottles sealed with Teflon-lined lids, and were used within 60 days of preparation.

Animal Handling and Dosing

Animal handling and dosing during the rat follow-up study were performed as described in the pilot study report (Exponent 2005), with modifications as described in the follow-up study design document (see Appendix A), a brief summary of which follows.

Thirty-eight 4-month-old female Sprague-Dawley rats, weighing between 250 and 290 g, were obtained from Harlan (Indianapolis, Indiana) and placed in individual stainless-steel cages. Each rat was weighed two days after arrival (Day –5) (during the quarantine period) and on Day 1 of the dosing period, and then weekly until study termination. The rats were provided with PMI Nutrition International Rodent LabDiet® 5001 (meal) and de-ionized water *ad libitum* during the one-week quarantine period, and their health status was monitored. All LabDiet® 5001 fed to the rats (including during the quarantine period and to the oil reference groups during the dosing period) was from the same batch of LabDiet® 5001 that was used by WIL Research to prepare the blended rat diets (Table 2). Five days prior to the start of dosing, healthy animals were assigned randomly to six dose groups (five rats/group for animals not being gavaged; seven rats/group for animals being gavaged; dose groups are identified in Table 5). Based on gavage-related mortality observed in the pilot study, seven (rather than five) were included in each of the oil reference groups during the compound administration phase of the study, to ensure that at least five animals reach the conclusion of the 30-day dosing period. At the end of the administration period, five rats were selected at random from all surviving rats in each gavage group for tissue collection.

During the 30-day dosing period, each rat received 50 g of feed every 2 days (clean feed for Groups 1–5, and feed/soil mixture for Group 6). The weight of any unconsumed feed at the end of each 2-day period was measured, and an estimate was made of the weight of any spilled feed. Dose groups 2–5 were gavaged daily with 1 mL of the corn-oil (for Group 2) or corn-oil/acetone reference mixtures (for Groups 3–5).

Twenty-four hours after the last dose was administered, the rats were weighed and terminated under CO_2 anesthesia. Their livers were excised, blotted dry, weighed, and wrapped in foil. The liver samples for the EROD and MROD assays were collected (1-g samples) from the livers of each rat. The sample was minced, placed in a 2-mL cryovial, immediately frozen in liquid nitrogen, and sent to Entrix for analysis. The remainder of the liver tissue was then frozen and shipped to Alta for the analytical work. For Groups 2–6, analyses were performed on each individual liver sample. For the control groups 1 and 2, a composite liver sample was created for analysis by compositing equal amounts of liver sample from each of the five animals in the group. As much fatty tissue as possible (3–6 g) was collected from within the abdominal cavity of each rat, weighed, and wrapped in foil. The fat samples were frozen and shipped to Alta for the analytical work. For the control groups 1 and 2, a composite adipose sample was created for analysis by compositing equal amounts of fatty tissue from each of the five animals within the group.

A 75-g post-dosing subsample of the blended rodent diet was collected and shipped to Alta for analysis of dioxins/furans, to evaluate the stability of the blended diet during the 30-day dosing period, and to confirm the doses of dioxins/furans delivered to the rats (Table 3). The CV among congener concentrations in all four samples of the blended rodent diet (three pre-dosing and one post-dosing) was no greater than 13% for any congener detected above the lower calibration limit, indicating that the diet was stable during the study. In addition, the gavage reference mixtures were shipped to Alta for post-dosing analysis (Table 4). The CV between congener concentrations in the pre- and post-dosing gavage reference mixtures was no greater than 17%, with nearly all below 10%, indicating that the reference mixtures were also stable during the study period.

Two rats, #25 (Group 2) and #52 (Group 5), did not complete the 30-day dosing period. These were sacrificed before study completion because of poor feed intake. On necropsy, they were diagnosed as having aspiration pneumonia. An additional six rats were randomly excluded from the group of animals used for tissue collection, as described above.

Rat carcasses from the follow-up study were wrapped in foil, placed in individual labeled zipper-sealed freezer bags, and archived (–80 °C) for possible further analysis.

Tissue Sample Homogenization and Analysis for EROD/MROD Activity and PCDD/F Concentrations

At Entrix, liver microsomes were prepared from each liver sample, and the protein levels and enzymatic activities were measured according to the MSU Standard Operating Procedure (SOP) No. 250 (v 1.1), titled *Protocol for Liver Microsome Preparation, and Microsomal Protein Measurement and AROD Assays in the same 96-Well Plate*. EROD/MROD activities and protein concentrations were measured fluorometrically at the end of the assay, using a Cytofluor multiplate reader (Appendix C).

At Alta, the rat liver samples were homogenized using a Cuisinart mini-prep processor. The processor was run on the "high" setting until the sample was liquefied (for the liver samples) or thoroughly homogenized (for the fat samples). The sample was then poured into separate 40-mL amber glass VOA vials for extraction. After homogenization of each sample, all parts of the processor that were in contact with sample material were washed with soap and hot water, rinsed with de-ionized water, and then rinsed with ultra-high-purity solvents (hexane followed by dichloromethane).

The rat fat samples were homogenized with a Sumeet Multi-Grind Model 964, which is a small-volume grinder that is suitable for small sample sizes. Samples were collected directly from the grinder into labeled amber glass jars. Between samples, all stainless-steel parts of the grinder that were in contact with sample material were washed with soap and hot water, rinsed with de-ionized water, and then serially rinsed with ultra-high-purity solvents (acetone, toluene, hexane, and dichloromethane). The polycarbonate grinder lid was washed with soap and hot water, rinsed with de-ionized water, and then serially rinsed with ultra-high-purity methanol followed by hexane.

Subsamples of the liver and fat homogenates were extracted in methylene chloride/hexane and analyzed for lipid content (EPA Method 1613), and PCDD/F concentrations by HR-GC/MS (EPA Method 1613).

Data Analysis

The EROD and MROD activities were analyzed as follows:

- The hepatic TEQ concentrations and levels of EROD and MROD activity among dosing groups were compared using an analysis of variance (ANOVA)

followed by Dunnett's multiple comparison test at an overall 95% confidence level, to identify the oil reference group or groups with hepatic TEQ and EROD and MROD activities that are not statistically significantly different from those of the soil group.

- The relationship between measured EROD and MROD activity and hepatic TEQ concentration among all experimental animals was assessed using linear regression to evaluate whether a statistically significant relationship between enzyme activity and hepatic TEQ was present.

The mass of each congener retained at the end of 30 days in the liver and adipose tissue in each animal was estimated by multiplying the tissue concentration by the measured organ weight (liver) or the estimated adipose tissue weight (estimated as a function of body weight at sacrifice using the method of Bailey et al. 1980, as reported by Brown et al. 1997). This estimated retained mass was compared to the total administered dose over 30 days to obtain the fraction of total administered dose retained by each animal at the end of 30 days.

The fraction of administered dose retained for each congener was evaluated for all individual animals across oil reference groups using multivariate linear regression (least squares) to identify any relationship between fraction retained and hepatic TEQ concentration, EROD activity, or MROD activity. Among the oil reference-treated animals, a statistically significant relationship between the fraction of any specific congener retained and the enzyme activity or hepatic TEQ concentration would indicate a dependency of elimination rate on that parameter for that congener.

Estimation of Relative Bioavailability

Relative bioavailability was estimated by comparing the fraction of administered dose retained in the tissues of animals in the groups dosed with soil with the fraction of administered dose retained by animals given a reference corn-oil solution, similar to the method used by Wittsiepe et al. (2004). The mathematical basis for the calculation is described in detail in the Exponent (2005) report on the pilot bioavailability study. As described in that report, this method relies on two key assumptions:

1. Elimination rates of the study congeners would be the same between the soil and oil reference groups, and
2. The majority of retained administered dose would be distributed in liver and adipose tissues, and the proportion of retained dose distributed to tissues other than liver and adipose would not be different in soil-dosed groups compared to oil reference-dosed groups.

If these two assumptions hold, the relative bioavailability of each congener in the soil group can be estimated by comparing the fraction of administered dose of that congener in the soil group (FR_{soil}) to the comparable fraction retained in the oil reference group (FR_{ref}):

$$RBA = \frac{FR_{soil}}{FR_{ref}} \qquad \text{(Eq. 1)}$$

Because of the differential hepatic EROD activity among experimental groups observed in the pilot study (Exponent 2005), the methods in this follow-up study were modified to use multiple oil reference dosing groups at varying fractions of the administered soil dose, as described above, resulting in at least one oil reference group with hepatic EROD activity and TEQ concentrations not significantly different from the soil group. Relative bioavailability of the congeners of interest in the soil was assessed by comparing the fraction retained between the soil group and the oil reference group or groups with the best-matched EROD activity and hepatic TEQ concentration. A TEQ-weighted estimate of relative bioavailability for the soil sample was estimated by weighting the individual congener bioavailability estimates by their respective percent contribution to the TEQ concentration of the soil sample.

Results

At the end of the administration period, five rats were selected at random from all surviving rats in each oil reference group for tissue collection. Tissue was collected from all five rats in the soil group and feed control group. As discussed in the Animal Handling and Dosing section, two rats from the oil reference groups (one each from Groups 2 and 5) were sacrificed before the end of the study because their feed intake had dropped significantly. Results from the rats that were sacrificed early or were randomly excluded were not included in the data analysis discussed below. Detailed study data are presented in Appendix D.

Feed Intake

Details of feed intake for all groups are presented in Table D-1, and the feed intake is illustrated in Figure 1. The mean daily feed intake for all dosing groups was approximately 15 g/day. The mean daily feed intake for the Tittabawassee River soil group was 18 g/day (Group 6), and was 17 g/day for the feed control group. The oil control and one of the oil reference groups (Groups 2 and 3) had a mean intake of 13 g/day, and the other two oil reference groups (Groups 4 and 5) had a mean intake of 14 g/day. The lower feed consumption in the oil reference groups compared to the soil and control feed groups is consistent with the expectation that these groups might consume less feed due to caloric intake from the oil gavage vehicle (9 kcal per g, or about 8 kcal per mL; USDA National Nutrient Database for Standard Reference, Release 17, 2004). This is approximately 15% of the caloric intake from feed observed in the soil groups, so the lower feed intake in the oil reference groups is consistent with an adjustment of feed intake by the animals, reflecting the caloric intake from corn-oil gavage.

The oil reference doses were prepared assuming that the rats in the soil group (Group 6) would consume 18 g/day, based on the pilot study results, so the observed daily feed intake matched what was anticipated. These intakes are somewhat lower than the 23 g/day that has been reported previously in the literature (Freeman et al. 1992).

Body and Liver Weights

Rat body weights for all six dosing groups averaged 268 g at study initiation (study day –5), and 280 g at study termination (Figure 2; detailed data for all animals are presented in Table D-2), a gain of 4% over the 30-day study period. This weight gain reflects the fact that female Sprague-Dawley rats have already reached adult body weight at 4 months of age. Rat liver weights at study termination ranged from 8.1 to 12.2 g (average of 9.6 g) over all dosing groups, which is approximately 3.4% of body weight (Table D-3).

Administered Doses

The average daily doses of compounds in each group are summarized in Table 6. As was intended, the administered dose was the highest for the soil group (Group 6), with a total mean TEQ dose of 2.1 ng/kg/day. The administered doses for the oil reference groups closely matched the proportional target doses, with mean TEQ doses that were 21%, 51%, and 83% of the dose to Group 6 for Groups 3, 4, and 5, respectively.

PCDD/F Tissue Concentrations

Hepatic and adipose TEQ concentrations by dose group are summarized in Table 7. Concentrations of specific congeners of interest in liver and adipose tissues for each rat in the oil reference and soil dose groups are reported in Table D-4. Tissue concentrations of the congeners of interest were all above detection limits and were also greater than the instrument calibration limits in nearly all samples from the oil reference and soil groups. The concentrations of PCDD/F congeners in composited samples of hepatic and adipose tissue from the feed and oil control groups were uniformly low (Table D-5). The hepatic TEQ concentration of the soil group was intermediate between the concentrations attained in the 0.5X and 0.8X oil reference groups, and was statistically significantly different from both of these groups.

EROD and MROD Activity

Mean EROD and MROD activities in rat liver tissue from all dose groups are reported in Table 8 and plotted in Figures 3 and 4, and the complete data set is presented in Tables D-6 and D-7. Both EROD and MROD displayed statistically significant increasing trends with increasing hepatic TEQ concentration, although the increase in MROD activity was much weaker than that seen for EROD activity (Figures 5 and 6). Mean MROD activities did not differ significantly among the oil reference groups and the soil group. However, there were statistically significant differences in mean EROD activity among the oil reference groups. The EROD activity in the soil group was statistically greater than that in the 0.2X and 0.5X oil reference groups (Groups 3 and 4), but was similar to that in the 0.8X oil reference group (Group 5).

Fraction of Administered Dose Retained in Oil Reference Groups, by Congener

Figure 7 illustrates the fraction of administered dose present in liver and adipose tissues, and in the summed tissues, for all non-control dose groups. A larger proportion of administered dose was retained in liver than in adipose tissue for all dose groups for four of the five congeners of interest (Figures 7 and 8). For 2,3,7,8-TCDF, the fraction retained in adipose tissue was slightly higher in two dose groups (Groups 3 and 4), equal in the soil group (Group 6), and in one group, the fraction retained in liver was higher than the fraction retained in adipose tissue (Group 5).

The coefficient of variability among individual animals within each group was generally less than 15%.

The results of linear regressions across the three oil reference groups for fraction of administered dose retained (liver plus adipose burden) as a function of hepatic TEQ, EROD activity, and MROD activity are presented in Table 9 and illustrated in Figure 9. The fraction of TCDF retained was strongly and inversely related to hepatic EROD activity, with a weaker but statistically significant negative relationship to hepatic TEQ concentration. For three congeners—4-PeCDF, 1,2,3,4,7,8-HxCDF, and 1,2,3,6,7,8-HxCDF—positive relationships were observed between hepatic TEQ and fraction retained. No statistically significant relationship was observed between fraction of administered 1-PeCDF retained and either enzyme activity or hepatic TEQ concentration.

The results for TCDF are consistent with the hypothesis underlying this study, that the elimination rate for TCDF is dose-dependent due to induction of hepatic CYP1A1 activity with resulting increased elimination (and concomitant decreased retention) of this compound. The results for the three congeners that demonstrate positive relationships between hepatic TEQ and retained fraction of administered dose may be due to binding to induced CYP1A2 protein. 4-PeCDF and the higher chlorinated furans bind strongly to CYP1A2 protein (Diliberto et al. 1999). Although MROD activity was not statistically significantly different among most dose groups, it did demonstrate a statistically significant positive trend with increasing hepatic TEQ, indicating that some induction of CYP1A2 protein and activity was occurring. This protein induction may have been sufficient to increase the hepatic sequestration (and therefore the fraction of administered dose retained) of 4-PeCDF and the two HxCDF congeners with increasing dose among the oil reference groups.

RBA Estimates

The results of the analysis of fraction retained as a function of hepatic TEQ and hepatic enzyme activity described above demonstrate that the elimination rates of four of the five tested congeners are affected by one or both of these parameters in the relevant dose range. Thus, the estimate of RBA obtained will vary depending on which oil reference group is used as the comparison (see Table D-8 for estimates of RBA based on each of the three oil reference groups). An accurate estimation of RBA for four of the five congeners requires comparing the retained fraction of administered dose between the soil group and an oil reference group matched on hepatic EROD activity and hepatic TEQ concentration. As discussed above, hepatic EROD activity in the soil group (Group 6) was similar to that in the 0.8X oil reference group (Group 5). Hepatic TEQ concentration in the soil group was intermediate between that observed in the 0.5X and 0.8X oil reference groups, and was statistically significantly different from both of these groups (see Table 7). Table 10 presents RBA calculations using both the 0.5X and 0.8X oil reference groups (Groups 4 and 5) as the basis for the calculations. While the two reference groups result in somewhat different estimates for individual congeners, the overall TEQ-weighted estimates of RBA are similar, regardless of which group is used.

Because the fractions of administered dose retained for four of the five tested congeners were significantly related to the hepatic TEQ concentration in the oil reference groups, the significant

differences between the soil and oil reference groups indicate that neither the 0.5X or the 0.8X groups (Groups 4 and 5) are accurate matches for the soil group. The dose-response relationships for fraction retained reported in Table 9 could be used to predict the fraction retained for each congener following administration in corn oil at the hepatic TEQ concentration observed in the soil group. These predicted values for fraction retained could then be used as the basis for a calculation of RBA at the matched hepatic TEQ concentration. However, given the close agreement between the RBA estimates obtained based on the 0.5X and 0.8X oil reference groups (60% vs. 58%, respectively), with estimates that fall well within the range of the CVs for the method, this additional step is probably unnecessary.

Discussion

The goals of this follow-up to the pilot bioavailability study were:

1. Evaluate EROD and MROD activity as a function of hepatic TEQ concentration in the tested dose range
2. Assess any dose-dependency of the elimination rate for each congener by examining the fraction of administered dose retained across dose rates
3. Base a revised RBA calculation on oil reference group(s) that match the soil group on hepatic TEQ and EROD activity, and compare the results to the original pilot-study results for rats and swine.

Observations regarding each of these goals based on results in the follow-up study are discussed below.

Hepatic EROD/MROD Activities

Hepatic EROD and MROD activity both demonstrated a positive, statistically significant dose-response relationship among the three oil reference groups with increasing hepatic TEQ concentrations, but the trend was stronger for EROD activity, resulting in statistically significant differences in EROD activity among dose groups. The dose group differences in MROD activity were not significant among the three oil reference groups.

Dose Dependence of Fraction Retained, by Congener

In this study, among the three oil reference groups with administered dose rates of 0.43, 1.1, and 1.7 ng TEQ/kg bodyweight per day, the fraction of administered dose retained at the end of 30 days was significantly affected by dose level for four of the five tested furan congeners. While the retained fraction of administered dose of TCDF decreased with increasing hepatic TEQ and EROD activity, the retained fractions of administered doses of 4-PeCDF, 1,2,3,4,7,8-HxCDF, and 1,2,3,6,7,8-HxCDF increased with increasing hepatic TEQ but were not statistically related to hepatic EROD activity. Thus, two different factors appear to be affecting the retention of administered dose:

1. For TCDF, previous studies suggested that CYP1A1 induction would enhance metabolism and therefore decrease retention. The results of this study are consistent with that hypothesis, and the fraction of administered TCDF retained at the end of 30 days was strongly dependent on hepatic EROD activity. For other congeners, there are also previous data suggesting elevated elimination rates at elevated dose rates, but in this study no relationship between hepatic EROD activity and fraction retained was observed for the other four tested congeners in the dose range evaluated.

2. For 4-PeCDF and the two HxCDF congeners tested, the observed increase in the fraction of administered dose retained with increasing hepatic TEQ may be due to induction of hepatic CYP1A2 protein. Although the trend in increasing MROD activity was relatively weak in the observed dose range, the increase in CYP1A2 protein may have been substantial enough to result in increased binding of these congeners to protein in the liver. This is supported by the slight trend of decreasing fraction retained in adipose tissue for these congeners (Figure 7), resulting in strong dose-related increases in the liver:adipose concentration ratio among the oil reference groups (Figure 8).

Calculation of RBA and Comparisons with Pilot-Study Results

The results of the tests of trend in retained congener fractions indicate that the accuracy of any calculation of RBA for the soil congeners using the mass-balance method in this study depends on matches to two factors: hepatic EROD activity and hepatic TEQ concentration. As discussed above, the 0.8X oil reference group (Group 5) provided a good match to the soil group (Group 6) for hepatic EROD activity, while the hepatic TEQ concentration of the soil group was intermediate between the 0.5X and the 0.8X oil reference groups. Thus, the RBA calculation can be made using each of these two oil reference groups or, as discussed above, using the interpolated fractions of congeners retained between these groups at the mean hepatic TEQ concentration of the soil group.

The estimated RBAs obtained in this follow-up study can be assessed in comparison to the results from the pilot study. Figure 10 presents the RBA estimates for the tested floodplain congeners obtained in rats in both the pilot and follow-up studies. Several observations can be made based on these estimates:

- The RBA estimate for TCDF in rats was affected substantially when the reference group was matched on hepatic EROD activity or hepatic TEQ, as in the follow-up study. The estimates derived for TCDF in the follow-up study are now similar to the estimates obtained for the other four congeners tested, which ranged from 54% to 67%.

- The RBA estimates for rats for the remaining tested furan congeners were reasonably similar between the pilot and follow-up studies. Although the choice of reference group influenced the RBA estimates for three of the other (non-TCDF) congeners, the new estimates are generally within one standard deviation of the original estimate from the pilot study.

Figure 11 presents the estimated RBAs by congener based on rats in the follow-up study and based on swine from the pilot study. The RBA estimates obtained in the follow-up study for all tested congeners based on rats are still significantly different from those obtained using swine as the experimental model in the pilot study.

Table 11 presents the TEQ-weighted estimates of relative bioavailability for both species from the pilot study and from rats in the follow-up study, as well as estimates of absolute bioavailability calculated assuming that absolute oral bioavailability of all congeners in corn oil is 80%. This assumption is probably reasonable for the tetra- and penta- chlorinated congeners. However, experimental data on dioxin congeners suggest that more highly chlorinated congeners may have somewhat lower absolute bioavailability from corn oil, with octa-chlorinated congeners having very low absolute bioavailability from oil vehicles (less than 15%) (see data summarized in Table 1-1 of U.S. EPA 2003). The magnitude of change in the overall TEQ-weighted RBA estimate in rats for the floodplain soil sample is small. The pilot study yielded a TEQ-weighted RBA of 63% vs. 58–60% in the follow-up study.

Conclusions and Recommendations

Conclusions

The follow-up study results demonstrate that:

- The elimination rates of four of the five furan congeners tested are dose-dependent, even in the relatively low-dose range tested here. Thus, any future studies of bioavailability conducted using the mass-balance approach relied on in this study should incorporate design features to ensure matching between soil and reference groups on hepatic TEQ concentration and EROD activity.

- Hepatic EROD induction itself cannot be used as a surrogate for estimating bioavailability. For the mixture of congeners tested here, hepatic EROD activity in the soil group was similar to that in the oil reference group given 80% of the same dose; however, on a mass-balance basis, the RBA was approximately 60% rather than 80%.

- The results of this follow-up study do not change the conclusion of the pilot study that, for the floodplain soil sample tested, the rat model results in statistically significantly higher estimated RBA than the swine model. This difference may be due to the mode of soil administration (soil mixed with feed in rats vs. soil samples wrapped in dough balls, with the dough balls prepared each day), or it may represent a true species difference in the gastrointestinal tract uptake of these compounds in soil. The soil/feed mixture used in the rat study was mixed thoroughly several weeks ahead of the 30-day study period. It is possible that prolonged contact between the soil and the relatively lipid-rich matrix of the feed could result in desorption of the contaminants into the feed, with resulting increase in apparent bioavailability from the soil. Alternatively, the observed species differences could represent true species differences in the extraction of dioxins and furans from the soil. Such differences are known for other types of compounds (for example, lead and other metals) (Weis and Lavelle 1991). Further experimentation and conclusions regarding the RBA of these compounds in humans should consider the comparative physiology of the rat and swine gastrointestinal tracts and the relative similarities and differences compared to human physiology (Kararli 1995; Miller and Ullrey 1987). However, a complete discussion of this issue is outside the scope of this report.

Study Design Recommendations

If further bioavailability testing is conducted, several steps could be taken to refine the current study design somewhat and to reduce costs:

1. Costs could be reduced by compositing tissue samples from all individual animals within each oil reference group for HR-GC/MS. In both the pilot and the follow-up studies, the variability in fraction of administered dose retained among animals in each oil reference group was relatively low, with CVs in the range of 10%. Compositing tissues in the oil reference groups would reduce analytical costs substantially, and the baseline data here that indicate CVs of approximately 10% within oil reference groups could be carried forward in estimation of CVs for the RBA calculations. Quantitation of tissue concentrations in individual animals in tested soil groups could be retained.

2. Quantitation of hepatic CYP1A2 protein could be added to help match soil and oil reference groups on CYP1A2 induction. Protein determination is more sensitive than MROD activity for CYP1A2 protein induction, which appears to be related to hepatic sequestration (and increased retention) in the relevant dose ranges for some key congeners.

3. Fairly consistent RBA estimates across congeners were obtained when hepatic EROD activity and TEQ concentration are matched between the soil and oil reference groups. Given this, analytical costs could be reduced by selecting one congener for analysis and using this congener as a marker for overall bioavailability. Individual congeners that dominate the TEQ should be considered for selection. In floodplain soil samples, the two predominant congeners are 4-PeCDF (contributing approximately 50% of floodplain soil TEQ) and TCDF (approximately 25% of TEQ). The RBA estimates for TCDF appear to be more sensitive to experimental factors than those for 4-PeCDF. Given this, and the dominance of 4-PeCDF in the soil TEQ, 4-PeCDF could be used as a surrogate for the overall bioavailability of the furan contamination in the floodplain soils. Use of a single congener as the target for HR-GC/MS analysis would reduce analytical costs by more than 50%.

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Figures

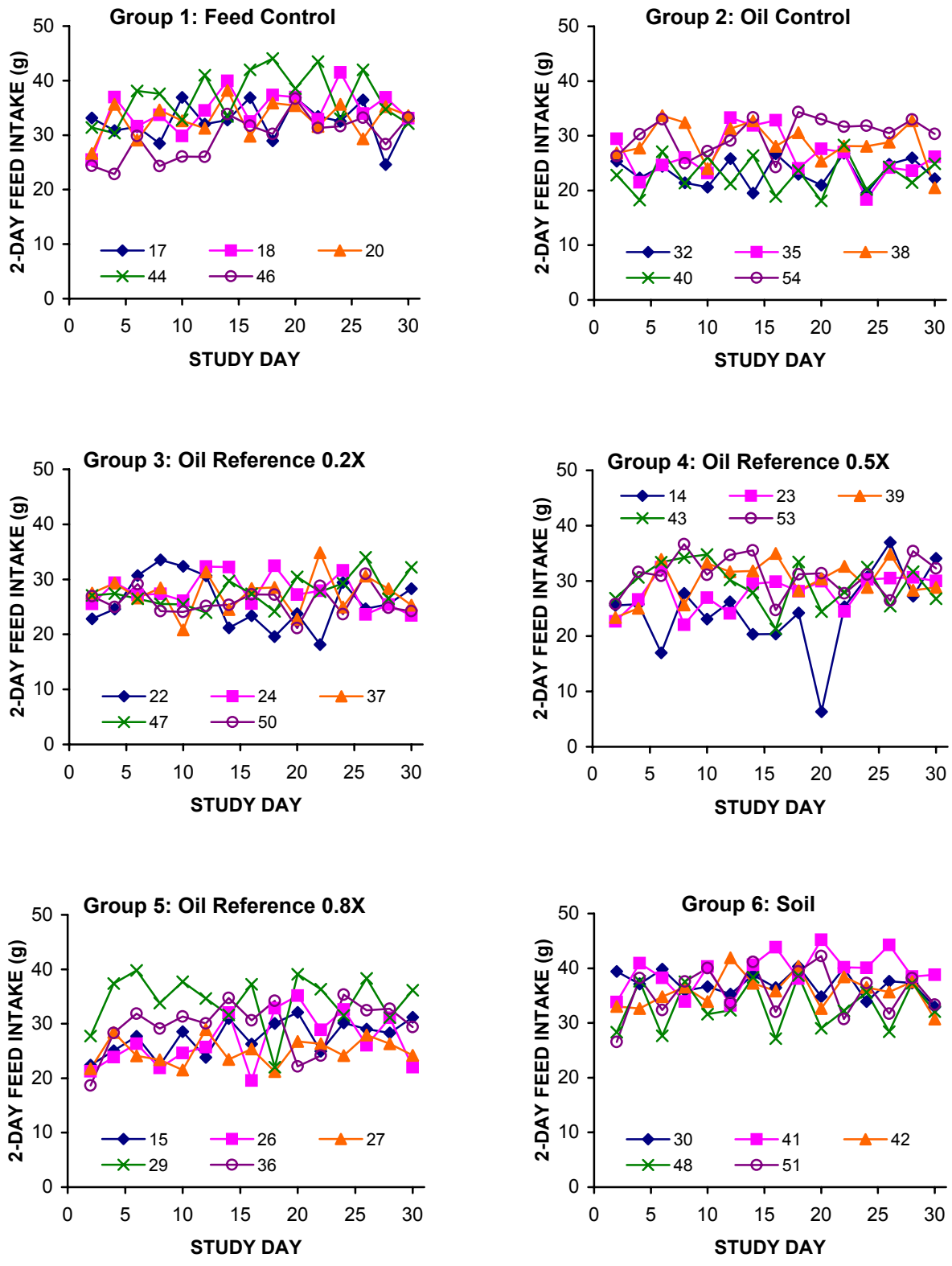

Figure 1. Feed intake for the follow-up rat study

Followup_Calcs.xls Fig_Feed 6/8/2006 (2:03 PM)

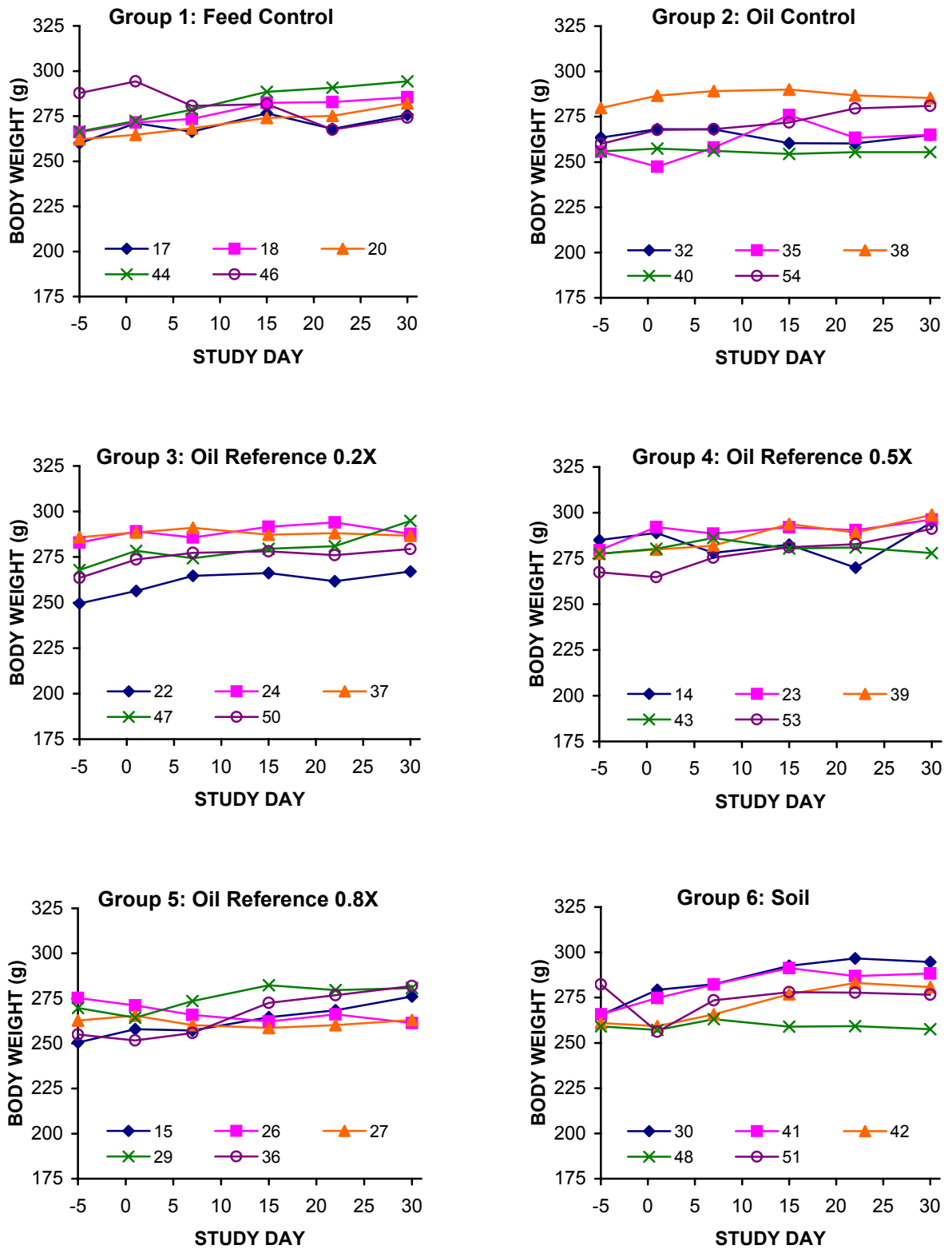

Figure 2. Body weights for the follow-up rat study

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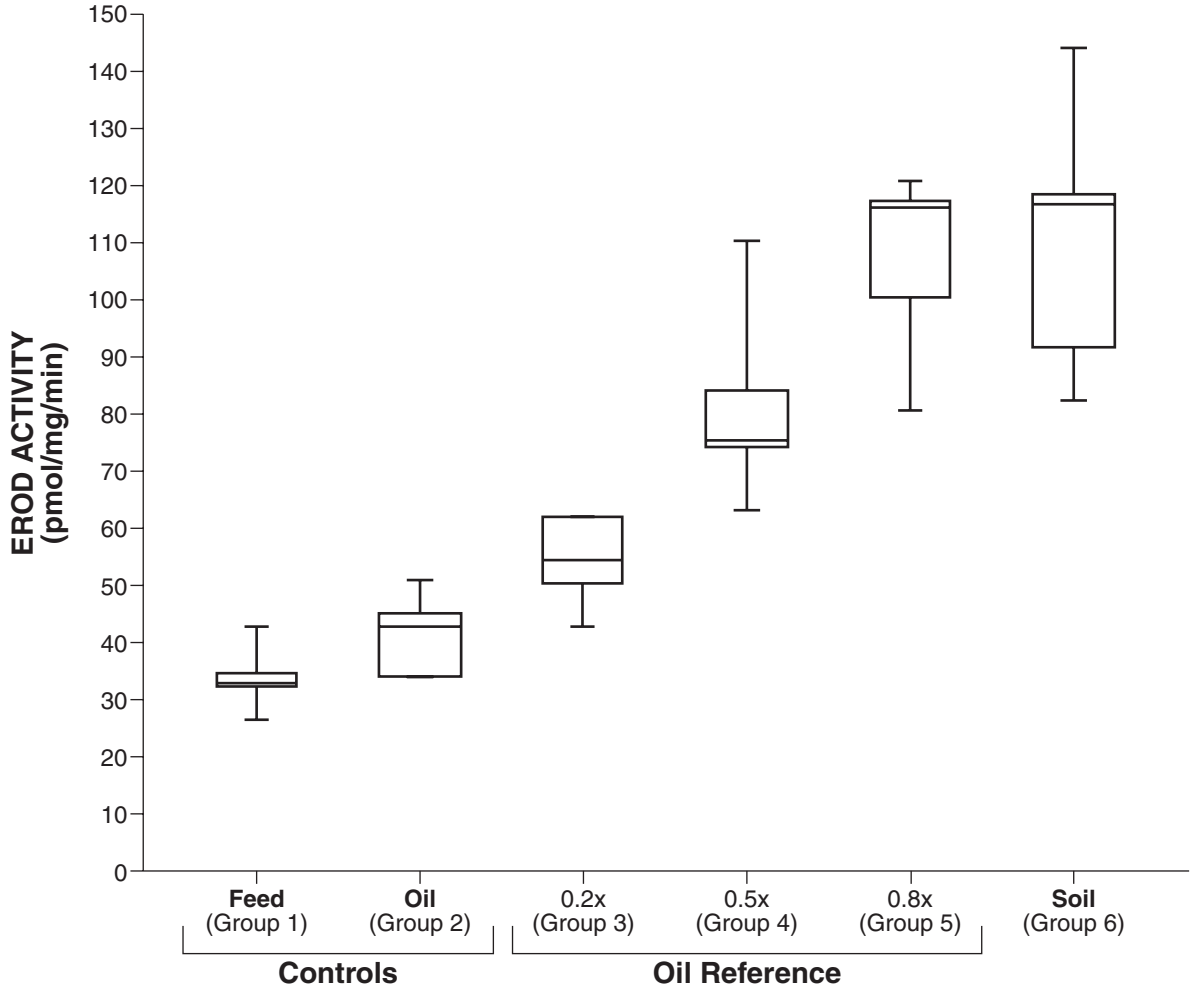

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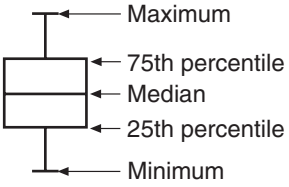
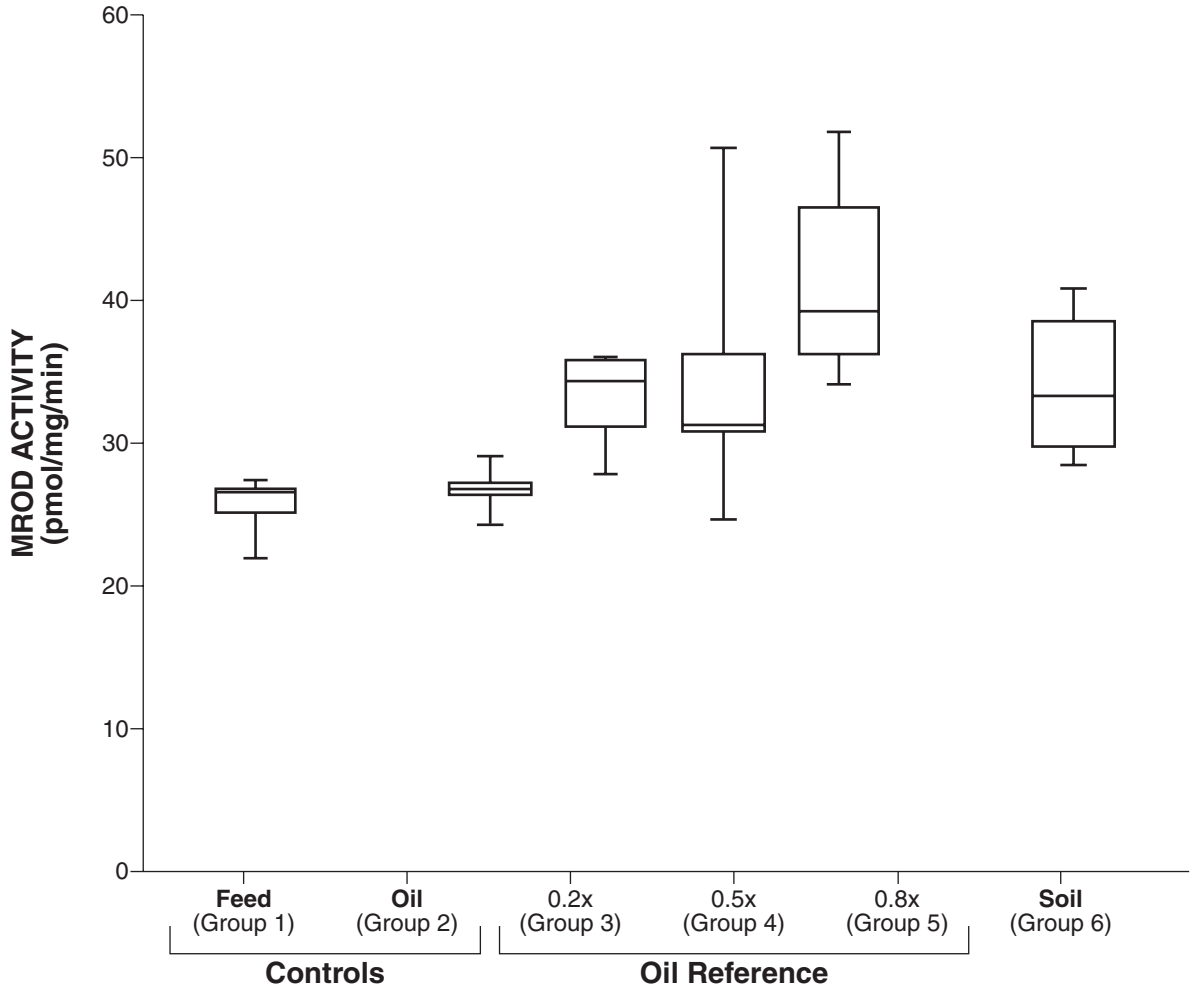


Note: The EROD activity in Group 6 was statistically elevated compared to all other groups except Group 5 (see Table 8).

Figure 3. EROD enzyme induction in the follow-up rat study



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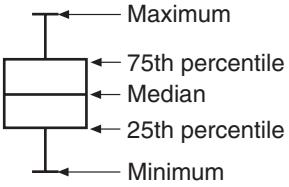


Note: The only statistically significant difference among groups was between Groups 2 and 5 (see Table 8).

Figure 4. MROD enzyme induction in the follow-up rat study

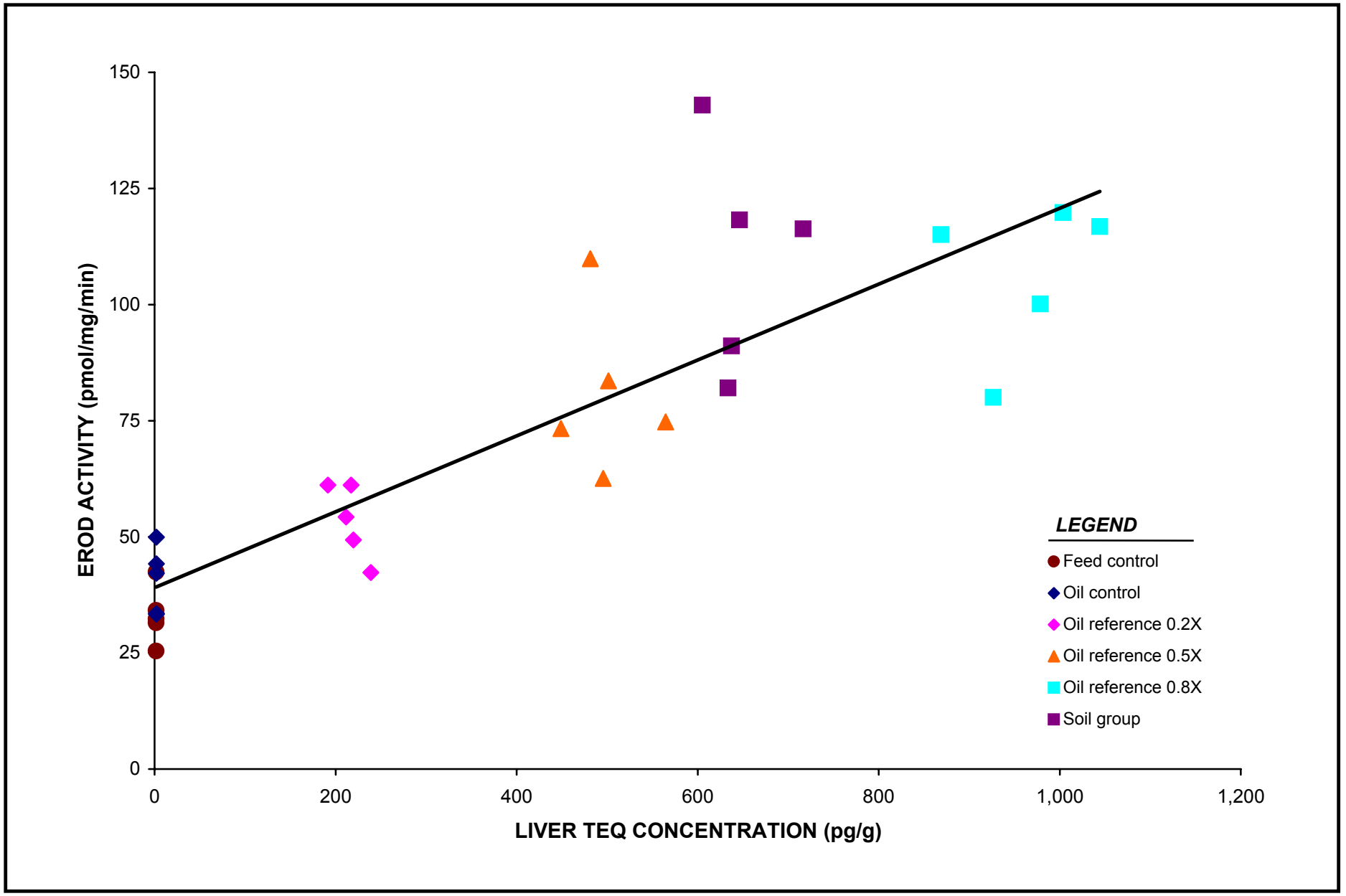


Figure 5. EROD activity vs. liver TEQ concentration in the rat follow-up study

EROD_MROD_analysis_May26aft.xls Fig5_EROD 6/8/2006 (1:55 PM)

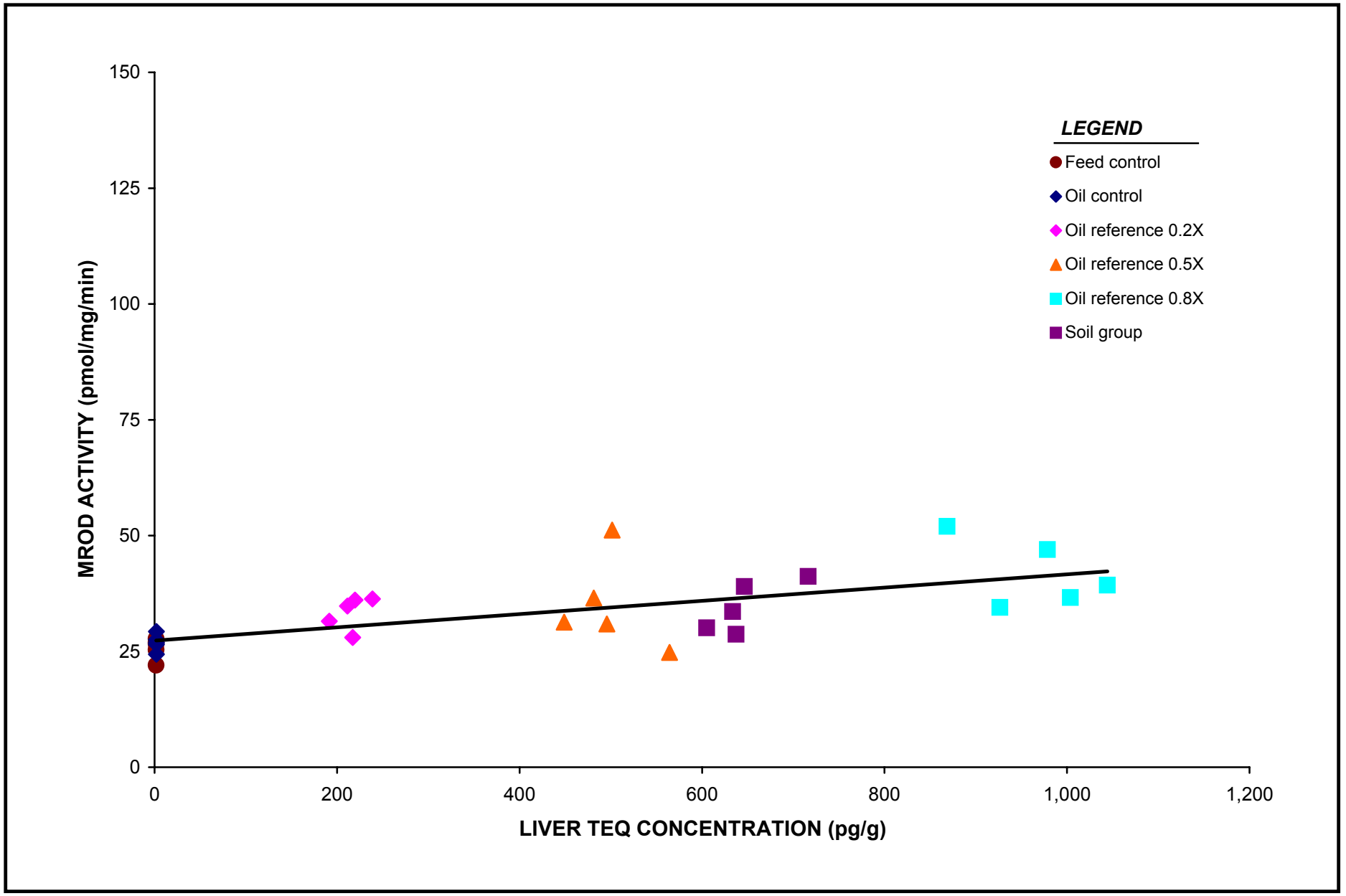
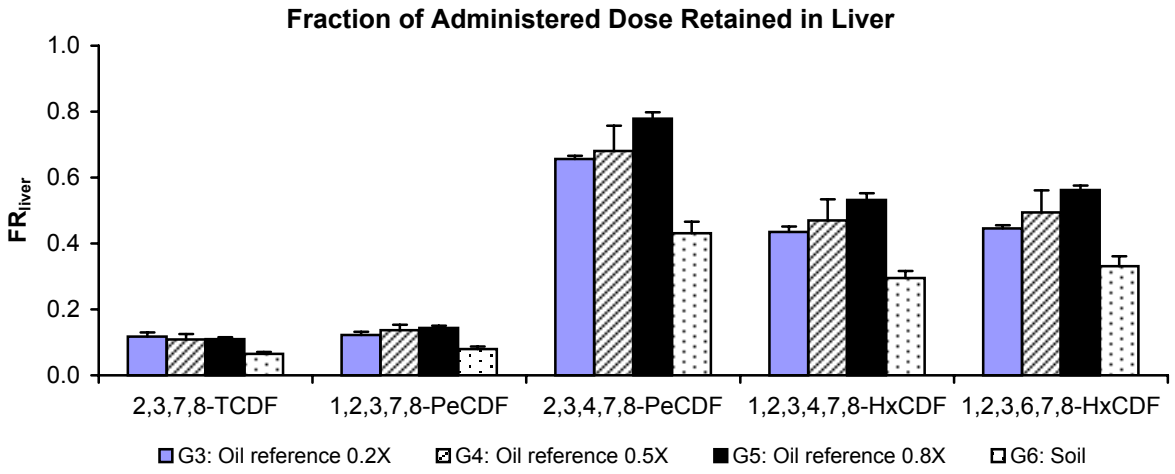
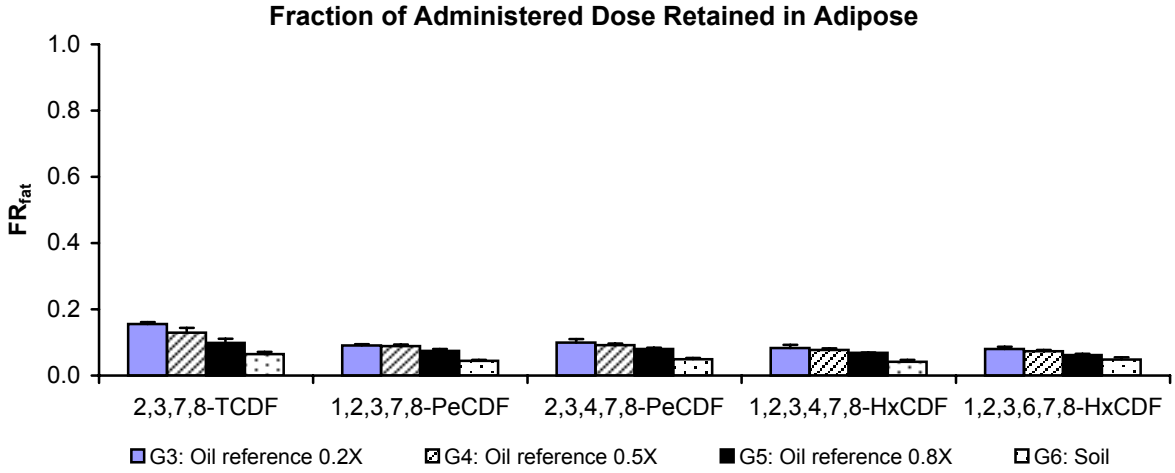


Figure 6. MROD activity vs. liver TEQ concentration in the rat follow-up study

EROD_MROD_analysis_May26aft.xls Fig6_MROD 6/8/2006 (1:55 PM)





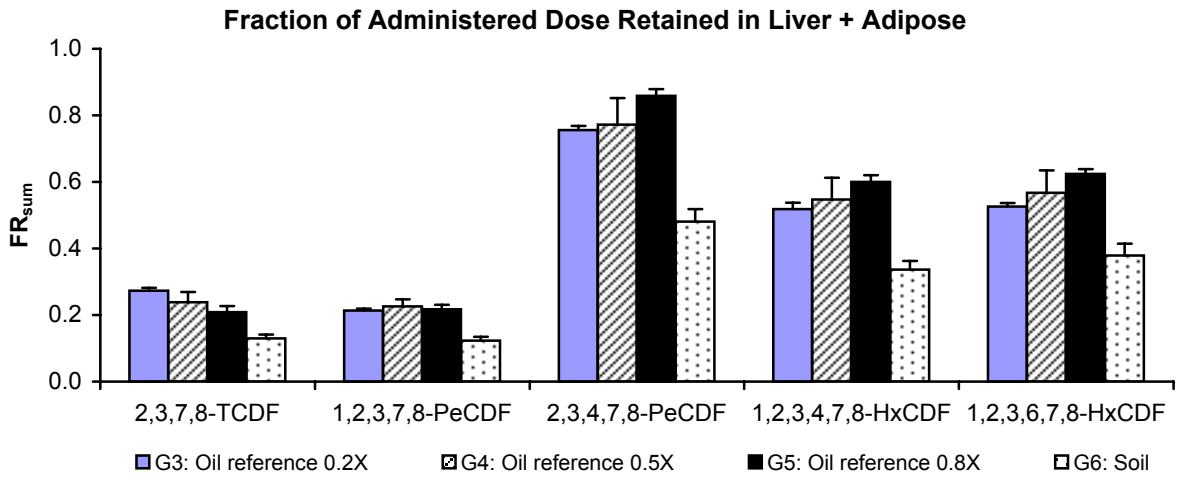


Figure 7. Distribution of administered doses in rat tissues

Followup_Calcs.xls Fig_Fraction 6/8/2006 (2:02 PM)

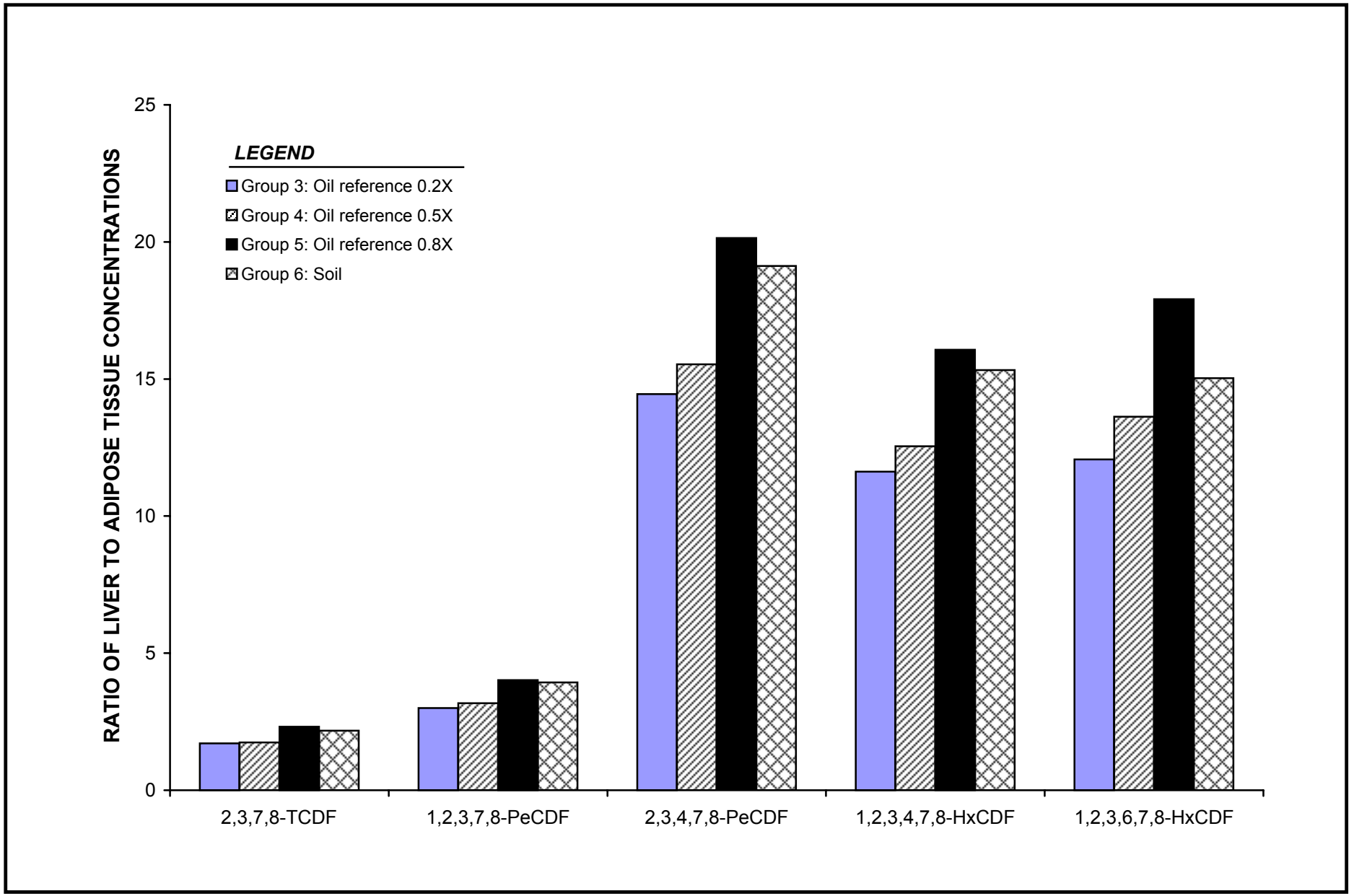


Figure 8. Ratio of liver to adipose tissue concentrations in the rat follow-up study

Followup_Calcs.xls Fig_LFratio 6/8/2006 (2:02 PM)

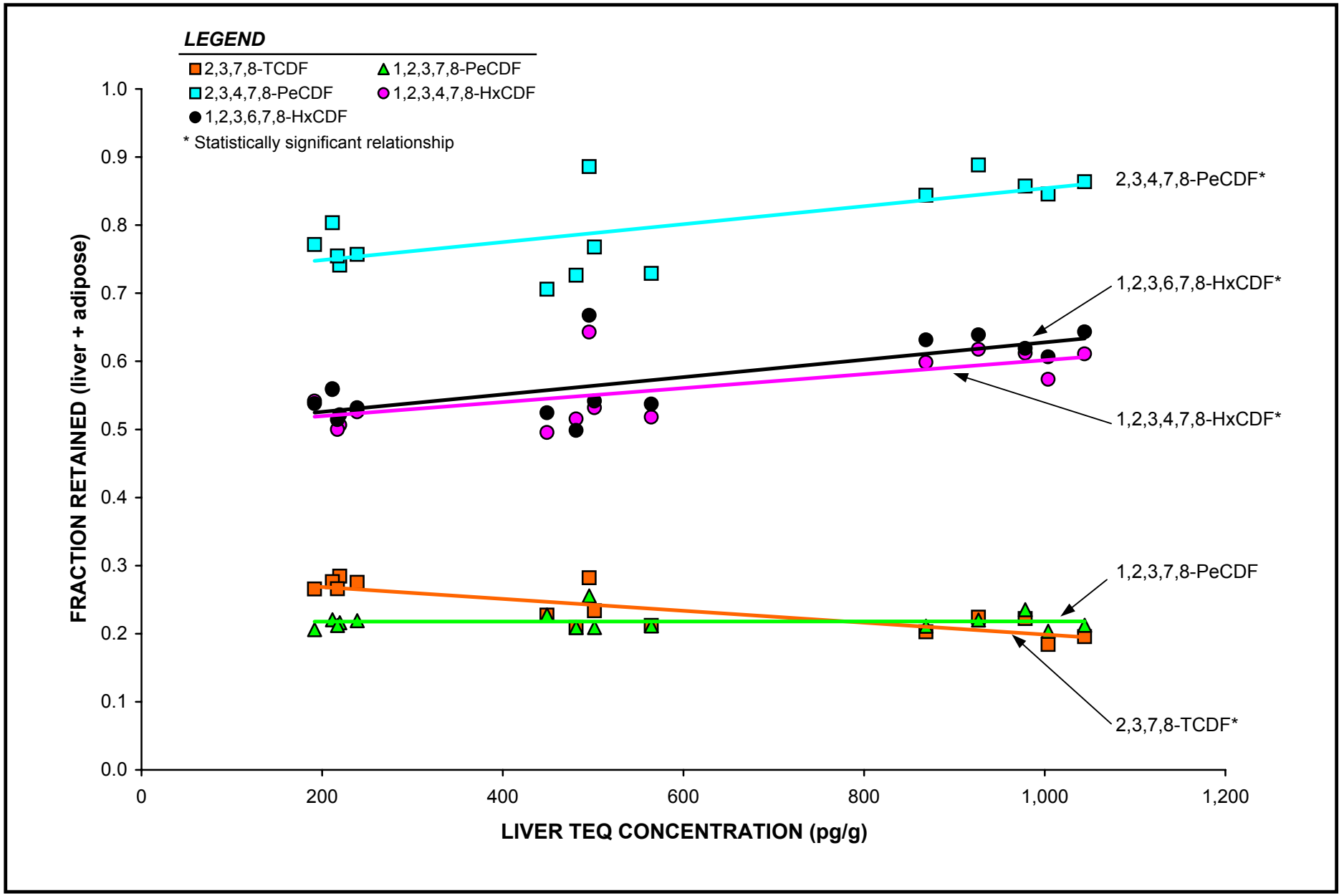


Figure 9. Fraction retained (sum of liver and adipose) vs. liver TEQ concentration in the rat follow-up study

EROD_MROD_analysis_May26aft.xls Fig9_FRvsLiverTEQ 6/8/2006 (1:56 PM)

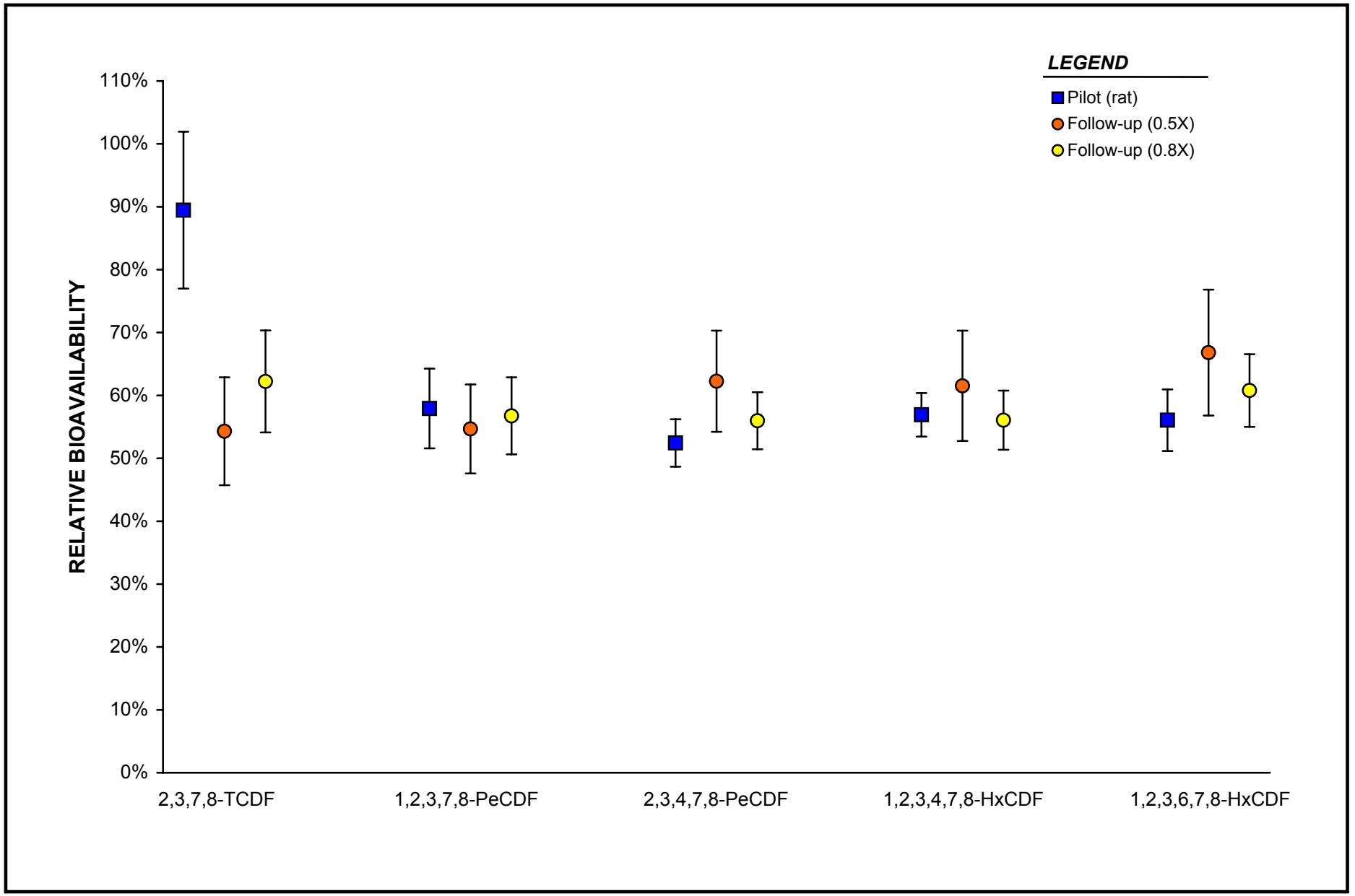


Figure 10. Comparison of RBAs (based on fraction retained in liver + adipose tissues) for rats between pilot and follow-up studies

Fig_Dow_Comp2_text.xls Chart_rat 6/8/2006 (1:59 PM)

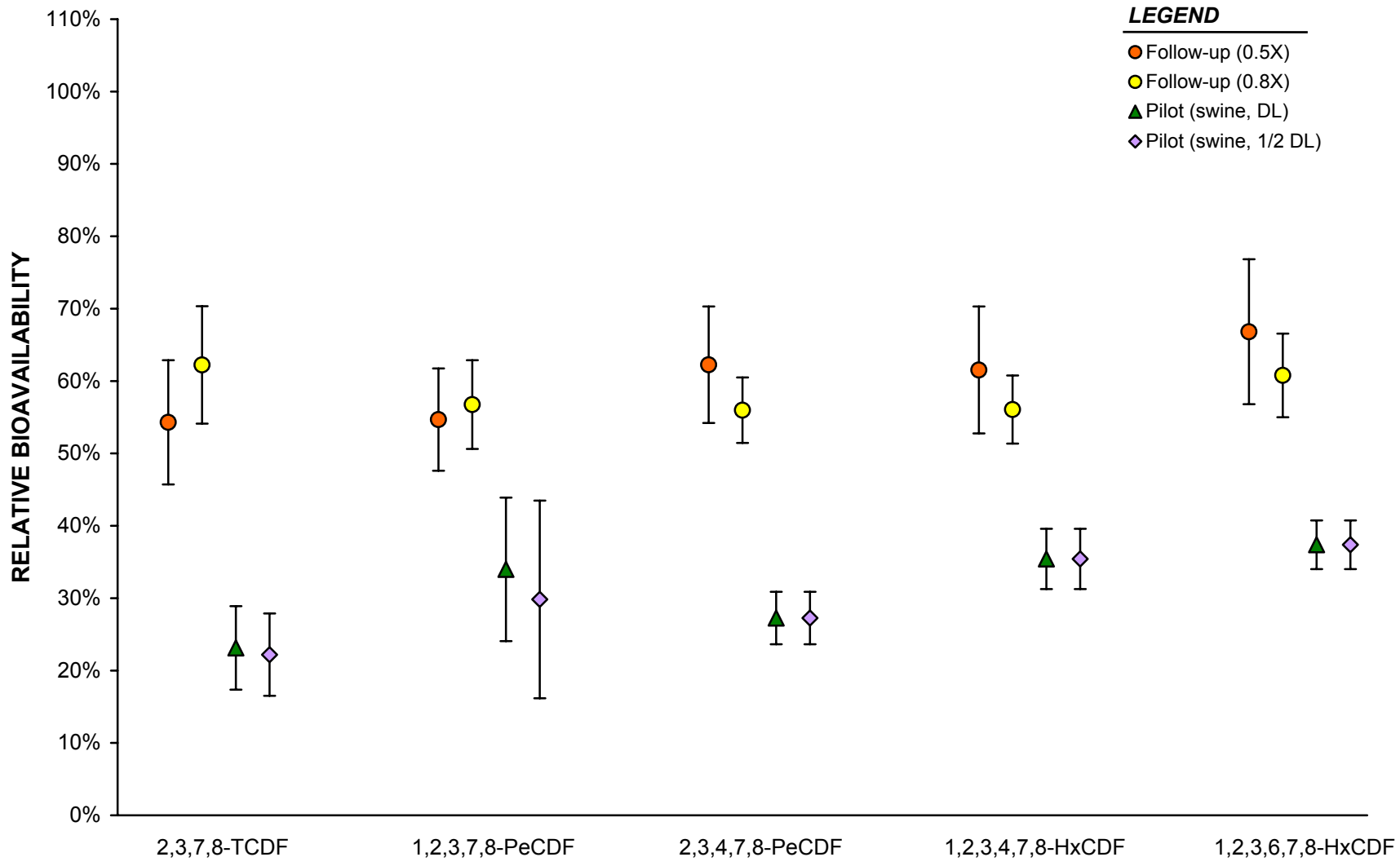


Figure 11. Comparison of RBAs (based on fraction retained in liver + adipose tissues) between swine (pilot study) and rats (follow-up study)

Fig_Dow_Comp2_text.xls Chart_Swine 6/8/2006 (1:59 PM)

Tables

Table 1. PCDD/F concentrations in triplicate samples of pilot study test soil (<250 µm)

Sample Location:		Tittabawassee River Flood Plain Soil (Imerman Park 2)						
Sample ID:		THT02769						
Date:		7/8/2004						
Tag Number:		57273	57274	57275	Mean	Coefficient		
Analyte	WHO TEF	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	Concentration (pg/g)	of Variability (%)	TEQ (pg/g)	% of TEQ
PCDDs/Fs								
2,3,7,8-TCDD	1	4.70	4.90	4.77	4.79	2.1%	4.79	0.6%
1,2,3,7,8-PeCDD	1	5.36 *J*	4.87	5.16	5.13	4.8%	5.13	0.6%
1,2,3,4,7,8-HxCDD	0.1	4.30 *J*	2.92 *U*[a]	3.60 *J*	3.61 *J*	19%	0.361	0.04%
1,2,3,6,7,8-HxCDD	0.1	26.3	18.7	17.9	21.0	22%	2.10	0.2%
1,2,3,7,8,9-HxCDD	0.1	8.04 *J*	7.30	7.68	7.67	4.8%	0.767	0.09%
1,2,3,4,6,7,8-HpCDD	0.01	490	383	346	406	18%	4.06	0.5%
OCDD	0.0001	4,540	3,820 *B*	3,530 *B*	3,963 *B*	13%	0.396	0.05%
2,3,7,8-TCDF	0.1	2,550 *E*	1,950	1,950	2,150	16%	215	25%
1,2,3,7,8-PeCDF	0.05	1,320	965	943	1,076	20%	53.8	6.3%
2,3,4,7,8-PeCDF	0.5	1,060	808	780	883	17%	441	52%
1,2,3,4,7,8-HxCDF	0.1	869	654	635	719	18%	71.9	8.5%
1,2,3,6,7,8-HxCDF	0.1	196 *D*	151 *D*	144 *D*	164 *D*	17%	16.4	1.9%
2,3,4,6,7,8-HxCDF	0.1	112	88.0	85.9	95.3	15%	9.53	1.1%
1,2,3,7,8,9-HxCDF	0.1	171	121	119	137	22%	13.7	1.6%
1,2,3,4,6,7,8-HpCDF	0.01	842	670	657 *D*	723	14%	7.23	0.9%
1,2,3,4,7,8,9-HpCDF	0.01	83.6	60.5	60.8	68.3	19%	0.683	0.08%
OCDF	0.0001	1,530	1,160	1,100	1,263	18%	0.126	0.01%
TEQ (pg/g)							**847**	
Other Parameters								
Solids, Total (%)	--	--	--	--	98.9	--	--	--
pH (s.u.)	--	--	--	--	7.69	--	--	--
Carbon, Total Organic (%)	--	--	--	--	2.73	--	--	--
Grain Size (%)								
Coarse sand (250 µm – 2 mm)	--	--	--	--	42.1	--	--	--
Fine sand (106 – 250 µm)	--	--	--	--	26.8	--	--	--
Very fine sand (75 – 106 µm)	--	--	--	--	8.78	--	--	--
Percent silt (4 – 75 µm)	--	--	--	--	21.4	--	--	--
Percent clay (< 4 µm)	--	--	--	--	0.86	--	--	--

Note: These results are the same as those presented in the pilot study report. The soil sample was not re-analyzed for the follow-up study.
B – This compound was also detected in the method blank.
D – The amount reported is the maximum possible concentration due to possible chlorinated diphenylether interference.
E – The amount detected is above the Upper Calibration Limit of the instrument.
J – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor
Highlighting indicates the five congeners that contribute most to the total TEQ
If more than half of the results for a chemical were qualified with a *B*, *D*, *E*, or *J*, then the associated mean concentration was also qualified.

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).

Table 2. PCDD/F concentrations in Rodent Lab Diet 5001 and corn oil

Sample ID:		Rodent Lab Diet 5001		Corn Oil (Spectrum Chemical)	
Date:		2/24/2006		2/24/2006	
Analyte	WHO TEF	Concentration (pg/g)	TEQ (pg/g)	Concentration (pg/mL)	TEQ (pg/mL)
PCDDs/Fs					
2,3,7,8-TCDD	1	0.0852 *U*	0.0852	0.599 *U*	0.599
1,2,3,7,8-PeCDD	1	0.0756 *U*	0.0756	0.569 *U*	0.569
1,2,3,4,7,8-HxCDD	0.1	0.0815 *U*	0.00815	1.07 *U*	0.107
1,2,3,6,7,8-HxCDD	0.1	0.0833 *U*	0.00833	1.03 *U*	0.103
1,2,3,7,8,9-HxCDD	0.1	0.0745 *U*[a]	0.00745	0.990 *U*	0.0990
1,2,3,4,6,7,8-HpCDD	0.01	0.850 *J*	0.00850	0.816 *U*	0.00816
OCDD	0.0001	10.2 *B*	0.00102	6.50 *J*	0.00065
2,3,7,8-TCDF	0.1	0.157 *J*	0.0157	0.834 *U*	0.0834
1,2,3,7,8-PeCDF	0.05	0.0861 *U*	0.00431	1.01 *U*	0.0505
2,3,4,7,8-PeCDF	0.5	0.0546 *U*[a]	0.0273	0.959 *U*	0.480
1,2,3,4,7,8-HxCDF	0.1	0.0281 *U*	0.00281	0.282 *U*	0.0282
1,2,3,6,7,8-HxCDF	0.1	0.0264 *U*	0.00264	0.254 *U*	0.0254
2,3,4,6,7,8-HxCDF	0.1	0.0290 *U*	0.00290	0.286 *U*	0.0286
1,2,3,7,8,9-HxCDF	0.1	0.0451 *U*	0.00451	0.436 *U*	0.0436
1,2,3,4,6,7,8-HpCDF	0.01	0.110 *U*	0.00110	0.400 *U*	0.00400
1,2,3,4,7,8,9-HpCDF	0.01	0.138 *U*	0.00138	0.460 *U*	0.00460
OCDF	0.0001	0.335 *J*	3.35E-05	2.25 *U*	0.000225
TEQ			**0.257**		**2.234**

Note: *J* – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).

Table 3. PCDD/F concentrations in blended rat diet

Sample ID:		Soil THT02769/Diet Blend										
Date:		11/16/2005										
		Pre-Dosing Analysis							Pre- and Post-Dosing Analysis			
Analyte	WHO TEF	Top (#1) Concentration (pg/g)	Middle (#2) Concentration (pg/g)	Bottom (#3) Concentration (pg/g)	Mean Concentration (pg/g)	Standard Deviation (pg/g)	Coefficient of Variability (%)	Post-Dosing Analysis (pg/g)	Mean Concentration (pg/g)	Coefficient of Variability (%)	TEQ (pg/g)	% of TEQ
2,3,7,8-TCDD	1	0.369 *U*	0.344 *U*	0.480 *J*	0.398 *U*	0.072	18%	0.311 *J*	0.354 *J*	19%	0.354	0.9%
1,2,3,7,8-PeCDD	1	0.407 *U*	0.384 *U*	0.487 *U*	0.426 *U*	0.054	13%	0.357 *U*[a]	0.392 *U*	14%	0.392	1.0%
1,2,3,4,7,8-HxCDD	0.1	0.593 *U*	0.532 *U*	0.640 *U*	0.588 *U*	0.054	9.2%	0.262 *U*[a]	0.425 *U*	33%	0.0425	0.1%
1,2,3,6,7,8-HxCDD	0.1	1.75 *J*	1.28 *U*[a]	1.54 *J*	1.52 *J*	0.24	15%	2.17 *J*	1.85 *J*	22%	0.185	0.5%
1,2,3,7,8,9-HxCDD	0.1	0.601 *U*	0.494 *U*	0.585 *U*	0.560 *U*	0.058	10%	0.724 *J*	0.642 *U*	16%	0.0642	0.2%
1,2,3,4,6,7,8-HpCDD	0.01	29.8	27.4	26.1	27.8	1.9	6.8%	31.7	29.7	8.7%	0.297	0.8%
OCDD	0.0001	257	220	204	227	27	12%	237 *B*	232	9.9%	0.0232	0.1%
2,3,7,8-TCDF	0.1	67.1	67.7	75.5	70.1	4.7	6.7%	88.4	79.3	13%	7.93	21%
1,2,3,7,8-PeCDF	0.05	46.4	48.7	54.0	49.7	3.9	7.8%	49.2	49.5	6.4%	2.48	6.4%
2,3,4,7,8-PeCDF	0.5	38.6	39.7	44.3	40.9	3.0	7.4%	43.7	42.3	6.8%	21.2	55%
1,2,3,4,7,8-HxCDF	0.1	31.3	34.3	38.8	34.8	3.8	11%	32.0	33.4	9.9%	3.34	8.7%
1,2,3,6,7,8-HxCDF	0.1	8.41	7.71	8.93	8.35	0.61	7.3%	8.02	8.19	6.4%	0.819	2.1%
2,3,4,6,7,8-HxCDF	0.1	4.17	4.25	4.19	4.20	0.042	1.0%	4.11 *J*	4.16	1.4%	0.416	1.1%
1,2,3,7,8,9-HxCDF	0.1	6.38	6.60	7.41	6.80	0.54	8.0%	6.48	6.64	7.0%	0.664	1.7%
1,2,3,4,6,7,8-HpCDF	0.01	33.3	32.7	32.7	32.9	0.35	1.1%	38.6	35.8	8.3%	0.358	0.9%
1,2,3,4,7,8,9-HpCDF	0.01	2.98	3.67	3.69	3.45	0.40	12%	3.20 *J*	3.32	10%	0.0332	0.1%
OCDF	0.0001	59.1	60.7	55.7	58.5	2.6	4.4%	68.5	63.5	8.9%	0.00635	0.02%

Note: *J* – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.
TEQ – Toxicity Equivalence Concentration
WHO TEF – World Health Organization Toxicity Equivalence Factor
Highlighting indicates the five congeners in each sample that contribute most to the total TEQ.
If more than half of the results for a chemical were qualified with a *U* or *J*, then the associated mean concentration was also qualified.

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).

Table 4. Analytical results for oil reference mixtures used in follow-up rat study

Analyte	Target Concentration (pg/mL)	Pre-Dosing Measured Concentration (pg/mL)	Relative Percent Difference[a]	Post-Dosing Measured Concentration (pg/mL)	Average Measured Concentration[b] (pg/mL)	Coefficient of Variability[c]
Group 3: Oil Reference 0.2X						
2,3,7,8-TCDF	252	267	5.6%	268	268	0.3%
1,2,3,7,8-PeCDF	179	188	4.9%	182	185	2.3%
2,3,4,7,8-PeCDF	147	161	8.9%	171	166	4.3%
1,2,3,4,7,8-HxCDF	125	121	3.5%	123	122	1.2%
1,2,3,6,7,8-HxCDF	30.1	34.7	14%	37.2	36.0	4.9%
Group 4: Oil Reference 0.5X						
2,3,7,8-TCDF	631	645	2.2%	700	673	5.8%
1,2,3,7,8-PeCDF	447	439	1.9%	465	452	4.1%
2,3,4,7,8-PeCDF	368	385	4.5%	459	422	12%
1,2,3,4,7,8-HxCDF	313	291	7.3%	322	307	7.2%
1,2,3,6,7,8-HxCDF	75.2	78.4	4.2%	100	89.2	17%
Group 5: Oil Reference 0.8X						
2,3,7,8-TCDF	1,009	976	3.4%	1,070	1,023	6.5%
1,2,3,7,8-PeCDF	716	690	3.7%	724	707	3.4%
2,3,4,7,8-PeCDF	589	594	0.9%	689	642	10%
1,2,3,4,7,8-HxCDF	501	450	11%	488	469	5.7%
1,2,3,6,7,8-HxCDF	120	127	5.5%	145	136	9.4%

[a] The relative percent difference (RPD) between the target and pre-dosing measured concentrations is calculated as the absolute value of the difference divided by the average of the target and pre-dosing measured concentrations.

[b] Average of pre- and post-dosing measured concentrations.

[c] Coefficient of variability between pre- and post-dosing measured concentrations.

Table 5. Dose groups and test materials used in the rat follow-up study

Dose Group	Group Name	Description
1	Feed control	Undosed control group, fed clean feed, no gavage
2	Oil control	Undosed control group, fed clean feed, gavaged with unspiked corn oil
3	Oil reference 0.2X	Reference group, with corn oil spiked at 20% of calculated PCDD/F dose administered to Group 6
4	Oil reference 0.5X	Reference group, with corn oil spiked at 50% of calculated PCDD/F dose administered to Group 6
5	Oil reference 0.8X	Reference group, with corn oil spiked at 80% of calculated PCDD/F dose administered to Group 6
6	Soil group	Tittabawassee River floodplain soil blended with diet, nominal daily dose rate X

Table 6. Average daily doses administered to rats

	WHO TEF	Soil (Group 6) Average Daily Dose (ng/kg bw/day) Mean	SD	TEQ	Oil Reference 0.2X (Group 3) Average Daily Dose (ng/kg bw/day) Mean	SD	TEQ	Oil Reference 0.5X (Group 4) Average Daily Dose (ng/kg bw/day) Mean	SD	TEQ	Oil Reference 0.8X (Group 5) Average Daily Dose (ng/kg bw/day) Mean	SD	TEQ
2,3,7,8-TCDF	0.1	5.20	0.17	0.520	0.959	0.038	0.0959	2.36	0.044	0.236	3.83	0.0776	0.383
1,2,3,7,8-PeCDF	0.05	3.24	0.11	0.162	0.662	0.026	0.0331	1.59	0.030	0.0794	2.65	0.0536	0.132
2,3,4,7,8-PeCDF	0.5	2.77	0.091	1.39	0.594	0.023	0.297	1.48	0.028	0.741	2.40	0.0487	1.20
1,2,3,4,7,8-HxCDF	0.01	2.19	0.072	0.0219	0.436	0.017	0.00436	1.08	0.020	0.0108	1.76	0.0356	0.0176
1,2,3,6,7,8-HxCDF	0.01	0.537	0.018	0.00537	0.129	0.0050	0.00129	0.313	0.00588	0.00313	0.509	0.0103	0.00509
Total Mean TEQ Dose:		--	--	**2.10**	--	--	**0.431**	--	--	**1.07**	--	--	**1.74**

Notes:

All dose groups used for analyses were comprised of 5 animals
WHO TEF – World Health Organization Toxicity Equivalence Factor
SD – Standard deviation
TEQ – Toxicity Equivalence Concentration

Table 7. Summary of TEQ concentrations in liver and adipose tissues

Group/Tissue	TEQ Concentrations (pg/g) Average	SD	Statistical Analysis[a]
Group 1: Feed Control			
Liver	0.719 [b]	--	--
Fat	0.199 [b]	--	--
Group 2: Oil Control			
Liver	0.877 [b]	--	--
Fat	0.210 [b]	--	--
Group 3: Oil Reference (0.2X)			
Liver	216	17	Significantly different from Group 6
Fat	21.6	1.3	Significantly different from Group 6
Group 4: Oil Reference (0.5X)			
Liver	498	42	Significantly different from Group 6
Fat	45.5	3.3	Not significantly different from Group 6
Group 5: Oil Reference (0.8X)			
Liver	964	68	Significantly different from Group 6
Fat	65.9	3.0	Significantly different from Group 6
Group 6: Soil			
Liver	648	41	Significantly different from all other groups
Fat	49.4	2.2	Significantly different from all other groups

[a] Comparisons were conducted using an ANOVA followed by Dunnett's multiple comparison test at an overall 95 percent confidence level (overall alpha = 0.05).

[b] Laboratory analyses were performed on a composite sample of all five rats in group.

Table 8. Summary of EROD and MROD liver microsomal activity data

	N	Liver Microsomal Activities (pmol/mg/min) Minimum	Maximum	Mean	SD	Conclusion
EROD						
G1: Feed control	5	25.4	42.4	33.2	6.1	not significantly different from G2[a]
G2: Oil control	5	33.4	49.9	40.6	7.2	significantly lower than G4 and G5[b]
G3: Oil reference 0.2x	5	42.3	61.2	53.6	8.1	not significantly different from G2[b]
G4: Oil reference 0.5x	5	62.6	109.9	80.8	17.9	significantly higher than G2[b]
G5: Oil reference 0.8x	5	80.0	119.8	106.4	16.6	significantly higher than G2[b]
G6: Soil	5	82.0	142.9	110.1	24.1	significantly higher than all groups except G5[b]
MROD						
G1: Feed control	5	22.0	27.7	25.7	2.2	not significantly different from G2[a]
G2: Oil control	5	24.4	29.3	26.9	1.8	significantly lower than G5[b]
G3: Oil reference 0.2x	5	28.0	36.3	33.3	3.6	not significantly different from G2[b]
G4: Oil reference 0.5x	5	24.8	51.2	34.9	10.0	not significantly different from G2[b]
G5: Oil reference 0.8x	5	34.5	52.0	41.9	7.4	significantly higher than G2[b]
G6: Soil	5	28.7	41.2	34.5	5.5	not significantly different from any[b]

Notes: EROD – ethoxyresorufin O-deethylase
MROD – methoxyresorufin O-deethylase
SD – standard deviation

[a] Groups G1 and G2 compared using standard t-tests; Comparisons using Wilcoxon non-parametric test provided identical conclusions.

[b] Comparisons with groups G2 and G6 were each conducted using an ANOVA followed by Dunnett's multiple comparison test at an overall 95 percent confidence level (overall alpha = 0.05)

Table 9. Statistical analysis of fraction of administered dose retained vs. hepatic TEQ, EROD activity, and MROD activity

	Regression Coefficients									
	TCDF		1-PeCDF		4-PeCDF		1,2,3,4,7,8-HxCDF		1,2,3,6,7,8-HxCDF	
	β	p	β	p	β	p	β	p	β	p
Intercept	0.31	<0.0001	0.24	<0.0001	0.76	<0.0001	0.52	<0.0001	0.54	<0.0001
Hepatic TEQ (pg/g)	-1.9E-05	NS	3.3E-05	NS	0.00023	<0.01	0.00017	<0.01	0.00022	<0.01
EROD (pmol/mg/min)	-0.0011	<0.01	-0.000491	NS	-0.0016	NS	-0.0012	NS	-0.0015	NS
MROD (pmol/mg/min)	0.00077	NS	3.3E-05	NS	0.0011	NS	0.00089	NS	0.00063	NS
p for model[b]	<0.0001		NS		<0.05		<0.05		<0.01	

Note: NS – not significant

[a] Multivariate linear regression (least squares method)

[b] F-test significance

Table 10. Relative bioavailability estimates for the follow-up rat study based on 0.5X and 0.8X reference oil groups

		Fraction Retained (liver + adipose)						Relative Bioavailability			
	Percent of	Soil (Group 6)		0.5X (Group 4)		0.8X (Group 5)		Using 0.5X (Group 4)		Using 0.8X (Group 5)	
Congener	Soil TEQ	Mean	SD	Mean	SD	Mean	SD	Mean	CV	Mean	CV
2,3,7,8-TCDF	25.4%	0.13	0.012	0.24	0.030	0.21	0.019	54%	16%	62%	13%
1,2,3,7,8-PeCDF	6.3%	0.12	0.011	0.23	0.021	0.22	0.014	55%	13%	57%	11%
2,3,4,7,8-PeCDF	52.1%	0.48	0.037	0.77	0.080	0.86	0.021	62%	13%	56%	8.1%
1,2,3,4,7,8-HxCDF	8.5%	0.34	0.026	0.55	0.066	0.60	0.020	62%	14%	56%	8.4%
1,2,3,6,7,8-HxCDF	1.9%	0.38	0.035	0.57	0.067	0.62	0.014	67%	15%	61%	10%
TEQ-Weighted:								**60%**		**58%**	

Notes: RBA – relative bioavailability, calculated using Equation 1 (see text)
SD – standard deviation
CV – coefficient of variability $CV = (CV_{soil}^2 + CV_{reference}^2)^{0.5}$

Table 11. TEQ-weighted relative and absolute bioavailability estimates for the pilot and follow-up studies

		Mean RBA[a]					Estimated Absolute Bioavailability[b]				
		Pilot					Pilot				
	Percent of		Swine		Follow-Up, Rat			Swine		Follow-Up, Rat	
Congener	Soil TEQ	Rat	ND=1/2 DL	ND=DL	Using 0.5X[c]	Using 0.8X[d]	Rat	ND=1/2 DL	ND=DL	Using 0.5X[c]	Using 0.8X[d]
Tittabawassee River Flood Plain Soil											
2,3,7,8-TCDF	25.4%	0.89	0.22	0.23	0.54	0.62	0.72	0.18	0.18	0.43	0.50
1,2,3,7,8-PeCDF	6.3%	0.58	0.30	0.34	0.55	0.57	0.46	0.24	0.27	0.44	0.45
2,3,4,7,8-PeCDF	52.1%	0.52	0.27	0.27	0.62	0.56	0.42	0.22	0.22	0.50	0.45
1,2,3,4,7,8-HxCDF	8.5%	0.57	0.35	0.35	0.62	0.56	0.46	0.28	0.28	0.49	0.45
1,2,3,6,7,8-HxCDF	1.9%	0.56 [e]	0.37	0.37	0.67	0.61	0.45 [e]	0.30	0.30	0.53	0.49
TEQ-Weighted:		**0.63**	**0.27**	**0.27**	**0.60**	**0.58**	**0.51**	**0.22**	**0.22**	**0.48**	**0.46**

[a] RBA estimates for soil compared to corn oil reference material based on liver plus adipose tissue measurements.

[b] Assuming an absolute availability from corn oil of 80%.

[c] Using the 0.5X dose group (Group 4) as the reference group for calculating RBA

[d] Using the 0.8X dose group (Group 5) as the reference group for calculating RBA

[e] Outlier omitted from rat RBA estimate from the pilot study; see results section of pilot study report for discussion.

Appendix A

Study Design Modifications for the Follow-Up to the Pilot Study of Oral Bioavailability of Dioxins/Furans in Midland Soil

Exponent®

Study Design Modifications for the Follow-Up to the Pilot Study of Oral Bioavailability of Dioxins/Furans in Midland Soil

Prepared for

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Study Design Modifications for the Follow-Up to the Pilot Study of Oral Bioavailability of Dioxins/Furans in Midland Soil

Introduction

This document describes a proposed study design for a follow-up to the pilot study of the oral bioavailability of dioxins and furans from Midland and Tittabawassee River flood-plain soils. The pilot study results showed statistically significant differences in hepatic EROD activity (a marker for cytochrome P450 1A1 induction) between the rats dosed with soils and their respective reference groups, with higher enzyme activity observed in the reference-group rats compared to the rats in the respective soil groups. This follow-up study is designed to repeat the pilot rat study, with study design modifications structured to allow an assessment of the possible impact of the differential enzyme induction on the estimation of relative bioavailability of these compounds from soil.

The observed differences in EROD activity were likely due to a difference in absorbed dose of dioxin and furan (PCDD/F) compounds (Figure 1). Rats in the corn oil reference groups received greater administered doses of PCDD/Fs than the soil/feed mixture groups, due to lower-than-expected consumption of feed by all rat groups (Table 1). In addition, the fraction of administered dose absorbed in the soil groups may have been ¼ to ½ of the fraction absorbed from the corn oil gavage administration. The initial study utilized comparable corn oil and soil/feed mixture dosages of dioxins and furans, which did not take into account these two variables. The difference in EROD activity between the soil and reference groups is likely due to higher liver concentrations achieved due to higher absorbed doses of PCDD/Fs in the reference groups compared to the soil groups and resulting hepatic EROD activity.

CYP1A1 is involved in the metabolism of several of the key TCDD toxic equivalency (TEQ)-contributing compounds in the Midland and Tittabawassee River flood-plain soils, and induction of this enzyme can result in an increased rate of metabolism for these compounds. Because the method used to estimate relative bioavailability in this study relies on an assumption that the elimination rate (including elimination through metabolism and other clearance mechanisms) for each compound is the same in the soil and reference oil dose groups, demonstrated statistically significant differences in EROD activity among the groups may result in invalid estimates of relative bioavailability for any congener for which metabolism is mediated by CYP1A1. In the pilot study, estimates of relative bioavailability for many of the compounds in the study were statistically significantly different between the rats and the swine. The rats displayed different EROD activities in the soil and reference groups (while the swine did not); therefore, this factor may account for some of the observed differences in apparent relative bioavailability between the two species. Other factors related to differing tissue concentrations, including differential rates of passive elimination at different liver or body concentrations, could also lead to confounding of the interpretation of the initial pilot study results.

Methods

This follow-up to the pilot study is designed to repeat the rat study of the Tittabawassee River flood-plain soil assessed in the pilot study. The pilot study design will be used, with key modifications designed to provide data to address the issues raised by differential EROD or MROD induction.

1. *Use of additional reference corn oil groups.* In the pilot study, the reference corn oil materials were prepared with concentrations of the key contaminants designed to result in a match to the *administered* dose of these compounds in the soil/feed mixture. In this follow-up study, the reference oil will be formulated at three doses in an attempt to bracket the anticipated *absorbed* dose of compounds from the soil/feed mixture. The purpose of this modification is to try to achieve reference corn oil dosed groups with hepatic TEQ concentrations that bracket and/or approximate the hepatic TEQ concentrations resulting from the consumption of the soil/feed mixture. This, in turn, should result in one or more reference corn oil groups with hepatic EROD and MROD activity similar to that in the soil/feed mixture group.

2. *Selection of reference corn oil dose levels.* No differential enzyme induction between experimental dose groups (reference corn oil groups vs. soil/feed groups) was observed in the swine study from either tested soil. The relative bioavailability estimates from the swine portion of the pilot study for the five tested furan compounds in the Tittabawassee River flood-plain soil ranged from a low of 0.22 for 2,3,7,8-TCDF to a high of 0.37 for 1,2,3,6,7,8-HxCDF, with a TEQ-weighted mean of 0.27. The relative bioavailability estimates in swine for the five key compounds in the Midland soil ranged from 0.18 for TCDD to 0.55 for 1,2,3,4,6,7,8-HpCDD, with a TEQ-weighted mean of 0.23 to 0.29, depending on the assumptions used for non-detectable compounds. These estimates provide a hypothesis for the level of relative bioavailability that may be observed in the absence of possible confounding from differential EROD activity. Based on this, the reference corn oil materials will be formulated to bracket the anticipated absorbed doses from the soil/feed mixture. Thus, reference corn oil mixtures will be formulated to achieve administered daily doses equal to 0.2, 0.5, and 0.8 times the administered doses in the soil/feed mixture. Because the same soils are being used as were used in the pilot study, the original reference corn oil mixture will serve as a fourth dosing level for assessment of dose-related changes in hepatic TEQ and EROD/MROD activity.

3. *Addition of undosed controls for hepatic EROD/MROD activity determination.* The relatively low levels of EROD activity observed in the pilot study raised questions on the part of the peer-review committee regarding the variability in control EROD activity. Non-simultaneous background-exposed animals from a previous phase of the project showed low levels of EROD activity, but no undosed controls were included in the pilot-study protocol. In this follow-up study, two undosed control groups (both groups fed clean feed, and one group administered corn oil gavage with no spiked dioxin or furan congeners) will be maintained for the 30-day study duration, and liver tissue will be collected at the end of the study. EROD and MROD activities will be measured in these control animals, to confirm the low activities observed in the earlier background study. These data will assist in interpreting the EROD/MROD activity data obtained from

dosed animals. Liver and adipose tissue concentrations in the each of the control rat groups (clean feed only and clean feed plus corn oil) will be measured in composited samples of livers and adipose tissues collected from five animals in each of these groups, to confirm the background tissue concentrations for use in EROD/MROD dose-response analysis.

Additional modifications unrelated to the differential EROD activity will be made based on the results of the pilot study, to streamline the study and respond to animal care issues raised in the first study:

1. In the pilot study, tissues were collected and homogenized from pairs of rats in order to collect large enough fat samples to achieve sufficiently low detection limits, to ensure detection of the administered compounds. The results of the pilot study demonstrated that the tissue concentrations (particularly in liver) in these animals easily exceeded detection limits for all congeners of relevance for both soils. For that reason, the follow-up study will analyze tissues (liver and fat) from five single animals per dose group, rather than five pairs of animals

2. Based on gavage-related mortality observed in the pilot study, seven (rather than five) rats will be included in each of the corn oil gavage groups during the compound administration phase of the study, to ensure that at least five animals reach the conclusion of the 30-day dosing period. At the end of the administration period, five rats will be selected at random from all surviving rats in each gavage group for tissue collection. Remaining rat carcasses will be frozen and stored, in case additional follow-up analyses are deemed necessary.

Tables 2 and 3 present a summary of the dose groups, dosing material analysis, and tissue analysis for the follow-up study.

As in the pilot study, the soil/feed mixture will be prepared at WIL Research. All analytical work, and the preparation of the reference corn oil dosing materials, will be conducted at Alta Analytical. Analysis of hepatic tissue samples for EROD and MROD activity will be conducted by Entrix. Animal husbandry and dosing will be conducted at the College of Veterinary Medicine at the University of Missouri—Columbia, under the direction of Dr. Stan Casteel. Other aspects of animal husbandry, diet, etc., will be conducted as described in the pilot-study report.

Data Analysis

1. *Assessment of dose-dependence of elimination rate by congener.* Liver and adipose tissue concentration data from each animal in each of the three corn oil reference groups will be analyzed to estimate the fraction of total administered dose retained in the tissues at the end of the 30-day dosing period for each of the five target congeners. Data generated from the corn oil reference group from the original pilot study will also be included in this analysis. If there is no dose dependence of elimination rate for a given congener, the fraction of administered dose retained should be similar among all groups

regardless of administered dose. If the fraction of administered dose retained decreases with increasing administered dose, this provides evidence that the elimination rate of this congener is dose dependent in the range of doses examined.

2. *Evaluation of EROD/MROD activity as a function of hepatic TEQ.* EROD and MROD activities for all individual animals and dose groups will be plotted versus hepatic TEQ concentration. The liver-tissue concentration-response curves for EROD and MROD activity will be characterized (similar to Figure 1 of this document). The reference corn oil group(s) that provide the closest match to the EROD activity of the soil/feed group will be identified.

3. *Comparison of fraction of soil dose retained to initial pilot study.* Tissue retention and concentrations in the soil/feed mixture group will be compared to the results from the initial pilot-study Tittabawassee River flood-plain soil/feed mixture group to evaluate the degree to which the results are reproducible from experiment to experiment.

4. *RBA calculation.* The relative bioavailability of the contaminants from the soil/feed mixture will be estimated using the same calculation procedures outlined in the pilot-study report. However, these calculations will be presented based only on the one or two reference corn oil group(s) with hepatic TEQ and EROD activities that are most similar to those of the soil/feed mixture group, as identified in step 2 above.

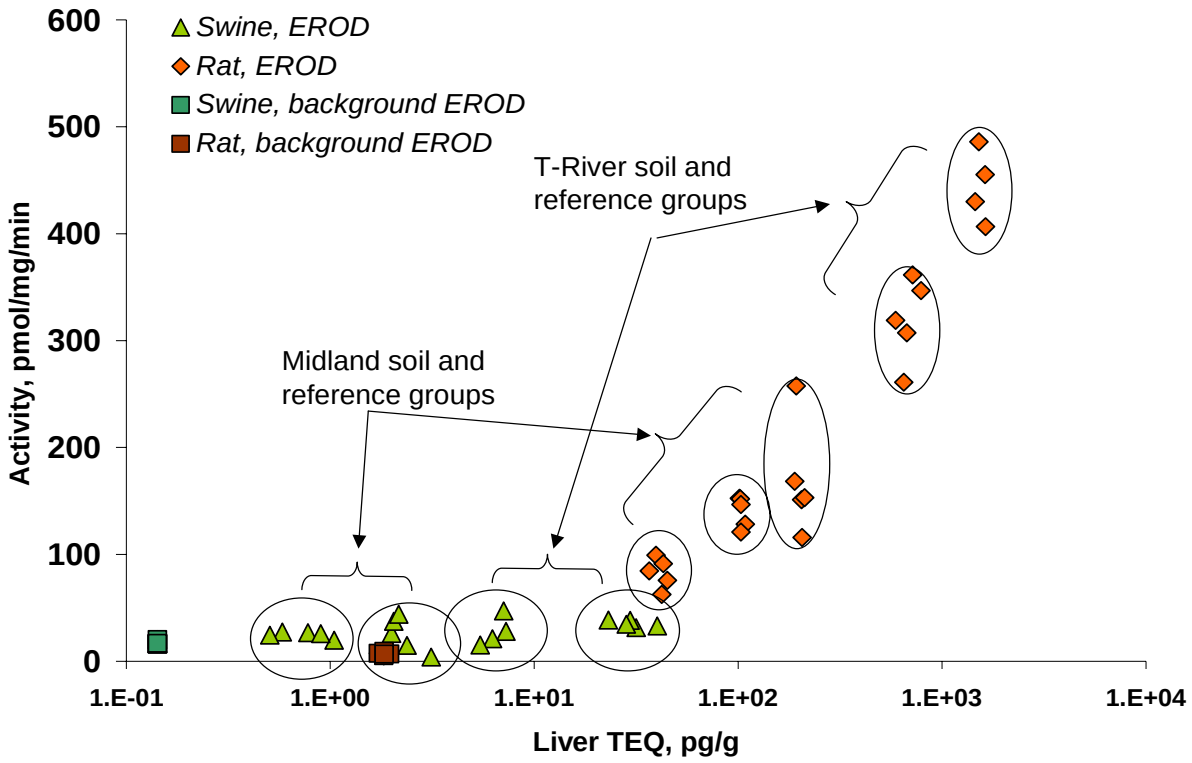

Figure 1. EROD activity as a function of liver TEQ concentration for the rat and swine experimental groups in the oral bioavailability pilot study. While the swine demonstrated no statistically significant differences in hepatic EROD activity between reference oil and soil groups, such statistically significant differences were observed in the rat groups, with reference oil and feed groups demonstrating elevated liver TEQ and EROD activity compared to soil groups for both soils. There was no overlap in the EROD activity or hepatic TEQ concentrations between soil and reference oil groups for either soil.

Table 1. Comparison of administered doses and hepatic TEQ concentrations in rat study groups in initial pilot study

Dose Group	Admin. Dose (ng TEQ/kg-d)	Hepatic TEQ (pg/g)	#-Fold Difference Compared to Soil Group	
			Admin. Dose	Hepatic TEQ
Midland Soil/Feed	0.6	41	--	--
Ref. Feed	0.7	104	1.2	2.5
Ref. Oil Gavage	1.0	201	1.7	4.9
T-River Soil/Feed	2.6	684	--	--
Ref. Oil Gavage	2.9	1556	1.1	2.3

Table 2. Summary of dose groups for follow-up study

Group	Description	Number of Animals in Test	HR-GC/MS Analysis		EROD/MROD Analysis
			Liver	Adipose	
FC	Feed control	5	1[a]	1[a]	5
GC	Corn oil gavage control	7	1[a]	1[a]	5
SF	Tittabawassee River soil/feed mixture, nominal daily dose rate Y	5	5	5	5
G1	Reference corn oil spiked at 0.2×Y	7	5[b]	5[b]	5
G2	Reference corn oil spiked at 0.5×Y	7	5[b]	5[b]	5
G3	Reference corn oil spiked at 0.8×Y	7	5[b]	5[b]	5
	Totals:	38	22	22	30

[a] Liver tissue samples from five animals in each of the control groups will be collected and composited for HR-GC/MS analysis, to confirm liver tissue concentrations at background levels for use in EROD/MROD dose-response analysis.

[b] Five animals randomly selected from all remaining group animals at the end of the 30-day dosing period.

Table 3. Summary of samples for HR-GC/MS analysis

Sample Description	Number of Analyses
Soil/feed mixture, pre-test characterization, triplicate split sample for analysis	3[a]
Soil/feed mixture, post-administration for confirmation of stability	1
Unspiked corn oil, pre-test confirmation of lack of dioxin/furan contamination	1
Reference corn oil solutions, pre-test characterization for confirmation of compound concentrations	3[a]
Reference corn oil solutions, post-administration for confirmation of stability	3
Liver tissue samples, five each from four dose groups plus 1 composited liver tissue sample from each of the two control groups	22
Adipose tissue samples, five each from four dose groups	22

[a] These analyses will be requested on a “rush” basis, in order to prepare dosing solutions and feed mixtures in a compressed time frame.

Appendix B

WIL Research Report: Preparation of Diets for a Dietary Exposure Study with Dioxin-Contaminated Soils in Rats

PROJECT TITLE

Preparation of Diets for a Dietary Exposure Study with a Dioxin-Contaminated Soil in Rats

PROJECT NUMBER

WIL-518002

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Ashland, OH 44805-9281

SPONSOR

Exponent, Inc.
4875 Pearl East Circle
Suite 201
Boulder, CO 80301

GENERAL CONSIDERATIONS

To my knowledge, there were no significant deviations from the intended scope of work or the Standard Operating Procedures of WIL Research Laboratories, LLC that would be expected to affect the scientific integrity of this study.

Daniel W. Sved, Ph.D.
Director, Metabolism and
Analytical Chemistry

12 January 2006
Date

PREPARATION OF DIETS FOR A DIETARY EXPOSURE STUDY WITH A DIOXIN-CONTAMINATED SOIL IN RATS

1. INTRODUCTION

WIL Research Laboratories, LLC was subcontracted by Exponent, Inc. to prepare a rodent diet containing 5% of a test soil and to provide additional basal rodent diet. Samples of the dietary admixture were sent to Alta Analytical Laboratory for analysis. The dietary admixture and basal diet were shipped to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia.

2. TEST MATERIALS

The following material was supplied to WIL Research Laboratories for use in preparing the dietary admixture.

A. Test Soil

The test soil was received from Exponent, Inc., Boulder, CO on November 9, 2005 and was assigned WIL Log No. 6705A. The material was labeled with the following information.

061804-SOI-02769-00.5
Lot# DPW
Sampling Site: THT02769 (IP-2)
Sample Type Other <250 μm
455 g
Bottle Archive 3 of 3
Tag No. 59512

3. BASAL DIET

The basal diet used for this project was PMI International, LLC Certified Rodent LabDiet 5001 (meal). Lot number OCT 26 05 1 was used for the dietary admixture, which was prepared on November 16, 2005; the remaining diet from this lot was shipped to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia.

4. MIXING PROCEDURE

A total batch size of 5 kg was prepared. The required amount of test soil, 250 g, was weighed into a tared vessel. A pre-mixture was prepared by transferring the test soil to a Hobart mixer containing 1000 g of basal diet and the

components were mixed for 5 minutes with the speed setting on 1. The pre-mixture was transferred to a V-blender along with the remaining amount of basal diet (3750 g) needed to achieve the total batch size. The components were mixed for 15 minutes using the intensifier bar for the first and last 5 minutes.

5. SAMPLE COLLECTION AND SHIPMENT

Three samples (approximately 100 g each) of the dietary admixture were collected into plastic ziplock-type bags. Samples were collected from the initial (bottom), middle, and last (top) portions of the admixture as it was discharged from the V-blender. Samples were shipped under ambient conditions to Alta Analytical Laboratory using an overnight courier on November 16, 2005.

6. SHIPMENT OF DIETARY ADMIXES

Upon receiving authorization from Exponent, the dietary admixture and remaining basal diets were shipped under ambient conditions to the Veterinary Medical Diagnostic Laboratory, University of Missouri-Columbia using an overnight courier. Additionally, the remaining basal diet (three boxes each containing 22.67 kg of lot number OCT 26 05 1) was also shipped.

7. DISPOSITION OF REMAINING TEST MATERIALS

Following shipment of the dietary admixture, any remaining test soil was returned to the supplier.

Appendix C

Entrix Report

QUANTIFICATION OF EROD AND MROD ACTIVITIES IN RAT LIVER MICROSOMES: FEBRUARY 22, 2006 SAMPLES

Prepared for:

Exponent
Colleen Cushing

Prepared by:

ENTRIX, Inc.
John L. Newsted, Ph.D.
John P. Giesy, Ph.D.

March, 2006

Overview

This interim report summarizes the results of the analysis of Ethoxyresorufin *O*-deethyalse (EROD) and Methoxyresorufin *O*-demethylase activity in the liver microsomes of rats. Liver samples were collected from rats feed as part of a study to evaluate the bioavailability of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) from soils to organisms consuming soil. The protocols used to prepare liver microsomes and to measure both the protein levels and the enzymatic activities are outlined in the MSU-ATL SOP# 250, version 1.1 (Protocol for Liver Microsome Preparation and Microsomal Protein Measurement and AROD Assays in the same 96-Well Plate).

Methods

Rat livers were collected on 2-22-2006, frozen in liquid nitrogen and shipped to Entrix for processing. Samples were received by Entrix on 2-23-2006 and immediately sent to Michigan State University-Aquatic Toxicology Laboratory and stored in liquid nitrogen until processed. The dates for the preparation of liver microsomes preparation are shown in Table 1.

Table 1. Rat liver samples and dates of Microsomal preparation for use in analysis of cytochrome P450 activities. [a]

Preparation Date	Rat Liver Samples
3/6/2006	14, 15, 17, 18, 20, 22
3/7/2006	23, 24, 26, 27, 29, 30, 32, 35, 36, 37, 38, 39
3/8/2006	40, 41, 42, 43, 44, 46, 47, 48, 50, 51, 53, 54

[a] Microsomes were processed and then stored at -80^{o}C until EROD and MROD analysis

As outlined in SOP# 250, sets of proteins and resorufin standards were run with each microtiter plate to account for differences in assay conditions and instrumental performance. All Microsomal samples were thawed and stored on ice (4^{o}C) prior to the start of the enzyme assays. All working solutions including resorufin standards, 7-ethoxyresorufin (7-ER) and 7-methoxyresorufin (7-MR) and NADPH solutions were prepared the day of the assay and stored on ice prior to use. Incubation conditions and enzymatic substrate concentrations for the rat EROD and MROD assays are given below:

Pre-incubation time: 10 min @ 37^{o}C
Incubation time: 10 min @ 37^{o}C

Final Substrate Concentrations:

7-ER 2.5 µM
7-MR 5.0 µM

Fluorescence Filter Settings:

AROD: Excitation -538 nm
Emission - 590 nm
Protein: Excitation - 355 nm
Emission - 460 nm

EROD/MROD activities and protein concentrations were measured within the same wells in a 96-well plate. Protein concentrations were measured by a fluorometric method at the end of incubation time and differences between animals and replicates were taken into account during the analysis of the data. Fluorescence was measured with a Fluoroskan Ascent 2.5 multiplate reader (Thermo Electron Corp.) and the data was electronically collected and stored as an Excel file (*.xls). Protein concentrations and enzymatic activities were calculated using Excel (Office 2003). In addition, all descriptive statistics were calculated in Excel. These files have been attached to this report in Appendices A (EROD) and B (MROD).

Results

All rat liver samples were analyzed for EROD and MROD on 3-21-06 while proteins were determined on 3-22-06 (Table 2). For the EROD analyses, the intra-sample variability across all groups was relatively low and coefficients of variation (CVs) ranged from 0.63% to 7.52% with an average value of 3.06%. The intra-group variability for EROD was slightly greater than that observed for within samples and the CVs ranged from 15% to 22% with an average value of 18%. The variability observed in the MROD analyses was slightly greater than that observed in the EROD results. For MROD, the intra-sample CVs ranged from 0.38% to 8.2% with an average value of 5.0% across all samples. The intra-group variability was much greater than the intra-sample variability in that group CVs ranged from 17% to 46% and averaged 28% for all groups.

There was an increase in EROD activity when evaluated by groups with the least activity being observed in Group 1 while the greatest was observed in Group 5 where average EROD activities were 33.2 and 106 pmol/mg protein/min, respectively. The activity in Group 6 appeared to have reached a plateau and did not differ from that observed in Group 5 samples.

The general trend in MROD activity was similar to that observed for EROD where the least activities were measured in Groups 1 and 2 followed by an increase in activity up to a maximal level in samples from Group 5. There was approximately a 39% decrease in the measured MROD activity between Groups 5 and 6.

Conclusions

Assays were conducted with microsomes prepared from rat livers to measure the activity of two cytochrome P450s, P450 1A1 (EROD) and P450 1A2 (MROD). The overall variability in EROD and MROD activity measured either on a sample basis or on a group was similar with intra-sample variability was on average, less than 5%. Intra-group as determined by differences in measured values within a group was greater than that observed within a sample and averaged approximately 18% and 28% for EROD and MROD, respectively. Activity of both enzymes increased across the groups with the least enzymatic activity being observed in Group 1 rats and the greatest activity being observed in Group 5 rats. For Group 6 rats, EROD activity did not increase but was equivalent to that measured in Group 5 rats while for MROD, the activity in Group 6 rats was approximately 39% less than that measured in Group 5 rats.

Table 2. Mixed function oxygenase activities in rat liver samples. [a]

Group	Sample	EROD (pmol/mg/min)	MROD (pmol/mg/min)
Gp-1	17	31.5 ± 0.43	26.9 ± 2.26
	18	25.4 ± 0.82	27.7 ± 1.03
	20	32. 3 ± 0.38	26.6 ± 1.08
	44	42.4 ± 2.29	22.0 ± 1.05
	46	34.1 ± 0.40	25.3 ± 1.05
	Group Average	**33.2 ± 6.13**	**25.7 ± 2.2**
Gp-2	32	33.5 ± 1.04	29.3 ± 1.18
	35	33.4 ± 0.88	26.5 ± 2.16
	38	44.2 ± 0.45	24.4 ± 0.30
	40	49.9 ± 0.85	26.9 ± 1.63
	54	42.2 ± 0.88	27.5 ± 1.43
	Group Average	**40.6 ± 7.15**	**26.9 ± 1.8**
Gp-3	22	42.3 ± 1.25	36.3 ± 1.56
	24	49.3 ± 1.38	36.1 ± 2.27
	37	54.3 ± 0.52	34.8 ± 2.47
	47	61.2 ± 1.99	31.5 ± 1.87
	50	62.1 ± 0.99	28.0 ± 0.97
	Group Average	**53.6 ± 8.07**	**33.3 ± 3.6**
Grp-4	14	73.3 ± 2.52	31.3 ± 1.30
	23	83.6 ± 4.53	51.2 ± 0.30
	39	110 ± 8.26	36.5 ± 0.58
	43	74.7 ± 2.03	24.8 ± 1.36
	53	62.6 ± 1.91	30.9 ± 1.76
	Group Average	**80.8 ± 17.9**	**34.9 ± 10**
Gp-5	15	115 ± 4.84	52.0 ± 2.78
	26	120 ± 4.04	36.6 ± 2.40
	27	117 ± 6.76	39.3 ± 1.32
	29	100 ± 3.54	47.0 ± 3.59
	36	80.0 ± 3.55	34.5 ± 2.62
	Group Average	**106 ± 16.6**	**41.9± 7.4**
Gp-6	30	82.0 ± 1.89	33.6 ± 2.67
	41	118 ± 4.67	39.0 ± 1.02
	42	143 ± 8.34	30.1 ± 1.43
	48	116 ± 0.73	41.2 ± 1.93
	51	91.1 ± 1.00	28.7 ± 1.37
	Group Average	**110 ± 24.1**	**34.5 ± 5.5**

[a] Activities given as means and standard deviations. Each sample was analyzed in triplicate.

APPENDICES

Appendix A: Chain of Custody and Data Sheets

CHAIN OF CUSTODY FORM COC # : 200

Dioxin Rat-1

Jan-06

SAMPLE ID.		NUMBER	DATE COLLECTED	MATRIX	ANALYTE	REMARKS
DioxRat-1	Gp-1	17	2/22/2006	Liver	MROD/EROD	Minced liver tissue approximately 1 g
DioxRat-1	Gp-1	18	2/22/2006	Liver	MROD/EROD	Frozen immediately in liquid N2 and
DioxRat-1	Gp-1	20	2/22/2006	Liver	MROD/EROD	stored/shipped in N2
DioxRat-1	Gp-1	44	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-1	46	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-2	32	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-2	35	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-2	38	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-2	40	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-2	54	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-3	22	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-3	24	2/22/2006	Liver	MROD/EROD	SENT TO
DioxRat-1	Gp-3	37	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-3	47	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-3	50	2/22/2006	Liver	MROD/EROD	EASTRIK
DioxRat-1	Gp-4	14	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-4	23	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-4	39	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-4	43	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-4	53	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-5	15	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-5	26	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-5	27	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-5	29	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-5	36	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-6	30	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-6	41	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-6	42	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-6	48	2/22/2006	Liver	MROD/EROD	
DioxRat-1	Gp-6	51	2/22/2006	Liver	MROD/EROD	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Margaret Drane	2/22/06	Robert McGee 12/23/06			
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Appendix B: EROD Excel Spreadsheets

EROD #1															
Measurement count: 1 Ex: 538 Em: 590 Scaling Factor : 1/1															
Temp(¡C)	25.7	1	1	2	3	4	5	6	7	8	9	10	11	12	
							2.541	65.32	65.84	64.86	2.618	82.13	82.27	86	
				1.108	14.93	109.6	2.119	82.56	82.27	85.69	3.134	72.3	76.66	78.68	
				1.096	15.05	109.3	1.625	30.67	31.03	29.2	2.27	73.44	69.91	78.39	
				1.082	14.88	108.7	1.652	20.22	21.18	20.11	2.307	59.11	59.35	61.22	
				8.21	54.8	147.5	1.638	27.69	25.64	26.33	1.694	24.43	25.62	23.14	
				8.234	54.77	148.4	1.916	36.69	38.05	36.03	1.654	22.06	21.95	22.83	
				8.258	54.66	149.7	2.172	45.69	45.08	44.67	2.487	48.3	49.68	52.68	
							1.859	35.76	34.53	34.21	1.981	38.96	38.83	40.85	
Protein #1															
Measurement count: 1 Ex: 355 Em: 460 Scaling Factor : 1/1															
			1	2	3	4	5	6	7	8	9	10	11	12	
							587.5	678.1	656.1	640.3	525.7	554.3	544.6	546.4	
				140	199.9	332.7	501.9	575.5	563.4	557.2	554.5	578.9	581.1	587.6	
				141.1	206.3	334	672.4	692.3	697.2	651.5	456.1	524.9	497.3	509.2	
				140.7	208.4	335.4	539.3	584.8	599.5	555.9	525.8	569.3	556.7	565.9	
				171.3	274.9	369.3	555.4	617.7	586.1	588.3	431.9	546.3	552	532.6	
				172.7	273.6	371.1	638.6	647	636.7	623.8	451.6	512.4	503.1	507	
				170.3	268.9	368.7	393.4	452.9	470.1	434.1	437.1	504.5	499.2	505	
							530.1	556	546.2	521.7	471.4	553.2	549.1	566	
EROD #2															
Measurement count: 1 Ex: 538 Em: 590 Scaling Factor : 1/1															
Temp(¡C)	25.7	1	1	2	3	4	5	6	7	8	9	10	11	12	
							1.496	17.54	17.59	17.16	1.771	34.41	33.24	35.05	
				1.064	15.07	108	1.876	49	49.15	45.03	2.24	66.59	64.75	66	
				1.054	15.05	109.6	1.346	27.66	28.85	29.47	1.569	36.63	37.99	38.67	
				1.059	14.91	109	2.222	65.65	67.04	69.01	2.242	54.02	57.36	59.37	
				8.278	54.22	147.9	2.255	79.12	79.15	75.93	1.792	34.7	36.25	39.01	
				8.255	55.4	150.2	1.967	50.61	51.47	55.09	1.505	25.05	26.04	26.14	
				8.342	54.45	148.8	1.475	22.32	21.79	21.74	1.582	1.132	1.217	1.127	
							1.445	24.91	24.51	25.11	1.488	1.162	1.156	1.087	
Protein #2															
Measurement count: 1 Ex: 355 Em: 460 Scaling Factor : 1/1															
			1	2	3	4	5	6	7	8	9	10	11	12	
							363.7	396.3	395.4	393.5	491.8	509.1	519.3	525	
				127.3	249.2	336.9	424	436.2	435.8	448.8	523.4	533.6	526.6	534.4	
				128.5	256.1	341.1	499.5	512	530.3	527.1	543.5	545.6	553.4	574.4	
				123.5	253.4	335.7	516.3	511.2	530.9	561.4	548.8	551.9	573	583.5	
				181.5	306.2	553.9	501.1	504.6	525.4	532.1	517.1	522.1	537.3	548.3	
				180.4	307.2	552.9	621.9	608.5	620.1	629.8	527	536.6	553.7	540.7	
				179.3	301.6	556	552.3	563.2	553.4	560.2	4.203	127.4	134	135.2	
							538.2	539.6	533.1	508.5	7.78	137	135.2	130.6	

EROD PLATE 1

Set 1: EROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					2.541	65.32	65.84	64.86	2.618	82.13	82.27	86.0
B		1.108	14.93	109.6	2.119	82.56	82.27	85.69	3.134	72.3	76.66	78.68
C		1.096	15.05	109.3	1.625	30.67	31.03	29.2	2.27	73.44	69.91	78.39
D		1.082	14.88	108.7	1.652	20.22	21.18	20.11	2.307	59.11	59.35	61.22
E		8.21	54.8	147.5	1.638	27.69	25.64	26.33	1.694	24.43	25.62	23.14
F		8.234	54.77	148.4	1.916	36.69	38.05	36.03	1.654	22.06	21.95	22.83
G		8.258	54.66	149.7	2.172	45.69	45.08	44.67	2.487	48.3	49.68	52.68
H					1.859	35.76	34.53	34.21	1.981	38.96	38.83	40.85

Set 2: Protein Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					587.5	678.1	656.1	640.3	525.7	554.3	544.6	546.4
B		140	199.9	332.7	501.9	575.5	563.4	557.2	554.5	578.9	581.1	587.6
C		141.1	206.3	334	672.4	692.3	697.2	651.5	456.1	524.9	497.3	509.2
D		140.7	208.4	335.4	539.3	584.8	599.5	555.9	525.8	569.3	556.7	565.9
E		171.3	274.9	369.3	555.4	617.7	586.1	588.3	431.9	546.3	552	532.6
F		172.7	273.6	371.1	638.6	647	636.7	623.8	451.6	512.4	503.1	507
G		170.3	268.9	368.7	393.4	452.9	470.1	434.1	437.1	504.5	499.2	505
H					530.1	556	546.2	521.7	471.4	553.2	549.1	566

	Entrix	Exponent	
Cells	Sample ID	Group	Sample
A5-8	S14	Gp-4	14
B5-8	S15	Gp-5	15
C5-8	S17	Gp-1	17
D5-8	S18	Gp-1	18
E5-8	S20	Gp-1	20
F5-8	S22	Gp-3	22
G5-8	S23	Gp-4	23
H5-8	S24	Gp-3	24
A9-12	S26	Gp-5	26
B9-12	S29	Gp-5	29
C9-12	S27	Gp-5	27
D9-12	S30	Gp-6	30
E9-12	S32	Gp-2	32
F9-12	S35	Gp-2	35
G9-12	S36	Gp-5	36
H9-12	S37	Gp-3	37

EROD PLATE 2

Set 1: EROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					1.496	17.54	17.59	17.16	1.771	34.41	33.24	35.05
B		1.064	15.07	108	1.876	49	49.15	45.03	2.24	66.59	64.75	66
C		1.054	15.05	109.6	1.346	27.66	28.85	29.47	1.569	36.63	37.99	38.67
D		1.059	14.91	109	2.222	65.65	67.04	69.01	2.242	54.02	57.36	59.37
E		8.278	54.22	147.9	2.255	79.12	79.15	75.93	1.792	34.7	36.25	39.01
F		8.255	55.4	150.2	1.967	50.61	51.47	55.09	1.505	25.05	26.04	26.14
G		8.342	54.45	148.8	1.475	22.32	21.79	21.74				
H					1.445	24.91	24.51	25.11				

Set 2: Protein Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	0	0	363.7	396.3	395.4	393.5	491.8	509.1	519.3	525.0
B	0	127.3	249.2	336.9	424	436.2	435.8	448.8	523.4	533.6	526.6	534.4
C	0	128.5	256.1	341.1	499.5	512	530.3	527.1	543.5	545.6	553.4	574.4
D	0	123.5	253.4	335.7	516.3	511.2	530.9	561.4	548.8	551.9	573	583.5
E	0	181.5	306.2	553.9	501.1	504.6	525.4	532.1	517.1	522.1	537.3	548.3
F	0	180.4	307.2	552.9	621.9	608.5	620.1	629.8	527	536.6	553.7	540.7
G	0	179.3	301.6	556	552.3	563.2	553.4	560.2				
H	0	0	0	0	538.2	539.6	533.1	508.5				

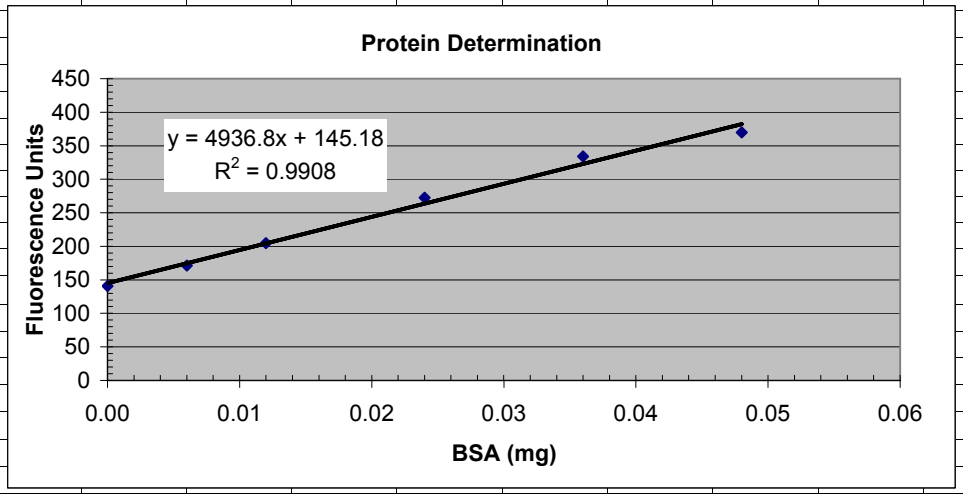
	Entrix	Exponent	
Cells	Sample ID	Group	Sample
A5-8	S38	Gp-2	38
B5-8	S39	Gp-4	39
C5-8	S40	Gp-2	40
D5-8	S41	Gp-6	41
E5-8	S42	Gp-6	42
F5-8	S43	Gp-4	43
G5-8	S44	Gp-1	44
H5-8	S46	Gp-1	46
A9-12	S47	Gp-3	47
B9-12	S48	Gp-6	48
C9-12	S50	Gp-3	50
D9-12	S51	Gp-6	51
E9-12	S53	Gp-4	53
F9-12	S54	Gp-2	54
G9-12			
H9-12			

Samples:		Liver Microsomes Processed on 3/6 to 3/8, 2006										
Analysis:		EROD analyses conducted on 03-21-2006										
Plate #1												
Set 1: EROD Fluorescence Readings												

	1	2	3	4	5	6	7	8	9	10	11	12
A				0.0	2.54	65.3	65.8	64.9	2.6	82.1	82.3	86.0
B		1.1	14.9	109.6	2.12	82.6	82.3	85.7	3.1	72.3	76.7	78.7
C		1.1	15.1	109.3	1.63	30.7	31.0	29.2	2.3	73.4	69.9	78.4
D		1.1	14.9	108.7	1.65	20.2	21.2	20.1	2.3	59.1	59.4	61.2
E		8.2	54.8	147.5	1.64	27.7	25.6	26.3	1.7	24.4	25.6	23.1
F		8.2	54.8	148.4	1.92	36.7	38.1	36.0	1.7	22.1	22.0	22.8
G		8.3	54.7	149.7	2.17	45.7	45.1	44.7	2.5	48.3	49.7	52.7

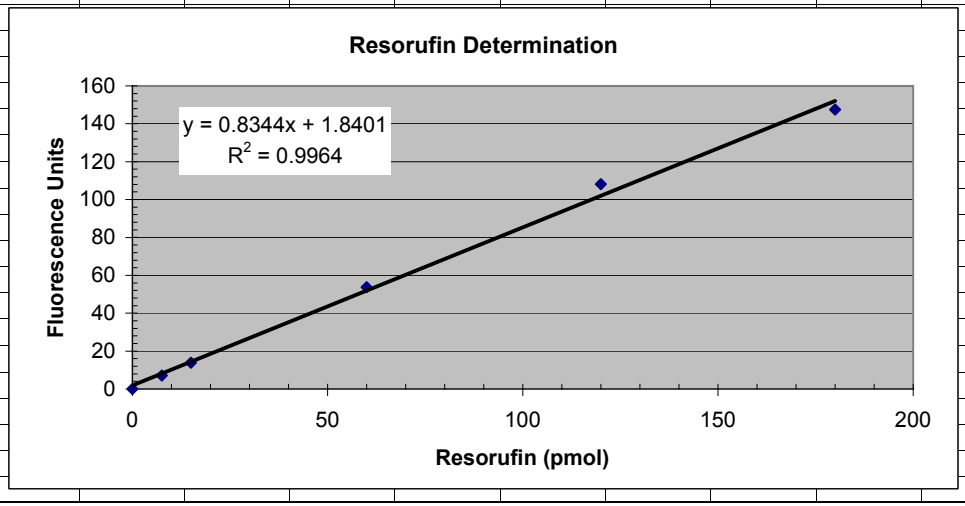
Protein Determination

BSA (mg)	Mean Fluor.
0.00	141
0.006	171
0.012	205
0.024	272
0.036	334
0.048	370



Resorufin Determination

Resorufin (pmol)	Mean Fluor.	Adj. Fluor.
0	1.10	0.007
7.5	8.2	7.1
15	15.0	13.9
60	54.7	53.6
120	109.2	108.1
180	148.5	147.4



Set 1: Resorufin Content (pmol)

	1	2	3	4	5	6	7	8	9	10	11	12
A					0.8	76.1	76.7	75.5	0.9	96.2	96.4	100.9
B					0.3	96.7	96.4	100.5	1.6	84.4	89.7	92.1
C					-0.3	34.6	35.0	32.8	0.5	85.8	81.6	91.7
D					-0.2	22.0	23.2	21.9	0.6	68.6	68.9	71.2
E					-0.2	31.0	28.5	29.4	-0.2	27.1	28.5	25.5
F					0.1	41.8	43.4	41.0	-0.2	24.2	24.1	25.2
G					0.4	52.6	51.8	51.3	0.8	55.7	57.3	60.9
H					0.0	40.7	39.2	38.8	0.2	44.5	44.3	46.8

y = 1.7073x + 30.29 X= 0.8344

Intercept= 1.8401

Set 2: Protein Concentration (mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A					0.090	0.108	0.103	0.100	0.077	0.083	0.081	0.081
B					0.072	0.087	0.085	0.083	0.083	0.088	0.088	0.090
C					0.107	0.111	0.112	0.103	0.063	0.077	0.071	0.074
D					0.080	0.089	0.092	0.083	0.077	0.086	0.083	0.085
E					0.083	0.096	0.089	0.090	0.058	0.081	0.082	0.078
F					0.100	0.102	0.100	0.097	0.062	0.074	0.073	0.073
G					0.050	0.062	0.066	0.059	0.059	0.073	0.072	0.073
H					0.078	0.083	0.081	0.076	0.066	0.083	0.082	0.085

y = 20735x + 194.95 X= 4936.8

Intercept= 145.18

Not used for STDs and/or samples

EROD Activity (pmmol/min/mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A						70.5	74.1	75.3		116.1	119.1	124.1
B						111.0	113.8	120.4		96.1	101.6	102.8
C						31.2	31.3	32.0		111.6	114.4	124.4
D						24.7	25.2	26.3		79.9	82.7	83.5
E						32.4	31.9	32.7		33.3	34.6	32.5
F						41.1	43.6	42.3		32.6	33.2	34.3
G						84.3	78.7	87.7		76.5	80.0	83.6
H						48.9	48.2	50.9		53.8	54.2	54.8

Assay Time: 10 min

EROD Activity (pmmol/min/mg)

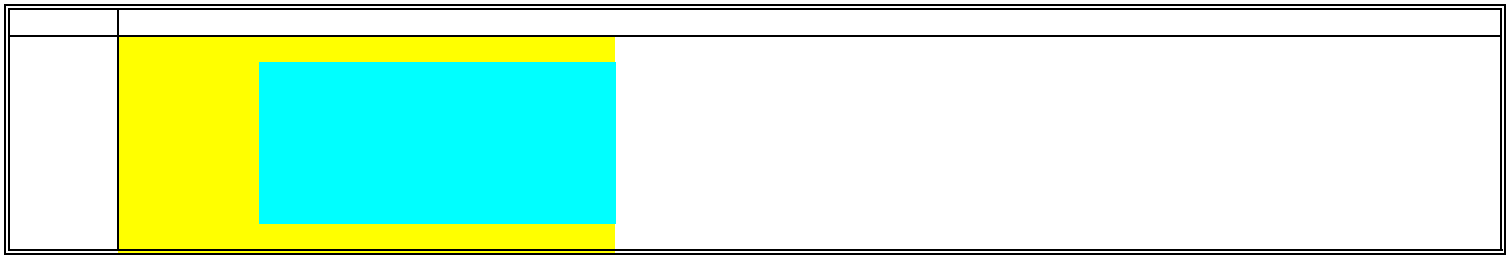
				Raw			**Adjusted**			**Statistics**	
Cells	Sample ID	Blank	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Mean	SD	CV (%)
A5-8	S14	0.0	70.5	74.1	75.3	70.5	74.1	75.3	73.3	2.5	3.4
B5-8	S15	0.0	111.0	113.8	120.4	111.0	113.8	120.4	115.1	4.84	4.2
C5-8	S17	0.0	31.2	31.3	32.0	31.2	31.3	32.0	31.5	0.43	1.4
D5-8	S18	0.0	24.7	25.2	26.3	24.7	25.2	26.3	25.4	0.82	3.2
E5-8	S20	0.0	32.4	31.9	32.7	32.4	31.9	32.7	32.3	0.38	1.2
F5-8	S22	0.0	41.1	43.6	42.3	41.1	43.6	42.3	42.3	1.25	3.0
G5-8	S23	0.0	84.3	78.7	87.7	84.3	78.7	87.7	83.6	4.53	5.4
H5-8	S24	0.0	48.9	48.2	50.9	48.9	48.2	50.9	49.3	1.38	2.8
A9-12	S26	0.0	116.1	119.1	124.1	116.1	119.1	124.1	119.8	4.04	3.4
B9-12	S29	0.0	96.1	101.6	102.8	96.1	101.6	102.8	100.1	3.54	3.5
C9-12	S27	0.0	111.6	114.4	124.4	111.6	114.4	124.4	116.8	6.76	5.8
D9-12	S30	0.0	79.9	82.7	83.5	79.9	82.7	83.5	82.0	1.89	2.3
E9-12	S32	0.0	33.3	34.6	32.5	33.3	34.6	32.5	33.5	1.04	3.1
F9-12	S35	0.0	32.6	33.2	34.3	32.6	33.2	34.3	33.4	0.88	2.6
G9-12	S36	0.0	76.5	80.0	83.6	76.5	80.0	83.6	80.0	3.55	4.4
H9-12	S37	0.0	53.8	54.2	54.8	53.8	54.2	54.8	54.3	0.52	1.0

Sample Identifications (IDs) can be found in Laboratory Book (Dow#1)

Samples: Liver Microsomes Processed on 3/6 to 3/8, 2006
Analysis: EROD analyses conducted on 03-214-2006
Plate # 2

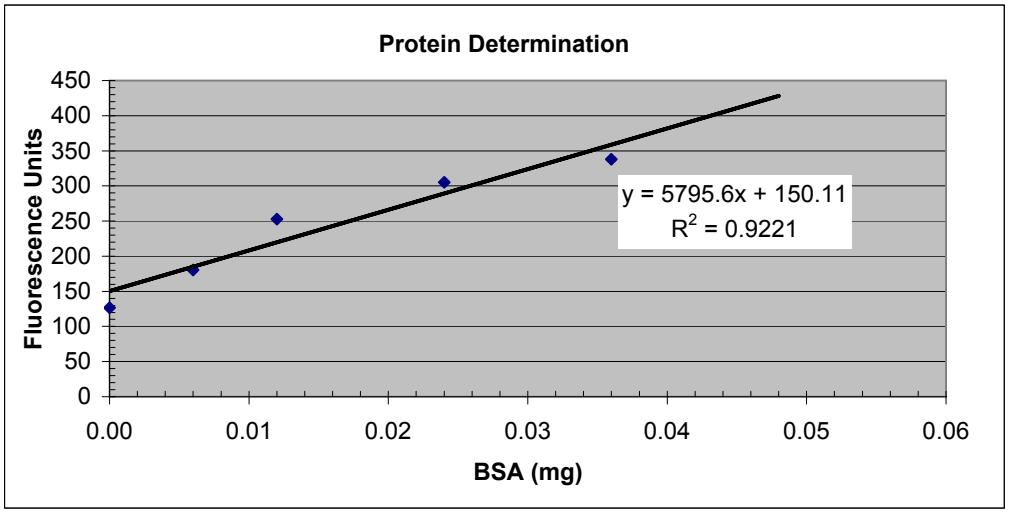
Set 1: EROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					1.50	17.54	17.59	17.16	1.77	34.41	33.24	35.05
B		1.06	15.07	108.00	1.88	49.00	49.15	45.03	2.24	66.59	64.75	66.00
C		1.05	15.05	109.60	1.35	27.66	28.85	29.47	1.57	36.63	37.99	38.67
D		1.06	14.91	109.00	2.22	65.65	67.04	69.01	2.24	54.02	57.36	59.37
E		8.28	54.22	147.90	2.26	79.12	79.15	75.93	1.79	34.70	36.25	39.01
F		8.26	55.40	150.20	1.97	50.61	51.47	55.09	1.51	25.05	26.04	26.14
G		8.34	54.45	148.80	1.48	22.32	21.79	21.74				
H					1.45	24.91	24.51	25.11				



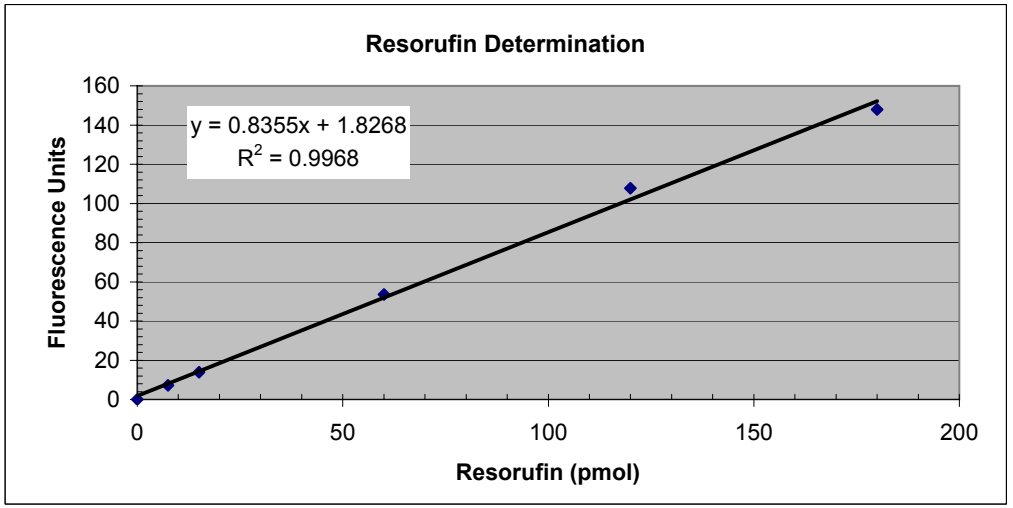
Protein Determination

BSA (mg)	Mean Fluor.
0.00	126
0.006	180
0.012	253
0.024	305
0.036	338
0.048	554



Resorufin Determination

Resorufin (pmol)	Mean Fluor.	Adj. Fluor.
0	1.06	0
7.5	8.3	7.2
15	15.0	14.0
60	54.7	53.6
120	108.9	107.8
180	149.0	147.9



Set 1: Resorufin Content (pmol)

	1	2	3	4	5	6	7	8	9	10	11	12
A					-0.4	18.8	18.9	18.4	-0.1	39.0	37.6	39.8
B					0.1	56.5	56.6	51.7	0.5	77.5	75.3	76.8
C					-0.6	30.9	32.3	33.1	-0.3	41.7	43.3	44.1
D					0.5	76.4	78.1	80.4	0.5	62.5	66.5	68.9
E					0.5	92.5	92.5	88.7	0.0	39.3	41.2	44.5
F					0.2	58.4	59.4	63.8	-0.4	27.8	29.0	29.1
G					-0.4	24.5	23.9	23.8				
H					-0.5	27.6	27.1	27.9				

y = 1.7073x + 30.29 X= 0.8355
Intercept= 1.8268

Set 2: Protein Concentration (mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A					0.037	0.042	0.042	0.042	0.059	0.062	0.064	0.065
B					0.047	0.049	0.049	0.052	0.064	0.066	0.065	0.066
C					0.060	0.062	0.066	0.065	0.068	0.068	0.070	0.073
D					0.063	0.062	0.066	0.071	0.069	0.069	0.073	0.075
E					0.061	0.061	0.065	0.066	0.063	0.064	0.067	0.069
F					0.081	0.079	0.081	0.083	0.065	0.067	0.070	0.067
G					0.069	0.071	0.070	0.071				
H					0.067	0.067	0.066	0.062				

y = 20735x + 194.95 X= 5795.6
Intercept= 150.11

Not used for STDs and/or samples

EROD Activity (pmmol/min/mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A						44.3	44.6	43.7		63.0	59.0	61.5
B						114.4	114.9	100.3		117.1	115.9	115.8
C						49.5	49.3	50.9		61.0	62.2	60.2
D						122.6	118.8	113.3		90.1	91.1	92.1
E						151.2	142.9	134.6		61.3	61.7	64.8
F						73.8	73.3	77.0		41.7	41.6	43.2
G						34.4	34.3	33.7				
H						41.1	41.1	45.1				

Assay Time: 10 min

EROD Activity (pmmol/min/mg)

			Raw			Adjusted			Statistics		
Cells	Sample ID	Blank	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Mean	SD	CV (%)
A5-8	S38	0.0	44.3	44.6	43.7	44.3	44.6	43.7	44.2	0.4	1.0
B5-8	S39	0.0	114.4	114.9	100.3	114.4	114.9	100.3	109.9	8.26	7.5
C5-8	S40	0.0	49.5	49.3	50.9	49.5	49.3	50.9	49.9	0.85	1.7
D5-8	S41	0.0	122.6	118.8	113.3	122.6	118.8	113.3	118.2	4.67	4.0
E5-8	S42	0.0	151.2	142.9	134.6	151.2	142.9	134.6	142.9	8.34	5.8
F5-8	S43	0.0	73.8	73.3	77.0	73.8	73.3	77.0	74.7	2.03	2.7
G5-8	S44	0.0	34.4	34.3	33.7	34.4	34.3	33.7	34.1	0.40	1.2
H5-8	S46	0.0	41.1	41.1	45.1	41.1	41.1	45.1	42.4	2.29	5.4
A9-12	S47	0.0	63.0	59.0	61.5	63.0	59.0	61.5	61.2	1.99	3.3
B9-12	S48	0.0	117.1	115.9	115.8	117.1	115.9	115.8	116.3	0.73	0.6
C9-12	S50	0.0	61.0	62.2	60.2	61.0	62.2	60.2	61.2	0.99	1.6
D9-12	S51	0.0	90.1	91.1	92.1	90.1	91.1	92.1	91.1	1.00	1.1
E9-12	S53	0.0	61.3	61.7	64.8	61.3	61.7	64.8	62.6	1.91	3.0
F9-12	S54	0.0	41.7	41.6	43.2	41.7	41.6	43.2	42.2	0.88	2.1
G9-12											
H9-12											

Sample Identifications (IDs) can be found in Laboratory Book (Dow#1)

Summary of EROD Results

Entrix	Exponent		Statistics			Group Statistics	
Sample ID	Group	Sample	Mean	Stdev	CV (%)	Mean	Stdev
S17	Gp-1	17	31.5	0.43	1.37		
S18	Gp-1	18	25.4	0.82	3.21		
S20	Gp-1	20	32.3	0.38	1.18	33.2	6.13
S46	Gp-1	46	42.4	2.29	5.40		
S44	Gp-1	44	34.1	0.40	1.17		
S32	Gp-2	32	33.5	1.04	3.10		
S35	Gp-2	35	33.4	0.88	2.64		
S38	Gp-2	38	44.2	0.45	1.01	40.6	7.15
S40	Gp-2	40	49.9	0.85	1.69		
S54	Gp-2	54	42.2	0.88	2.10		
S22	Gp-3	22	42.3	1.25	2.95		
S24	Gp-3	24	49.3	1.38	2.79		
S37	Gp-3	37	54.3	0.52	0.95	53.6	8.07
S47	Gp-3	47	61.2	1.99	3.25		
S50	Gp-3	50	61.2	0.99	1.62		
S14	Gp-4	14	73.3	2.52	3.43		
S23	Gp-4	23	83.6	4.53	5.42		
S39	Gp-4	39	109.9	8.26	7.52	80.8	17.9
S43	Gp-4	43	74.7	2.03	2.71		
S53	Gp-4	53	62.6	1.91	3.05		
S15	Gp-5	15	115.1	4.84	4.21		
S26	Gp-5	26	119.8	4.04	3.37		
S27	Gp-5	27	116.8	6.76	5.79	106.4	16.6
S29	Gp-5	29	100.1	3.54	3.53		
S36	Gp-5	36	80.0	3.55	4.43		
S30	Gp-6	30	82.0	1.89	2.31		
S41	Gp-6	41	118.2	4.67	3.95		
S42	Gp-6	42	142.9	8.34	5.84	110.1	24.1
S48	Gp-6	48	116.3	0.73	0.63		
S51	Gp-6	51	91.1	1.00	1.09		

Appendix C: MROD Excel Spreadsheets

MROD #1															
Measurement count: 1 Ex: 538 Em: 590 Scaling Factor : 1/1															
Temp(¡C)	25.7	1	1	2	3	4	5	6	7	8	9	10	11	12	
							2.685	28.32	29.91	30.89	2.709	26.03	26.06	29.25	
				1.919	14.33	98.25	2.577	38.33	36.98	35.74	2.647	29.1	29.12	33.74	
				1.858	14.32	98.43	2.474	23.78	26.03	25.2	2.857	30.21	31.42	34.44	
				1.919	14.19	98.08	2.566	21.01	22.67	21.73	2.685	22.71	26.11	26.32	
				8.182	50.04	132.9	2.517	20.53	21.18	20.92	2.656	20.15	20.43	22.14	
				8.382	49.92	133.2	2.712	29.23	32.11	26.92	2.637	16.55	17.38	19.07	
				8.466	49.94	133.8	2.635	27.42	27.15	26.35	2.736	21.35	21.83	24.51	
							2.666	27.24	22.91	26.04	2.55	24.17	26.68	29.27	
Protein #1															
Measurement count: 1 Ex: 355 Em: 460 Scaling Factor : 1/1															
			1	2	3	4	5	6	7	8	9	10	11	12	
							603.1	580.2	603.1	586.9	448.5	492.8	483.3	493.1	
				117.7	244.1	333.3	460.4	474.8	488.8	483.8	421.2	436.8	457.1	458.4	
				119.5	248.6	333.3	570.6	595.1	584.8	551	493.8	517.1	524	545.2	
				117.6	246	334.1	482.9	505.4	508.2	504.7	422.1	486.5	495	488.9	
				177.9	302.7	550.3	509.7	509.3	513.4	488.8	432.6	460	475.2	477.7	
				179.7	299.8	547.6	476.3	525.3	542.8	503.8	318.9	442.6	446.9	443.3	
				179.3	301	559.3	387.2	395.1	392.5	382.2	407.8	436.9	451.1	446.8	
							450.4	490.9	459.2	463.7	476.6	487.3	506.5	510.5	
MROD #2															
Measurement count: 1 Ex: 538 Em: 590 Scaling Factor : 1/1															
Temp(¡C)	25.7	1	1	2	3	4	5	6	7	8	9	10	11	12	
							2.588	12.08	12.27	11.92	2.762	21.13	20.86	23.07	
				2.177	14.53	98.95	2.654	20.63	19.99	20.71	2.796	27.1	28.68	29.74	
				2.075	14.46	99.21	2.586	19.7	20.13	18.74	2.806	20.88	21.42	22.4	
				2.109	14.17	99.43	2.716	28	28.69	26.28	2.785	21.54	21.78	22.58	
				8.2	50.42	134.9	2.722	21.8	21.04	19.6	2.836	20.96	21.81	23.64	
				8.451	50.94	137	2.784	22.59	21.97	20.66	2.717	18.78	19.25	21	
				8.784	50.93	135.9	2.665	17.18	17.51	16.56	2.314	2.108	2.05	2.268	
							2.726	25.81	26.27	24.2	2.514	2.051	2.138	2.096	
Protein #2															
Measurement count: 1 Ex: 355 Em: 460 Scaling Factor : 1/1															
			1	2	3	4	5	6	7	8	9	10	11	12	
							346.2	384.9	392.8	386.3	497.8	511.2	510.7	511.1	
				121.4	241.9	334.1	411.5	438.9	436.9	440.1	482.6	517.4	522.7	519.1	
				122.4	245.1	338.5	518.2	512.8	537	539	530.1	545.1	567.2	558.4	
				122	241.9	339.5	513.5	531.9	535.1	518.6	520.3	563	555.1	545.1	
				190.4	296.5	568.3	498.3	515.3	512.3	507.3	501.4	527.1	521.9	533.2	
				181.4	297.5	559.7	602.2	618.2	608.3	620.7	519	520.3	519.2	528.6	
				184.2	295.6	555.4	589	532.6	566.4	554.5	4.312	121.4	126.4	126.4	
							482.9	537.9	537	525.5	4.339	127.8	126	129.9	

MROD PLATE 1

Set 1: MROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					2.685	28.32	29.91	30.89	2.709	26.03	26.06	29.3
B		1.919	14.33	98.25	2.577	38.33	36.98	35.74	2.647	29.1	29.12	33.74
C		1.858	14.32	98.43	2.474	23.78	26.03	25.2	2.857	30.21	31.42	34.44
D		1.919	14.19	98.08	2.566	21.01	22.67	21.73	2.685	22.71	26.11	26.32
E		8.182	50.04	132.9	2.517	20.53	21.18	20.92	2.656	20.15	20.43	22.14
F		8.382	49.92	133.2	2.712	29.23	32.11	26.92	2.637	16.55	17.38	19.07
G		8.466	49.94	133.8	2.635	27.42	27.15	26.35	2.736	21.35	21.83	24.51
H					2.666	27.24	22.91	26.04	2.55	24.17	26.68	29.27

Set 2: Protein Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					603.1	580.2	603.1	586.9	448.5	492.8	483.3	493.1
B		117.7	244.1	333.3	460.4	474.8	488.8	483.8	421.2	436.8	457.1	458.4
C		119.5	248.6	333.3	570.6	595.1	584.8	551	493.8	517.1	524	545.2
D		117.6	246	334.1	482.9	505.4	508.2	504.7	422.1	486.5	495	488.9
E		177.9	302.7	550.3	509.7	509.3	513.4	488.8	432.6	460	475.2	477.7
F		179.7	299.8	547.6	476.3	525.3	542.8	503.8	318.9	442.6	446.9	443.3
G		179.3	301	559.3	387.2	395.1	392.5	382.2	407.8	436.9	451.1	446.8
H					450.4	490.9	459.2	463.7	476.6	487.3	506.5	510.5

	Entrix	Exponent	
Cells	Sample ID	Group	Sample
A5-8	S14	Gp-4	14
B5-8	S15	Gp-5	15
C5-8	S17	Gp-1	17
D5-8	S18	Gp-1	18
E5-8	S20	Gp-1	20
F5-8	S22	Gp-3	22
G5-8	S23	Gp-4	23
H5-8	S24	Gp-3	24
A9-12	S26	Gp-5	26
B9-12	S29	Gp-5	29
C9-12	S27	Gp-5	27
D9-12	S30	Gp-6	30
E9-12	S32	Gp-2	32
F9-12	S35	Gp-2	35
G9-12	S36	Gp-5	36
H9-12	S37	Gp-3	37

MROD PLATE 2

Set 1: MROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					2.588	12.08	12.27	11.92	2.762	21.13	20.86	23.07
B		2.177	14.53	98.95	2.654	20.63	19.99	20.71	2.796	27.1	28.68	29.74
C		2.075	14.46	99.21	2.586	19.7	20.13	18.74	2.806	20.88	21.42	22.4
D		2.109	14.17	99.43	2.716	28	28.69	26.28	2.785	21.54	21.78	22.58
E		8.2	50.42	134.9	2.722	21.8	21.04	19.6	2.836	20.96	21.81	23.64
F		8.451	50.94	137	2.784	22.59	21.97	20.66	2.717	18.78	19.25	21
G		8.784	50.93	135.9	2.665	17.18	17.51	16.56				
H					2.726	25.81	26.27	24.2				

Set 2: Protein Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	0	0	346.2	384.9	392.8	386.3	497.8	511.2	510.7	511.1
B	0	121.4	241.9	334.1	411.5	438.9	436.9	440.1	482.6	517.4	522.7	519.1
C	0	122.4	245.1	338.5	518.2	512.8	537	539	530.1	545.1	567.2	558.4
D	0	122	241.9	339.5	513.5	531.9	535.1	518.6	520.3	563	555.1	545.1
E	0	190.4	296.5	568.3	498.3	515.3	512.3	507.3	501.4	527.1	521.9	533.2
F	0	181.4	297.5	559.7	602.2	618.2	608.3	620.7	519	520.3	519.2	528.6
G	0	184.2	295.6	555.4	589	532.6	566.4	554.5				
H	0	0	0	0	482.9	537.9	537	525.5				

	Entrix	Exponent	
Cells	Sample ID	Group	Sample
A5-8	S38	Gp-2	38
B5-8	S39	Gp-4	39
C5-8	S40	Gp-2	40
D5-8	S41	Gp-6	41
E5-8	S42	Gp-6	42
F5-8	S43	Gp-4	43
G5-8	S44	Gp-1	44
H5-8	S46	Gp-1	46
A9-12	S47	Gp-3	47
B9-12	S48	Gp-6	48
C9-12	S50	Gp-3	50
D9-12	S51	Gp-6	51
E9-12	S53	Gp-4	53
F9-12	S54	Gp-2	54
G9-12			
H9-12			

Samples: Liver Microsomes Processed on 3/6 to 3/8, 2006

Analysis: MROD analyses conducted on 03-21-2006

Plate #1

Set 1: EROD Fluorescence Readings

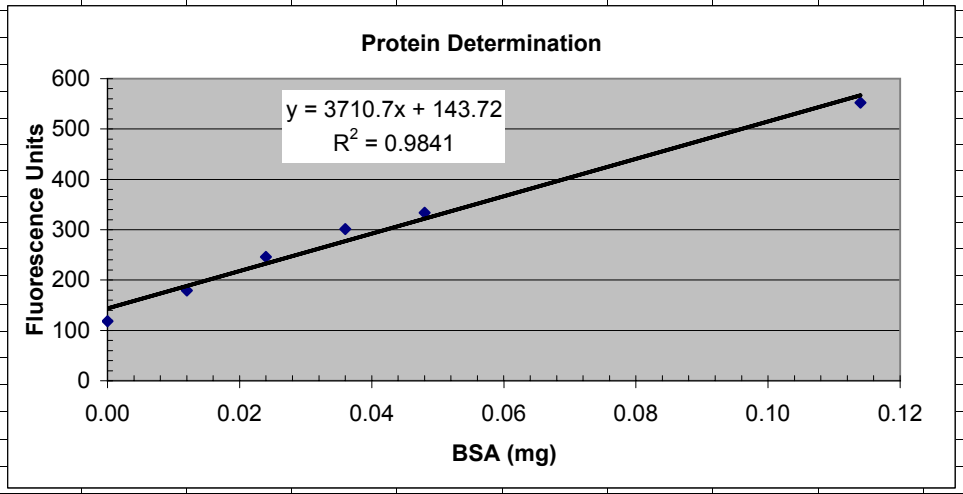
	1	2	3	4	5	6	7	8	9	10	11	12
A				0.0	2.69	28.3	29.9	30.9	2.7	26.0	26.1	29.3
B		1.9	14.3	98.3	2.58	38.3	37.0	35.7	2.6	29.1	29.1	33.7
C		1.9	14.3	98.4	2.47	23.8	26.0	25.2	2.9	30.2	31.4	34.4
D		1.9	14.2	98.1	2.57	21.0	22.7	21.7	2.7	22.7	26.1	26.3
E		8.2	50.0	132.9	2.52	20.5	21.2	20.9	2.7	20.2	20.4	22.1
F		8.4	49.9	133.2	2.71	29.2	32.1	26.9	2.6	16.6	17.4	19.1
G		8.5	49.9	133.8	2.64	27.4	27.2	26.4	2.7	21.4	21.8	24.5
H					2.67	27.2	22.9	26.0	2.6	24.2	26.7	29.3

Set 2: Protein Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					603	580	603	587	449	493	483	493
B		118	244	333	460	475	489	484	421	437	457	458
C		120	249	333	571	595	585	551	494	517	524	545
D		118	246	334	483	505	508	505	422	487	495	489
E		178	303	550	510	509	513	489	433	460	475	478
F		180	300	548	476	525	543	504	319	443	447	443
G		179	301	559	387	395	393	382	408	437	451	447
H					450	491	459	464	477	487	507	511

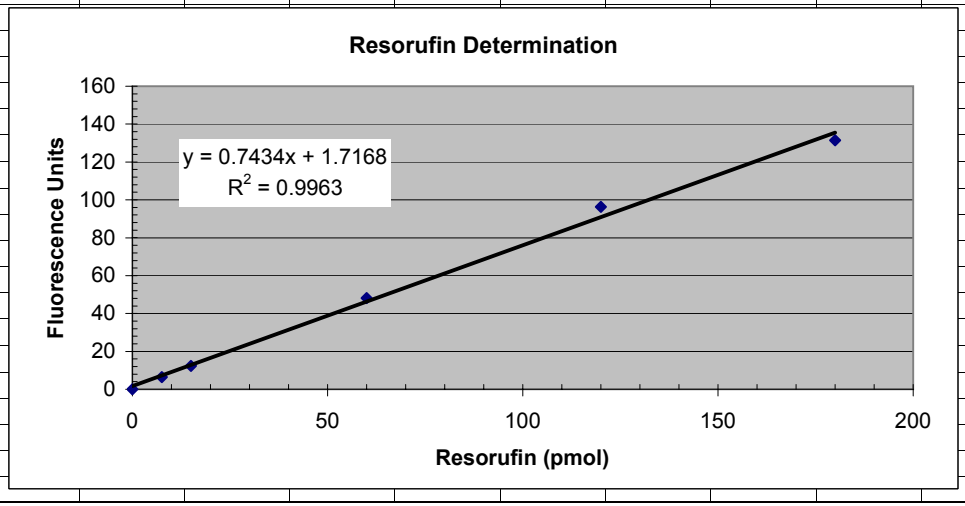
Protein Determination

BSA (mg)	Mean Fluor.
0.00	118
0.012	179
0.024	246
0.036	301
0.048	334
0.114	552



Resorufin Determination

Resorufin (pmol)	Mean Fluor.	Adj. Fluor.
0	1.90	0
7.5	8.3	6.4
15	14.3	12.4
60	50.0	48.1
120	98.3	96.4
180	133.3	131.4



Set 1: Resorufin Content (pmol)

	1	2	3	4	5	6	7	8	9	10	11	12
A					1.3	35.8	37.9	39.2	1.3	32.7	32.7	37.0
B					1.2	49.3	47.4	45.8	1.3	36.8	36.9	43.1
C					1.0	29.7	32.7	31.6	1.5	38.3	40.0	44.0
D					1.1	26.0	28.2	26.9	1.3	28.2	32.8	33.1
E					1.1	25.3	26.2	25.8	1.3	24.8	25.2	27.5
F					1.3	37.0	40.9	33.9	1.2	20.0	21.1	23.3
G					1.2	34.6	34.2	33.1	1.4	26.4	27.1	30.7
H					1.3	34.3	28.5	32.7	1.1	30.2	33.6	37.1

y = 1.7073x + 30.29 X= 0.7434

Intercept= 1.7168

Set 2: Protein Concentration (mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A					0.124	0.118	0.124	0.119	0.082	0.094	0.092	0.094
B					0.085	0.089	0.093	0.092	0.075	0.079	0.084	0.085
C					0.115	0.122	0.119	0.110	0.094	0.101	0.102	0.108
D					0.091	0.097	0.098	0.097	0.075	0.092	0.095	0.093
E					0.099	0.099	0.100	0.093	0.078	0.085	0.089	0.090
F					0.090	0.103	0.108	0.097	0.047	0.081	0.082	0.081
G					0.066	0.068	0.067	0.064	0.071	0.079	0.083	0.082
H					0.083	0.094	0.085	0.086	0.090	0.093	0.098	0.099

y = 20735x + 194.95 X= 3710.8

Intercept= 143.7

Not used for STDs and/or samples

MROD Activity (pmmol/min/mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A						30.4	30.6	32.9		34.8	35.8	39.3
B						55.2	51.0	49.9		46.6	43.6	50.8
C						24.4	27.5	28.8		38.1	39.0	40.7
D						26.6	28.7	27.7		30.6	34.7	35.6
E						25.7	26.3	27.8		29.1	28.2	30.5
F						36.0	38.0	34.9		24.8	25.8	28.9
G						51.0	51.0	51.6		33.4	32.7	37.5
H						36.7	33.5	37.9		32.6	34.3	37.5

Assay Time: 10 min

MROD Activity (pmmol/min/mg)

			Raw			**Adjusted**				**Statistics**	
Cells	Sample ID	Blank	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Mean	SD	CV (%)
A5-8	S14	0.0	30.4	30.6	32.9	30.4	30.6	32.9	31.3	1.3	4.3
B5-8	S15	0.0	55.2	51.0	49.9	55.2	51.0	49.9	52.0	2.78	5.3
C5-8	S17	0.0	24.4	27.5	28.8	24.4	27.5	28.8	26.9	2.26	8.4
D5-8	S18	0.0	26.6	28.7	27.7	26.6	28.7	27.7	27.7	1.03	3.7
E5-8	S20	0.0	25.7	26.3	27.8	25.7	26.3	27.8	26.6	1.08	4.1
F5-8	S22	0.0	36.0	38.0	34.9	36.0	38.0	34.9	36.3	1.56	4.3
G5-8	S23	0.0	51.0	51.0	51.6	51.0	51.0	51.6	51.2	0.30	0.6
H5-8	S24	0.0	36.7	33.5	37.9	36.7	33.5	37.9	36.1	2.27	6.3
A9-12	S26	0.0	34.8	35.8	39.3	34.8	35.8	39.3	36.6	2.40	6.6
B9-12	S29	0.0	46.6	43.6	50.8	46.6	43.6	50.8	47.0	3.59	7.6
C9-12	S27	0.0	38.1	39.0	40.7	38.1	39.0	40.7	39.3	1.32	3.4
D9-12	S30	0.0	30.6	34.7	35.6	30.6	34.7	35.6	33.6	2.67	7.9
E9-12	S32	0.0	29.1	28.2	30.5	29.1	28.2	30.5	29.3	1.18	4.0
F9-12	S35	0.0	24.8	25.8	28.9	24.8	25.8	28.9	26.5	2.16	8.1
G9-12	S36	0.0	33.4	32.7	37.5	33.4	32.7	37.5	34.5	2.62	7.6
H9-12	S37	0.0	32.6	34.3	37.5	32.6	34.3	37.5	34.8	2.47	7.1

Sample Identifications (IDs) can be found in Laboratory Book (Dow#1)

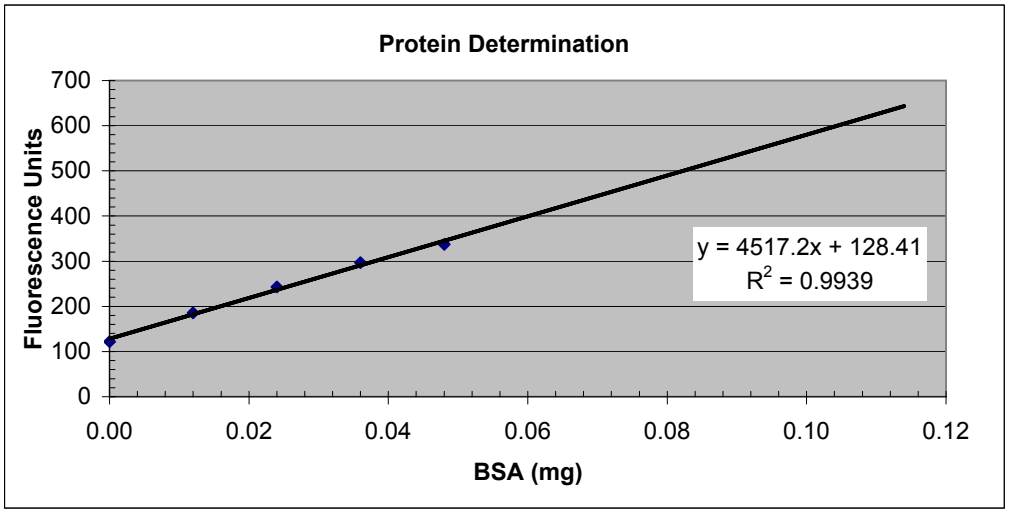
Samples: Liver Microsomes Processed on 3/6 to 3/8, 2006
Analysis: MROD analyses conducted on 03-21-2006
Plate # 2

Set 1: MROD Fluorescence Readings

	1	2	3	4	5	6	7	8	9	10	11	12
A					2.59	12.08	12.27	11.92	2.76	21.13	20.86	23.07
B		2.18	14.53	98.95	2.65	20.63	19.99	20.71	2.80	27.10	28.68	29.74
C		2.08	14.46	99.21	2.59	19.70	20.13	18.74	2.81	20.88	21.42	22.40
D		2.11	14.17	99.43	2.72	28.00	28.69	26.28	2.79	21.54	21.78	22.58
E		8.20	50.42	134.90	2.72	21.80	21.04	19.60	2.84	20.96	21.81	23.64
F		8.45	50.94	137.00	2.78	22.59	21.97	20.66	2.72	18.78	19.25	21.00
G		8.78	50.93	135.90	2.67	17.18	17.51	16.56				
H					2.73	25.81	26.27	24.20				

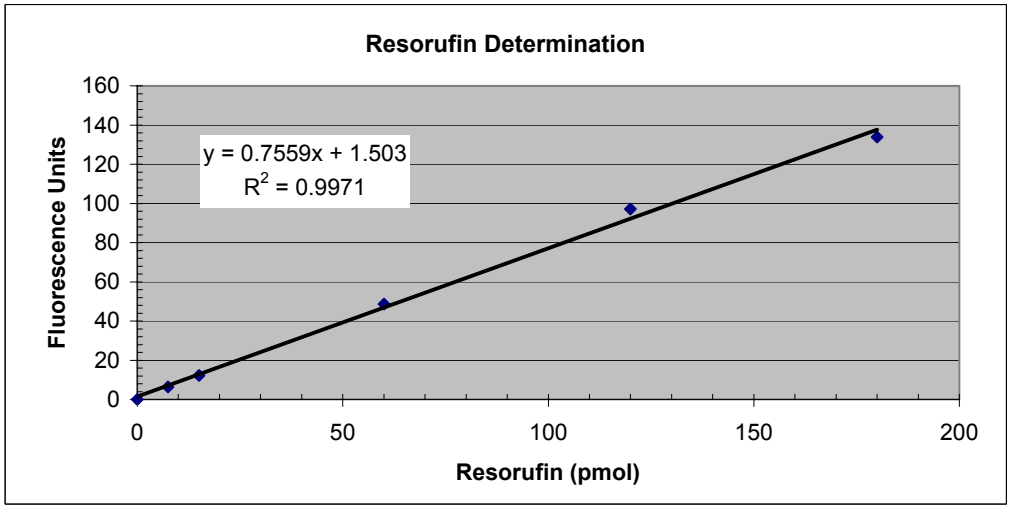
Protein Determination

BSA (mg)	Mean Fluor.
0.00	122
0.012	185
0.024	243
0.036	297
0.048	337
0.114	561



Resorufin Determination

Resorufin (pmol)	Mean Fluor.	Adj. Fluor.
0	2.12	0
7.5	8.5	6.4
15	14.4	12.3
60	50.8	48.6
120	99.2	97.1
180	135.9	133.8



Set 1: Resorufin Content (pmol)

	1	2	3	4	5	6	7	8	9	10	11	12
A					1.4	14.0	14.2	13.8	1.7	26.0	25.6	28.5
B					1.5	25.3	24.5	25.4	1.7	33.9	36.0	37.4
C					1.4	24.1	24.6	22.8	1.7	25.6	26.3	27.6
D					1.6	35.1	36.0	32.8	1.7	26.5	26.8	27.9
E					1.6	26.9	25.8	23.9	1.8	25.7	26.9	29.3
F					1.7	27.9	27.1	25.3	1.6	22.9	23.5	25.8
G					1.5	20.7	21.2	19.9				
H					1.6	32.2	32.8	30.0				

y = 1.7073x + 30.29 X= 0.7559
Intercept= 1.503

Set 2: Protein Concentration (mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A					0.048	0.057	0.059	0.057	0.082	0.085	0.085	0.085
B					0.063	0.069	0.068	0.069	0.078	0.086	0.087	0.086
C					0.086	0.085	0.090	0.091	0.089	0.092	0.097	0.095
D					0.085	0.089	0.090	0.086	0.087	0.096	0.094	0.092
E					0.082	0.086	0.085	0.084	0.083	0.088	0.087	0.090
F					0.105	0.108	0.106	0.109	0.086	0.087	0.087	0.089
G					0.102	0.089	0.097	0.094				
H					0.078	0.091	0.090	0.088				

y = 20735x + 194.95 X= 4517.2
Intercept= 128.4

Not used

MROD Activity (pmmol/min/mg)

	1	2	3	4	5	6	7	8	9	10	11	12
A						24.6	24.3	24.1		30.6	30.3	33.7
B						36.8	35.8	36.8		39.3	41.2	43.2
C						28.3	27.2	25.1		27.8	27.1	29.0
D						39.2	39.9	37.9		27.6	28.4	30.2
E						31.4	30.4	28.5		29.2	30.8	32.7
F						25.7	25.5	23.3		26.3	27.1	29.1
G						23.2	21.8	21.1				
H						35.5	36.2	34.2				

Assay Time: 10 min

MROD Activity (pmmol/min/mg)

			Raw			Adjusted			Statistics		
Cells	Sample ID	Blank	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Mean	SD	CV (%)
A5-8	S38	0.0	24.6	24.3	24.1	24.6	24.3	24.1	24.4	0.3	1.0
B5-8	S39	0.0	36.8	35.8	36.8	36.8	35.8	36.8	36.5	0.58	1.6
C5-8	S40	0.0	28.3	27.2	25.1	28.3	27.2	25.1	26.9	1.63	6.1
D5-8	S41	0.0	39.2	39.9	37.9	39.2	39.9	37.9	39.0	1.02	2.6
E5-8	S42	0.0	31.4	30.4	28.5	31.4	30.4	28.5	30.1	1.43	4.7
F5-8	S43	0.0	25.7	25.5	23.3	25.7	25.5	23.3	24.8	1.36	5.5
G5-8	S44	0.0	23.2	21.8	21.1	23.2	21.8	21.1	22.0	1.05	4.7
H5-8	S46	0.0	35.5	36.2	34.2	35.5	36.2	34.2	35.3	1.05	3.0
A9-12	S47	0.0	30.6	30.3	33.7	30.6	30.3	33.7	31.5	1.87	5.9
B9-12	S48	0.0	39.3	41.2	43.2	39.3	41.2	43.2	41.2	1.93	4.7
C9-12	S50	0.0	27.8	27.1	29.0	27.8	27.1	29.0	28.0	0.97	3.5
D9-12	S51	0.0	27.6	28.4	30.2	27.6	28.4	30.2	28.7	1.37	4.8
E9-12	S53	0.0	29.2	30.8	32.7	29.2	30.8	32.7	30.9	1.76	5.7
F9-12	S54	0.0	26.3	27.1	29.1	26.3	27.1	29.1	27.5	1.43	5.2
G9-12											
H9-12											

Sample Identifications (IDs) can be found in Laboratory Book (Dow#1)

Summary of MROD Results

Entrix	Exponent		Statistics			Group Statistics	
Sample ID	Group	Sample	Mean	Stdev	CV (%)	Mean	Stdev
S17	Gp-1	17	26.9	2.26	8.18		
S18	Gp-1	18	27.7	1.03	3.76		
S20	Gp-1	20	26.6	1.08	3.87	25.7	2.2
S44	Gp-1	44	22.0	1.05	4.89		
S46	Gp-1	46	25.3	1.05	2.89		
S32	Gp-2	32	29.3	1.18	4.09		
S35	Gp-2	35	26.5	2.16	8.14		
S38	Gp-2	38	24.4	0.30	1.09	26.9	1.8
S40	Gp-2	40	26.9	1.63	6.22		
S54	Gp-2	54	27.5	1.43	5.12		
S22	Gp-3	22	36.3	1.56	4.56		
S24	Gp-3	24	36.1	2.27	6.42		
S37	Gp-3	37	34.8	2.47	7.26	33.3	3.6
S47	Gp-3	47	31.5	1.87	5.94		
S50	Gp-3	50	28.0	0.97	3.50		
S14	Gp-4	14	31.3	1.30	4.29		
S23	Gp-4	23	51.2	0.30	0.38		
S39	Gp-4	39	36.5	0.58	1.56	34.9	10.0
S43	Gp-4	43	24.8	1.36	5.52		
S53	Gp-4	53	30.9	1.76	5.65		
S15	Gp-5	15	52.0	2.78	5.24		
S26	Gp-5	26	36.6	2.40	6.58		
S29	Gp-5	29	47.0	3.59	7.68	41.9	7.4
S27	Gp-5	27	39.3	1.32	3.54		
S36	Gp-5	36	34.5	2.62	7.61		
S30	Gp-6	30	33.6	2.67	7.97		
S41	Gp-6	41	39.0	1.02	2.50		
S42	Gp-6	42	30.1	1.43	4.70	34.5	5.5
S48	Gp-6	48	41.2	1.93	4.68		
S51	Gp-6	51	28.7	1.37	4.86		

Appendix D

Detailed Study Data

Table D-1. Rat feed intake during the follow-up study

	2-Day Feed Intake (g)															Total
Date:	25-Jan	27-Jan	29-Jan	31-Jan	2-Feb	4-Feb	6-Feb	8-Feb	10-Feb	12-Feb	14-Feb	16-Feb	18-Feb	20-Feb	22-Feb	Feed Intake
Study Day:	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	(g)
Group 1: Feed Control																
17	33.15	30.83	31.56	28.46	36.92	32.01	32.79	36.88	28.96	36.88	33.44	32.54	36.44	24.59	32.99	488.44
18	25.49	36.99	31.63	33.73	29.82	34.51	39.92	32.49	37.33	36.96	32.91	41.51	33.94	36.94	33.09	517.26
20	26.63	35.64	29.09	34.60	32.61	31.26	38.22	29.80	35.88	35.40	31.60	35.67	29.34	35.21	33.58	494.53
44	31.39	30.38	38.08	37.56	32.82	41.00	33.42	41.98	44.06	38.54	43.50	32.98	41.99	34.74	32.11	554.55
46	24.34	22.86	29.82	24.33	26.05	26.02	33.85	31.72	30.24	36.67	31.30	31.63	33.18	28.34	33.25	443.60
Mean:	**28.20**	**31.34**	**32.04**	**31.74**	**31.64**	**32.96**	**35.64**	**34.57**	**35.29**	**36.89**	**34.55**	**34.87**	**34.98**	**31.96**	**33.00**	**499.68**
Group 2: Oil Control																
19[a]	27.82	31.31	26.39	28.12	26.73	32.74	33.07	32.36	27.96	27.66	28.31	29.68	29.64	30.16	28.11	--
25[b]	25.16	30.08	22.66	0.27	--	--	--	--	--	--	--	--	--	--	--	--
32	25.37	22.28	24.43	21.42	20.59	25.80	19.53	26.71	22.94	21.00	26.79	19.45	24.78	25.96	22.15	349.20
35	29.46	21.51	24.65	26.02	23.18	33.30	31.89	32.83	24.02	27.60	27.00	18.33	24.18	23.60	26.13	393.70
38	26.84	27.75	33.66	32.42	24.00	31.30	32.76	28.10	30.57	25.35	28.12	28.06	28.81	32.74	20.49	430.97
40	22.83	18.24	27.08	21.35	26.06	21.21	26.37	18.93	23.67	18.13	28.33	20.20	24.32	21.46	24.87	343.05
54	26.31	30.31	33.04	24.98	27.20	29.10	33.34	24.27	34.35	33.02	31.66	31.84	30.50	32.95	30.33	453.20
Mean:	**26.16**	**24.02**	**28.57**	**25.24**	**24.21**	**28.14**	**28.78**	**26.17**	**27.11**	**25.02**	**28.38**	**23.58**	**26.52**	**27.34**	**24.79**	**394.02**
Group 3: Oil Reference 0.2X																
22	22.83	24.61	30.70	33.54	32.37	30.63	21.18	23.39	19.59	23.77	18.15	29.42	24.67	25.48	28.29	388.62
24	25.52	29.38	27.17	27.35	26.12	32.34	32.21	25.57	32.46	27.22	27.93	31.61	23.60	25.41	23.44	417.33
37	27.49	29.33	26.62	28.45	20.82	31.32	24.49	28.35	28.51	22.78	34.85	24.97	30.60	28.29	25.29	412.16
45[a]	24.45	25.88	24.71	27.54	20.68	26.31	28.10	21.13	28.02	23.89	22.42	30.09	25.05	16.75	0.14	--
47	27.07	27.41	26.49	25.56	25.43	23.93	29.70	27.38	24.19	30.43	27.75	29.28	34.02	26.45	32.18	417.27
49[a]	24.82	26.60	29.43	29.11	28.41	30.94	24.33	34.70	27.20	26.80	34.51	22.91	37.50	30.73	25.43	--
50	26.94	24.98	29.14	24.24	24.07	25.17	25.35	27.28	27.21	21.16	28.82	23.66	31.01	24.83	24.24	388.10
Mean:	**25.97**	**27.14**	**28.02**	**27.83**	**25.76**	**28.68**	**26.59**	**26.39**	**26.39**	**25.07**	**27.50**	**27.79**	**28.78**	**26.09**	**26.69**	**404.70**
Group 4: Oil Reference 0.5X																
14	25.54	25.79	17.01	27.77	23.07	26.21	20.33	20.39	24.20	6.33	25.34	30.74	36.95	27.24	34.09	371.00
21[a]	26.10	32.94	26.28	28.88	23.76	28.58	30.85	20.26	27.55	31.91	25.51	30.04	23.16	30.95	23.42	--
23	22.67	26.65	32.43	22.06	26.97	24.13	29.45	29.86	28.13	29.93	24.49	30.27	30.49	30.64	29.96	418.13
33[a]	26.29	30.14	26.90	22.27	22.79	23.81	26.28	28.10	31.53	23.10	32.35	36.04	35.44	43.59	38.59	--
39	23.39	25.04	33.88	25.66	33.19	31.68	31.78	34.97	28.22	30.35	32.65	28.82	34.80	28.29	28.81	451.53
43	26.86	30.62	33.36	34.20	34.76	30.15	27.89	21.33	33.42	24.45	28.00	32.51	25.43	31.64	26.77	441.39
53	25.80	31.59	30.91	36.63	31.09	34.70	35.53	24.74	31.20	31.36	27.73	31.13	26.45	35.36	32.26	466.48
Mean:	**24.85**	**27.94**	**29.52**	**29.26**	**29.82**	**29.37**	**29.00**	**26.26**	**29.03**	**24.48**	**27.64**	**30.69**	**30.82**	**30.63**	**30.38**	**429.71**

Table D-1. (cont.)

	2-Day Feed Intake (g)															Total
Date:	25-Jan	27-Jan	29-Jan	31-Jan	2-Feb	4-Feb	6-Feb	8-Feb	10-Feb	12-Feb	14-Feb	16-Feb	18-Feb	20-Feb	22-Feb	Feed Intake
Study Day:	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	(g)
Group 5: Oil Reference 0.8X																
15	22.41	25.05	27.71	22.33	28.54	23.84	30.95	26.26	30.06	32.11	24.97	30.13	29.01	28.33	31.18	412.88
26	21.25	23.87	26.33	21.88	24.62	25.72	32.05	19.55	32.84	35.16	28.87	32.60	26.05	31.12	22.04	403.95
27	21.73	28.41	24.12	23.40	21.49	28.94	23.46	25.40	21.20	26.75	26.33	24.17	27.95	26.31	24.21	373.87
28[a]	22.44	20.27	27.24	21.21	27.04	20.19	27.06	24.04	28.72	24.77	23.04	28.70	22.12	27.79	24.99	--
29	27.75	37.38	39.79	33.81	37.71	34.64	31.63	37.23	22.03	39.07	36.35	31.50	38.33	31.14	36.14	514.50
36	18.65	28.33	31.84	29.11	31.34	30.04	34.74	30.63	34.21	22.16	24.16	35.36	32.47	32.77	29.38	445.19
52[b]	24.71	25.12	27.10	27.57	12.46	--	--	--	--	--	--	--	--	--	--	--
Mean:	**22.36**	**28.61**	**29.96**	**26.11**	**28.74**	**28.64**	**30.57**	**27.81**	**28.07**	**31.05**	**28.14**	**30.75**	**30.76**	**29.93**	**28.59**	**430.08**
Group 6: Soil																
30	39.40	37.11	39.86	35.91	36.62	35.29	38.75	36.46	40.31	34.79	40.02	33.89	37.63	37.29	32.93	556.26
41	33.81	40.92	38.26	33.89	40.31	33.20	40.64	43.86	38.10	45.21	40.19	40.08	44.26	38.48	38.81	590.02
42	33.01	32.66	34.83	36.54	33.92	41.92	37.25	35.85	40.37	32.62	38.43	36.49	35.65	37.54	30.71	537.79
48	28.32	37.65	27.64	37.53	31.61	32.30	38.34	27.13	38.67	29.00	32.21	35.63	28.42	37.24	32.07	493.76
51	26.54	38.20	32.34	37.60	40.04	33.70	41.14	32.05	39.44	42.25	30.72	37.28	31.70	38.21	33.34	534.55
Mean:	**32.22**	**37.31**	**34.59**	**36.29**	**36.50**	**35.28**	**39.22**	**35.07**	**39.38**	**36.77**	**36.31**	**36.67**	**35.53**	**37.75**	**33.57**	**542.48**

[a] To allow for gavage-related mortality, seven rats, rather than five, were included in each of the corn oil gavage groups during the compound administration phase of the study. This rat was randomly selected to be excluded from the final group used for tissue collection, and feed intake values for this animal are not included in the group means.

[b] This rat was euthanized before the end of the study. Feed intake values for this animal are not included in the group means.

Table D-2. Rat body weights during the follow-up study

	Body Weight (g)						Mean
Date:	18-Jan	24-Jan	30-Jan	7-Feb	14-Feb	22-Feb	Body Weight
Study Day:	-5	1	7	15	22	30	(g)
Group 1: Feed Control							
17	260.00	271.10	266.43	276.55	267.87	275.73	271.54
18	266.10	271.40	273.42	282.37	282.77	285.47	279.09
20	262.10	264.59	268.23	273.94	275.20	282.15	272.82
44	266.50	272.31	278.60	288.44	290.69	294.25	284.86
46	287.80	294.23	280.61	281.65	267.48	274.20	279.63
Mean:	**268.50**	**274.73**	**273.46**	**280.59**	**276.80**	**282.36**	**277.59**
Group 2: Oil Control							
19[b]	256.30	280.67	260.09	267.71	268.25	--	--
25[c]	272.40	278.90	264.74	--	--	--	--
32	263.50	268.10	267.93	260.41	260.22	264.95	264.32
35	255.70	247.44	257.95	275.88	263.35	264.98	261.92
38	279.90	286.65	289.17	289.97	286.76	285.30	287.57
40	255.90	257.43	256.08	254.48	255.45	255.49	255.79
54	260.00	267.67	268.07	271.78	279.51	280.96	273.60
Mean:	**263.00**	**265.46**	**267.84**	**270.50**	**269.06**	**270.34**	**268.64**
Group 3: Oil Reference 0.2X							
22	249.50	256.36	264.69	266.17	261.76	267.10	263.22
24	282.90	289.14	285.66	291.59	294.02	287.66	289.61
37	285.90	288.56	291.09	287.29	288.03	286.63	288.32
45[b]	263.20	264.77	267.87	269.82	268.94	--	--
47	267.90	278.37	274.31	279.59	280.98	294.78	281.61
49[b]	276.70	269.59	274.95	275.94	278.29	--	--
50	263.60	273.71	277.26	278.15	275.98	279.33	276.89
Mean:	**269.96**	**277.23**	**278.60**	**280.56**	**280.15**	**283.10**	**279.93**
Group 4: Oil Reference 0.5X							
14	285.10	288.96	278.02	282.48	269.93	294.77	282.83
21[b]	269.30	279.29	276.86	277.89	281.79	--	--
23	279.40	292.15	288.49	292.02	290.48	296.23	291.87
33[b]	257.50	264.16	260.28	251.14	262.09	--	--
39	277.70	279.84	282.00	293.87	289.06	298.82	288.72
43	277.50	280.31	286.13	280.38	280.95	277.93	281.14
53	267.40	264.80	275.43	281.09	282.84	291.15	279.06
Mean:	**277.42**	**281.21**	**282.01**	**285.97**	**282.65**	**291.78**	**284.72**
Group 5: Oil Reference 0.8X							
15	250.60	257.91	257.27	264.59	268.47	276.11	264.87
26	275.30	271.07	265.84	262.17	266.11	261.30	265.30
27	262.70	265.48	260.25	258.62	260.19	262.98	261.50
28[b]	262.50	257.73	250.94	252.56	252.84	--	--
29	269.70	264.27	273.47	282.36	279.61	280.73	276.09
36	254.90	251.64	255.84	272.50	276.74	281.86	267.72
52[c]	257.90	261.84	256.02	--	--	--	--
Mean:	**262.64**	**262.07**	**262.53**	**268.05**	**270.22**	**272.60**	**267.10**

Table D-2. (cont.)

	Body Weight (g)						Mean
Date	18-Jan	24-Jan	30-Jan	7-Feb	14-Feb	22-Feb	Body Weight
Study Day	-5	1	7	15	22	30	(g)
Group 6: Soil							
30	265.30	279.34	282.45	292.53	296.60	294.65	289.11
41	265.70	274.73	282.27	291.34	286.97	288.25	284.71
42	261.00	259.19	265.70	276.95	283.14	280.78	273.15
48	259.10	257.16	263.06	258.96	259.30	257.50	259.20
51	282.20	256.15	273.55	277.99	277.72	276.55	272.39
Mean:	**266.66**	**265.31**	**273.41**	**279.55**	**280.75**	**279.55**	**275.71**

[a] Mean of body weights from study days 1, 7, 15, 22, and 30.

[b] To allow for gavage-related mortality, seven rats, rather than five, were included in each of the corn oil gavage groups during the compound administration phase of the study. This rat was randomly selected to be excluded from the final group used for tissue collection, and feed intake values for this animal are not included in the group means.

[c] This rat was euthanized before the end of the study. Feed intake values for this animal are not included in the group means.

Table D-3. Rat necropsy liver and fat sample weights

Rat #	Liver Weight (g)	Abdominal Fat Sample Weight (g)
Group 1: Feed Control		
17	10.87	2.85
18	10.08	5.02
20	11.38	3.62
44	10.50	5.58
46	8.92	4.23
Gp 1 Mean	**10.35**	**4.26**
Group 2: Oil Control		
32	8.10	2.99
35	9.27	3.15
38	10.61	3.70
40	8.09	4.76
54	9.63	5.04
Gp 2 Mean	**9.14**	**3.93**
Group 3: Oil Reference 0.2X		
22	8.45	5.21
24	8.91	4.64
37	9.77	4.08
47	10.31	3.84
50	8.89	4.44
Gp 3 Mean	**9.27**	**4.44**
Group 4: Oil Reference 0.5X		
14	10.59	6.83
23	10.19	4.55
39	9.93	4.79
43	8.54	3.57
53	12.23	5.26
Gp 4 Mean	**10.30**	**5.00**
Group 5: Oil Reference 0.8X		
15	10.19	4.16
26	8.73	3.56
27	8.63	3.29
29	9.13	4.26
36	10.03	4.19
Gp 5 Mean	**9.34**	**3.89**
Group 6: Soil		
30	10.30	4.00
41	9.10	5.48
42	9.48	3.96
48	8.41	3.38
51	9.13	2.85
Gp 6 Mean	**9.28**	**3.93**

Notes:

Liver was weighed, EROD/MROD sample cut out, remainder wrapped in foil and placed on dry ice.

For fat samples, samplers tried to get 4–5 g from same areas on all rats. Fat samples were weighed, wrapped in foil, and placed on dry ice

Table D-4. Tissue concentrations, doses, and RBA calculations for the rat follow-up study

	Tittabawassee River Soil (Group 6)												
						Using Mean BW						Using Terminal BW	
Analyte	Soil/ Diet Mean Conc. (pg/g)	Rat IDs	Total Feed Intake (g)	Mean BW[c] (g)	Terminal BW (g)	Total Dose[bw][a] (pg/g)	Avg. Daily Dose[bw][a] (pg/g)	Avg. Daily Dose[bw][a] S.D.	Total Dose (pg)	Liver Weight (g)	Liver Conc. (pg/g)	Fat Weight Fraction (wa) (unitless)	Fat Weight (g)
2,3,7,8-TCDF	79.3	Grp 6 Mean	542.48	275.71	279.55	156	5.198	0.171	43,019		300		
1,2,3,7,8-PeCDF	49.5	Grp 6 Mean	542.48	275.71	279.55	97.4	3.245	0.107	26,853		230		
2,3,4,7,8-PeCDF	42.3	Grp 6 Mean	542.48	275.71	279.55	83.2	2.773	0.091	22,947		1,066		
1,2,3,4,7,8-HxCDF	33.4	Grp 6 Mean	542.48	275.71	279.55	65.7	2.189	0.072	18,119		575		
1,2,3,6,7,8-HxCDF	8.19	Grp 6 Mean	542.48	275.71	279.55	16.1	0.537	0.018	4,443		158		
2,3,7,8-TCDF	79.3	30	556.26	289.11	294.65	153	5.086		44,111	10.3	311	0.0753	22.18
1,2,3,7,8-PeCDF	49.5	30	556.26	289.11	294.65	95.2	3.175		27,535	10.3	238	0.0753	22.18
2,3,4,7,8-PeCDF	42.3	30	556.26	289.11	294.65	81.4	2.713		23,530	10.3	1,040	0.0753	22.18
1,2,3,4,7,8-HxCDF	33.4	30	556.26	289.11	294.65	64.3	2.142		18,579	10.3	554	0.0753	22.18
1,2,3,6,7,8-HxCDF	8.19	30	556.26	289.11	294.65	15.8	0.525		4,556	10.3	153	0.0753	22.18
2,3,7,8-TCDF	79.3	41	590.02	284.71	288.25	164	5.478		46,789	9.10	319	0.074	21.33
1,2,3,7,8-PeCDF	49.5	41	590.02	284.71	288.25	103	3.419		29,206	9.10	232	0.074	21.33
2,3,4,7,8-PeCDF	42.3	41	590.02	284.71	288.25	87.7	2.922		24,958	9.10	1,060	0.074	21.33
1,2,3,4,7,8-HxCDF	33.4	41	590.02	284.71	288.25	69.2	2.307		19,707	9.10	575	0.074	21.33
1,2,3,6,7,8-HxCDF	8.19	41	590.02	284.71	288.25	17.0	0.566		4,832	9.10	154	0.074	21.33
2,3,7,8-TCDF	79.3	42	537.79	273.15	280.78	156	5.204		42,647	9.48	258	0.0725	20.36
1,2,3,7,8-PeCDF	49.5	42	537.79	273.15	280.78	97.5	3.249		26,621	9.48	198	0.0725	20.36
2,3,4,7,8-PeCDF	42.3	42	537.79	273.15	280.78	83.3	2.776		22,749	9.48	1,000	0.0725	20.36
1,2,3,4,7,8-HxCDF	33.4	42	537.79	273.15	280.78	65.8	2.192		17,962	9.48	544	0.0725	20.36
1,2,3,6,7,8-HxCDF	8.19	42	537.79	273.15	280.78	16.1	0.537		4,405	9.48	151	0.0725	20.36
2,3,7,8-TCDF	79.3	48	493.76	259.20	257.50	151	5.035		39,155	8.41	325	0.0679	17.48
1,2,3,7,8-PeCDF	49.5	48	493.76	259.20	257.50	94.3	3.143		24,441	8.41	253	0.0679	17.48
2,3,4,7,8-PeCDF	42.3	48	493.76	259.20	257.50	80.6	2.686		20,886	8.41	1,180	0.0679	17.48
1,2,3,4,7,8-HxCDF	33.4	48	493.76	259.20	257.50	63.6	2.121		16,492	8.41	635	0.0679	17.48
1,2,3,6,7,8-HxCDF	8.19	48	493.76	259.20	257.50	15.6	0.520		4,044	8.41	178	0.0679	17.48
2,3,7,8-TCDF	79.3	51	534.55	272.39	276.55	156	5.187		42,390	9.13	287	0.0717	19.82
1,2,3,7,8-PeCDF	49.5	51	534.55	272.39	276.55	97.1	3.238		26,460	9.13	227	0.0717	19.82
2,3,4,7,8-PeCDF	42.3	51	534.55	272.39	276.55	83.0	2.767		22,611	9.13	1,050	0.0717	19.82
1,2,3,4,7,8-HxCDF	33.4	51	534.55	272.39	276.55	65.5	2.185		17,854	9.13	567	0.0717	19.82
1,2,3,6,7,8-HxCDF	8.19	51	534.55	272.39	276.55	16.1	0.536		4,378	9.13	156	0.0717	19.82

Table D-4. (cont.)

	Tittabawassee River Soil (Group 6)										Oil Reference 0.2X (Group 3)			
Analyte	Fat Conc. (pg/g)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	WHO TEF (unitless)	Liver TEQ (pg/g)	Liver TEQ SD	Oil Reference 0.2X Mean Conc. (ng/mL)	Group 3 Rat IDs	Total Gavage Volume (mL)	Mean BW[c] (g)
2,3,7,8-TCDF	138	0.065	0.006	0.065	0.007	0.130	0.012	0.1	30.0	2.76	0.268	Grp 3 Mean	30	279.93
1,2,3,7,8-PeCDF	58.4	0.079	0.008	0.044	0.003	0.123	0.011	0.05	11.5	1.01	0.185	Grp 3 Mean	30	279.93
2,3,4,7,8-PeCDF	55.7	0.432	0.035	0.049	0.004	0.481	0.037	0.5	533	33.8	0.166	Grp 3 Mean	30	279.93
1,2,3,4,7,8-HxCDF	37.5	0.295	0.022	0.042	0.005	0.337	0.026	0.1	57.5	3.56	0.122	Grp 3 Mean	30	279.93
1,2,3,6,7,8-HxCDF	10.5	0.331	0.030	0.048	0.007	0.379	0.035	0.1	15.8	1.11	0.036	Grp 3 Mean	30	279.93
2,3,7,8-TCDF	149	0.073		0.075		0.148		0.1	31.1		0.268	22	30	263.22
1,2,3,7,8-PeCDF	62.0	0.089		0.050		0.139		0.05	11.9		0.185	22	30	263.22
2,3,4,7,8-PeCDF	57.7	0.455		0.054		0.510		0.5	520		0.166	22	30	263.22
1,2,3,4,7,8-HxCDF	39.8	0.307		0.048		0.355		0.1	55.4		0.122	22	30	263.22
1,2,3,6,7,8-HxCDF	10.8 *J*	0.346		0.053		0.398		0.1	15.3		0.036	22	30	263.22
2,3,7,8-TCDF	150	0.062		0.068		0.130		0.1	31.9		0.268	24	30	289.61
1,2,3,7,8-PeCDF	58.1	0.072		0.042		0.115		0.05	11.6		0.185	24	30	289.61
2,3,4,7,8-PeCDF	51.6	0.386		0.044		0.431		0.5	530		0.166	24	30	289.61
1,2,3,4,7,8-HxCDF	31.1	0.266		0.034		0.299		0.1	57.5		0.122	24	30	289.61
1,2,3,6,7,8-HxCDF	8.00 *J*	0.290		0.035		0.325		0.1	15.4		0.036	24	30	289.61
2,3,7,8-TCDF	126	0.057		0.060		0.118		0.1	25.8		0.268	37	30	288.32
1,2,3,7,8-PeCDF	56.5	0.071		0.043		0.114		0.05	9.90		0.185	37	30	288.32
2,3,4,7,8-PeCDF	54.7	0.417		0.049		0.466		0.5	500		0.166	37	30	288.32
1,2,3,4,7,8-HxCDF	38.3	0.287		0.043		0.331		0.1	54.4		0.122	37	30	288.32
1,2,3,6,7,8-HxCDF	11.0 *J*	0.325		0.051		0.376		0.1	15.1		0.036	37	30	288.32
2,3,7,8-TCDF	142	0.070		0.063		0.133		0.1	32.5		0.268	47	30	281.61
1,2,3,7,8-PeCDF	60.1	0.087		0.043		0.130		0.05	12.7		0.185	47	30	281.61
2,3,4,7,8-PeCDF	58.7	0.475		0.049		0.524		0.5	590		0.166	47	30	281.61
1,2,3,4,7,8-HxCDF	40.6	0.324		0.043		0.367		0.1	63.5		0.122	47	30	281.61
1,2,3,6,7,8-HxCDF	11.4 *J*	0.370		0.049		0.419		0.1	17.8		0.036	47	30	281.61
2,3,7,8-TCDF	123	0.062		0.058		0.119		0.1	28.7		0.268	50	30	276.89
1,2,3,7,8-PeCDF	55.4	0.078		0.042		0.120		0.05	11.4		0.185	50	30	276.89
2,3,4,7,8-PeCDF	56.0	0.424		0.049		0.473		0.5	525		0.166	50	30	276.89
1,2,3,4,7,8-HxCDF	37.8	0.290		0.042		0.332		0.1	56.7		0.122	50	30	276.89
1,2,3,6,7,8-HxCDF	11.5 *J*	0.325		0.052		0.377		0.1	15.6		0.036	50	30	276.89

Table D-4. (cont.)

	Oil Reference 0.2X (Group 3)														
		Using Mean BW						Using Terminal BW							
Analyte	Terminal BW (g)	Total Dose[bw][b] (pg/g)	Avg. Daily Dose[bw][a] (pg/g)	Avg. Daily Dose[bw][a] S.D.	Total Dose (pg)	Liver Weight (g)	Liver Conc. (pg/g)	Fat Weight Fraction (wa) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.
2,3,7,8-TCDF	283.10	28.7	0.959	0.038	8,040		103			60.5	0.118	0.012	0.155	0.006
1,2,3,7,8-PeCDF	283.10	19.8	0.662	0.026	5,550		74.2			24.7	0.123	0.009	0.091	0.004
2,3,4,7,8-PeCDF	283.10	17.8	0.594	0.023	4,980		358			24.8	0.656	0.010	0.100	0.011
1,2,3,4,7,8-HxCDF	283.10	13.1	0.436	0.017	3,660		175			15.1	0.435	0.016	0.083	0.010
1,2,3,6,7,8-HxCDF	283.10	3.86	0.129	0.005	1,080		52.6			4.36	0.446	0.009	0.081	0.006
2,3,7,8-TCDF	267.10	30.5	1.018		8,040	8.45	122	0.0698	18.64	63.4	0.128		0.147	
1,2,3,7,8-PeCDF	267.10	21.1	0.703		5,550	8.45	86.8	0.0698	18.64	25.9	0.132		0.087	
2,3,4,7,8-PeCDF	267.10	18.9	0.631		4,980	8.45	394	0.0698	18.64	23.6	0.669		0.088	
1,2,3,4,7,8-HxCDF	267.10	13.9	0.463		3,660	8.45	195	0.0698	18.64	14.8	0.450		0.075	
1,2,3,6,7,8-HxCDF	267.10	4.10	0.137		1,080	8.45	58.4	0.0698	18.64	4.33 *J*	0.457		0.075	
2,3,7,8-TCDF	287.66	27.8	0.925		8,040	8.91	116	0.0739	21.25	58.9	0.129		0.156	
1,2,3,7,8-PeCDF	287.66	19.2	0.639		5,550	8.91	79.9	0.0739	21.25	22.9	0.128		0.088	
2,3,4,7,8-PeCDF	287.66	17.2	0.573		4,980	8.91	362	0.0739	21.25	21.9	0.648		0.093	
1,2,3,4,7,8-HxCDF	287.66	12.6	0.421		3,660	8.91	177	0.0739	21.25	13.0 *J*	0.431		0.075	
1,2,3,6,7,8-HxCDF	287.66	3.73	0.124		1,080	8.91	53.6	0.0739	21.25	4.03 *J*	0.442		0.079	
2,3,7,8-TCDF	286.63	27.9	0.930		8,040	9.77	99.1	0.0737	21.12	59.3	0.120		0.156	
1,2,3,7,8-PeCDF	286.63	19.2	0.642		5,550	9.77	70.1	0.0737	21.12	25.5	0.123		0.097	
2,3,4,7,8-PeCDF	286.63	17.3	0.576		4,980	9.77	351	0.0737	21.12	27.1	0.689		0.115	
1,2,3,4,7,8-HxCDF	286.63	12.7	0.423		3,660	9.77	174	0.0737	21.12	16.3	0.464		0.094	
1,2,3,6,7,8-HxCDF	286.63	3.75	0.125		1,080	9.77	51.3	0.0737	21.12	4.89 *J*	0.464		0.096	
2,3,7,8-TCDF	294.78	28.6	0.952		8,040	10.31	84.7	0.0753	22.20	56.9	0.109		0.157	
1,2,3,7,8-PeCDF	294.78	19.7	0.657		5,550	10.31	60.8	0.0753	22.20	23.3	0.113		0.093	
2,3,4,7,8-PeCDF	294.78	17.7	0.589		4,980	10.31	319	0.0753	22.20	24.9	0.660		0.111	
1,2,3,4,7,8-HxCDF	294.78	13.0	0.433		3,660	10.31	158	0.0753	22.20	15.9	0.445		0.096	
1,2,3,6,7,8-HxCDF	294.78	3.84	0.128		1,080	10.31	47	0.0753	22.20	4.34 *J*	0.449		0.089	
2,3,7,8-TCDF	279.33	29.0	0.968		8,040	8.89	95.1	0.0722	20.18	64.0	0.105		0.161	
1,2,3,7,8-PeCDF	279.33	20.0	0.668		5,550	8.89	73.2	0.0722	20.18	26.1	0.117		0.095	
2,3,4,7,8-PeCDF	279.33	18.0	0.600		4,980	8.89	363	0.0722	20.18	26.3	0.648		0.107	
1,2,3,4,7,8-HxCDF	279.33	13.2	0.441		3,660	8.89	171	0.0722	20.18	15.3	0.415		0.084	
1,2,3,6,7,8-HxCDF	279.33	3.90	0.130		1,080	8.89	52.9	0.0722	20.18	4.23 *J*	0.435		0.079	

Table D-4. (cont.)

	Oil Reference 0.2X (Group 3)				Oil Reference 0.5X (Group 4)									
										Using Mean BW				
Analyte	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	WHO TEF (unitless)	Liver TEQ (pg/g)	Oil Reference 0.5X Mean Conc. (ng/mL)	Group 4 Rat IDs	Total Gavage Volume (mL)	Mean BW[c] (g)	Terminal BW (g)	Total Dose[bw][b] (pg/g)	Avg. Daily Dose[bw][a] (pg/g)	Avg. Daily Dose[bw][a] S.D.	Total Dose (pg)	Liver Weight (g)
2,3,7,8-TCDF	0.273	0.009	0.1	10.4	0.673	Grp 4 Mean	30	284.72	291.78	70.9	2.364	0.044	20,190	
1,2,3,7,8-PeCDF	0.213	0.006	0.05	3.76	0.452	Grp 4 Mean	30	284.72	291.78	47.6	1.588	0.030	13,560	
2,3,4,7,8-PeCDF	0.756	0.012	0.5	180	0.422	Grp 4 Mean	30	284.72	291.78	44.5	1.483	0.028	12,660	
1,2,3,4,7,8-HxCDF	0.518	0.019	0.1	17.5	0.307	Grp 4 Mean	30	284.72	291.78	32.3	1.079	0.020	9,210	
1,2,3,6,7,8-HxCDF	0.526	0.010	0.1	5.30	0.0892	Grp 4 Mean	30	284.72	291.78	9.40	0.313	0.006	2,676	
2,3,7,8-TCDF	0.275		0.1	12.2	0.673	14	30	282.83	294.77	71.4	2.380		20,190	10.59
1,2,3,7,8-PeCDF	0.219		0.05	4.34	0.452	14	30	282.83	294.77	47.9	1.598		13,560	10.59
2,3,4,7,8-PeCDF	0.757		0.5	197	0.422	14	30	282.83	294.77	44.8	1.492		12,660	10.59
1,2,3,4,7,8-HxCDF	0.526		0.1	19.5	0.307	14	30	282.83	294.77	32.6	1.085		9,210	10.59
1,2,3,6,7,8-HxCDF	0.532		0.1	5.84	0.0892	14	30	282.83	294.77	9.46	0.315		2,676	10.59
2,3,7,8-TCDF	0.284		0.1	11.6	0.673	23	30	291.87	296.23	69.2	2.306		20,190	10.19
1,2,3,7,8-PeCDF	0.216		0.05	4.00	0.452	23	30	291.87	296.23	46.5	1.549		13,560	10.19
2,3,4,7,8-PeCDF	0.741		0.5	181	0.422	23	30	291.87	296.23	43.4	1.446		12,660	10.19
1,2,3,4,7,8-HxCDF	0.506		0.1	17.7	0.307	23	30	291.87	296.23	31.6	1.052		9,210	10.19
1,2,3,6,7,8-HxCDF	0.522		0.1	5.36	0.0892	23	30	291.87	296.23	9.17	0.306		2,676	10.19
2,3,7,8-TCDF	0.276		0.1	9.91	0.673	39	30	288.72	298.82	69.9	2.331		20,190	9.93
1,2,3,7,8-PeCDF	0.220		0.05	3.51	0.452	39	30	288.72	298.82	47.0	1.566		13,560	9.93
2,3,4,7,8-PeCDF	0.804		0.5	176	0.422	39	30	288.72	298.82	43.8	1.462		12,660	9.93
1,2,3,4,7,8-HxCDF	0.559		0.1	17.4	0.307	39	30	288.72	298.82	31.9	1.063		9,210	9.93
1,2,3,6,7,8-HxCDF	0.560		0.1	5.13	0.0892	39	30	288.72	298.82	9.27	0.309		2,676	9.93
2,3,7,8-TCDF	0.266		0.1	8.47	0.673	43	30	281.14	277.93	71.8	2.394		20,190	8.54
1,2,3,7,8-PeCDF	0.206		0.05	3.04	0.452	43	30	281.14	277.93	48.2	1.608		13,560	8.54
2,3,4,7,8-PeCDF	0.771		0.5	160	0.422	43	30	281.14	277.93	45.0	1.501		12,660	8.54
1,2,3,4,7,8-HxCDF	0.542		0.1	15.8	0.307	43	30	281.14	277.93	32.8	1.092		9,210	8.54
1,2,3,6,7,8-HxCDF	0.538		0.1	4.70	0.0892	43	30	281.14	277.93	9.52	0.317		2,676	8.54
2,3,7,8-TCDF	0.266		0.1	9.51	0.673	53	30	279.06	291.15	72.4	2.412		20,190	12.23
1,2,3,7,8-PeCDF	0.212		0.05	3.66	0.452	53	30	279.06	291.15	48.6	1.620		13,560	12.23
2,3,4,7,8-PeCDF	0.755		0.5	182	0.422	53	30	279.06	291.15	45.4	1.512		12,660	12.23
1,2,3,4,7,8-HxCDF	0.500		0.1	17.1	0.307	53	30	279.06	291.15	33.0	1.100		9,210	12.23
1,2,3,6,7,8-HxCDF	0.514		0.1	5.29	0.0892	53	30	279.06	291.15	9.59	0.320		2,676	12.23

Table D-4. (cont.)

	Oil Reference 0.5X (Group 4)											
		Using Terminal BW										
Analyte	Liver Conc. (pg/g)	Fat Weight Fraction (wa) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	WHO TEF (unitless)	Liver TEQ (pg/g)
2,3,7,8-TCDF	206			118	0.109	0.016	0.130	0.014	0.239	0.030	0.1	
1,2,3,7,8-PeCDF	176			55.5	0.137	0.017	0.089	0.005	0.226	0.021	0.05	
2,3,4,7,8-PeCDF	830			53.4	0.681	0.077	0.091	0.005	0.772	0.080	0.5	
1,2,3,4,7,8-HxCDF	415			33.1	0.470	0.064	0.077	0.005	0.547	0.066	0.1	
1,2,3,6,7,8-HxCDF	125			9.17	0.494	0.067	0.073	0.003	0.568	0.067	0.1	
2,3,7,8-TCDF	196	0.0753	22.20	113	0.103		0.124		0.227		0.1	19.6
1,2,3,7,8-PeCDF	177	0.0753	22.20	54.5	0.138		0.089		0.227		0.05	8.85
2,3,4,7,8-PeCDF	744	0.0753	22.20	47.7	0.622		0.084		0.706		0.5	372
1,2,3,4,7,8-HxCDF	370	0.0753	22.20	29.1	0.425		0.070		0.496		0.1	37.0
1,2,3,6,7,8-HxCDF	115	0.0753	22.20	8.36 *J*	0.455		0.069		0.524		0.1	11.5
2,3,7,8-TCDF	208	0.0756	22.39	116	0.105		0.129		0.234		0.1	20.8
1,2,3,7,8-PeCDF	165	0.0756	22.39	51.4	0.124		0.085		0.209		0.05	8.25
2,3,4,7,8-PeCDF	838	0.0756	22.39	52.7	0.675		0.093		0.768		0.5	419
1,2,3,4,7,8-HxCDF	411	0.0756	22.39	31.7	0.455		0.077		0.532		0.1	41.1
1,2,3,6,7,8-HxCDF	123	0.0756	22.39	8.74 *J*	0.468		0.073		0.542		0.1	12.3
2,3,7,8-TCDF	182	0.0761	22.74	106	0.090		0.119		0.209		0.1	18.2
1,2,3,7,8-PeCDF	164	0.0761	22.74	53.0	0.120		0.089		0.209		0.05	8.2
2,3,4,7,8-PeCDF	807	0.0761	22.74	51.9	0.633		0.093		0.726		0.5	404
1,2,3,4,7,8-HxCDF	401	0.0761	22.74	33.6	0.432		0.083		0.515		0.1	40.1
1,2,3,6,7,8-HxCDF	113	0.0761	22.74	9.32 *J*	0.419		0.079		0.499		0.1	11.3
2,3,7,8-TCDF	227	0.0719	20.00	117	0.096		0.116		0.212		0.1	22.7
1,2,3,7,8-PeCDF	198	0.0719	20.00	58.8	0.125		0.087		0.211		0.05	9.90
2,3,4,7,8-PeCDF	941	0.0719	20.00	59.6	0.635		0.094		0.729		0.5	471
1,2,3,4,7,8-HxCDF	470	0.0719	20.00	37.9	0.436		0.082		0.518		0.1	47.0
1,2,3,6,7,8-HxCDF	144	0.0719	20.00	10.4 *J*	0.460		0.078		0.537		0.1	14.4
2,3,7,8-TCDF	219	0.0746	21.71	139	0.133		0.149		0.282		0.1	21.9
1,2,3,7,8-PeCDF	177	0.0746	21.71	59.9	0.160		0.096		0.256		0.05	8.85
2,3,4,7,8-PeCDF	819	0.0746	21.71	55.2	0.791		0.095		0.886		0.5	410
1,2,3,4,7,8-HxCDF	425	0.0746	21.71	33.3	0.564		0.079		0.643		0.1	42.5
1,2,3,6,7,8-HxCDF	130	0.0746	21.71	9.05 *J*	0.594		0.073		0.668		0.1	13.0

Table D-4. (cont.)

	Oil Reference 0.8X (Group 5)														
						Using Mean BW						Using Terminal BW			
Analyte	Oil Reference 0.8X Mean Conc. (ng/mL)	Group 5 Rat IDs	Total Gavage Volume (mL)	Mean BW[c] (g)	Terminal BW (g)	Total Dose[bw][b] (pg/g)	Avg. Daily Dose[bw][a] (pg/g)	Avg. Daily Dose[bw][a] S.D.	Total Dose (pg)	Liver Weight (g)	Liver Conc. (pg/g)	Fat Weight Fraction (wa) (unitless)	Fat Weight (g)	Fat Conc. (pg/g)	
2,3,7,8-TCDF	1.023	Grp 5 Mean	30	267.09	272.60	115	3.831	0.078	30,690		357			154	
1,2,3,7,8-PeCDF	0.707	Grp 5 Mean	30	267.09	272.60	79.4	2.648	0.054	21,210		325			81.0	
2,3,4,7,8-PeCDF	0.642	Grp 5 Mean	30	267.09	272.60	72.1	2.404	0.049	19,260		1,614			80.1	
1,2,3,4,7,8-HxCDF	0.469	Grp 5 Mean	30	267.09	272.60	52.7	1.757	0.036	14,070		807			50.2	
1,2,3,6,7,8-HxCDF	0.136	Grp 5 Mean	30	267.09	272.60	15.3	0.509	0.010	4,080		247			13.8	
2,3,7,8-TCDF	1.023	15	30	264.87	276.11	116	3.862		30,690	10.19	327	0.0716	19.77	146	
1,2,3,7,8-PeCDF	0.707	15	30	264.87	276.11	80.1	2.669		21,210	10.19	295	0.0716	19.77	74.3	
2,3,4,7,8-PeCDF	0.642	15	30	264.87	276.11	72.7	2.424		19,260	10.19	1,450	0.0716	19.77	74.7	
1,2,3,4,7,8-HxCDF	0.469	15	30	264.87	276.11	53.1	1.771		14,070	10.19	734	0.0716	19.77	47.5	
1,2,3,6,7,8-HxCDF	0.136	15	30	264.87	276.11	15.4	0.513		4,080	10.19	228	0.0716	19.77	12.8	*J*
2,3,7,8-TCDF	1.023	26	30	265.30	261.30	116	3.856		30,690	8.73	353	0.0686	17.94	143	
1,2,3,7,8-PeCDF	0.707	26	30	265.30	261.30	79.9	2.665		21,210	8.73	328	0.0686	17.94	81.2	
2,3,4,7,8-PeCDF	0.642	26	30	265.30	261.30	72.6	2.420		19,260	8.73	1,690	0.0686	17.94	85.5	
1,2,3,4,7,8-HxCDF	0.469	26	30	265.30	261.30	53.0	1.768		14,070	8.73	814	0.0686	17.94	53.6	
1,2,3,6,7,8-HxCDF	0.136	26	30	265.30	261.30	15.4	0.513		4,080	8.73	256	0.0686	17.94	13.4	*J*
2,3,7,8-TCDF	1.023	27	30	261.50	262.98	117	3.912		30,690	8.63	372	0.069	18.14	154	
1,2,3,7,8-PeCDF	0.707	27	30	261.50	262.98	81.1	2.704		21,210	8.63	344	0.069	18.14	84.8	
2,3,4,7,8-PeCDF	0.642	27	30	261.50	262.98	73.7	2.455		19,260	8.63	1,750	0.069	18.14	84.5	
1,2,3,4,7,8-HxCDF	0.469	27	30	261.50	262.98	53.8	1.793		14,070	8.63	880	0.069	18.14	55.3	
1,2,3,6,7,8-HxCDF	0.136	27	30	261.50	262.98	15.6	0.520		4,080	8.63	268	0.069	18.14	17.2	
2,3,7,8-TCDF	1.023	29	30	276.09	280.73	111	3.705		30,690	9.13	377	0.0725	20.35	166	
1,2,3,7,8-PeCDF	0.707	29	30	276.09	280.73	76.8	2.561		21,210	9.13	355	0.0725	20.35	86.1	
2,3,4,7,8-PeCDF	0.642	29	30	276.09	280.73	69.8	2.325		19,260	9.13	1,630	0.0725	20.35	79.9	
1,2,3,4,7,8-HxCDF	0.469	29	30	276.09	280.73	51.0	1.699		14,070	9.13	834	0.0725	20.35	48.9	
1,2,3,6,7,8-HxCDF	0.136	29	30	276.09	280.73	14.8	0.493		4,080	9.13	247	0.0725	20.35	13.3	*J*
2,3,7,8-TCDF	1.023	36	30	267.72	281.86	115	3.821		30,690	10.03	355	0.0727	20.50	162	
1,2,3,7,8-PeCDF	0.707	36	30	267.72	281.86	79.2	2.641		21,210	10.03	305	0.0727	20.50	78.5	
2,3,4,7,8-PeCDF	0.642	36	30	267.72	281.86	71.9	2.398		19,260	10.03	1,550	0.0727	20.50	76.1	
1,2,3,4,7,8-HxCDF	0.469	36	30	267.72	281.86	52.6	1.752		14,070	10.03	773	0.0727	20.50	45.8	
1,2,3,6,7,8-HxCDF	0.136	36	30	267.72	281.86	15.2	0.508		4,080	10.03	235	0.0727	20.50	12.2	*J*

Table D-4. (cont.)

	Oil Reference 0.8X (Group 5)							
Analyte	Fraction Retained in Liver FR_{liver} (unitless)	FR_{liver} S.D.	Fraction Retained in Fat FR_{fat} (unitless)	FR_{fat} S.D.	Fraction Retained Liver+Fat FR_{sum} (unitless)	FR_{sum} S.D.	WHO TEF (unitless)	Liver TEQ (pg/g)
2,3,7,8-TCDF	0.109	0.007	0.099	0.013	0.208	0.019	0.1	
1,2,3,7,8-PeCDF	0.143	0.007	0.074	0.007	0.218	0.014	0.05	
2,3,4,7,8-PeCDF	0.778	0.020	0.080	0.003	0.859	0.021	0.5	
1,2,3,4,7,8-HxCDF	0.532	0.020	0.068	0.002	0.600	0.020	0.1	
1,2,3,6,7,8-HxCDF	0.562	0.014	0.062	0.003	0.624	0.014	0.1	
2,3,7,8-TCDF	0.109		0.094		0.203		0.1	32.7
1,2,3,7,8-PeCDF	0.142		0.069		0.211		0.05	14.75
2,3,4,7,8-PeCDF	0.767		0.077		0.844		0.5	725
1,2,3,4,7,8-HxCDF	0.532		0.067		0.598		0.1	73.4
1,2,3,6,7,8-HxCDF	0.569		0.062		0.631		0.1	22.8
2,3,7,8-TCDF	0.100		0.084		0.184		0.1	35.3
1,2,3,7,8-PeCDF	0.135		0.069		0.204		0.05	16.4
2,3,4,7,8-PeCDF	0.766		0.080		0.846		0.5	845
1,2,3,4,7,8-HxCDF	0.505		0.068		0.573		0.1	81.4
1,2,3,6,7,8-HxCDF	0.548		0.059		0.607		0.1	25.6
2,3,7,8-TCDF	0.105		0.091		0.196		0.1	37.2
1,2,3,7,8-PeCDF	0.140		0.073		0.212		0.05	17.2
2,3,4,7,8-PeCDF	0.784		0.080		0.864		0.5	875
1,2,3,4,7,8-HxCDF	0.540		0.071		0.611		0.1	88
1,2,3,6,7,8-HxCDF	0.567		0.076		0.643		0.1	26.8
2,3,7,8-TCDF	0.112		0.110		0.222		0.1	37.7
1,2,3,7,8-PeCDF	0.153		0.083		0.235		0.05	17.75
2,3,4,7,8-PeCDF	0.773		0.084		0.857		0.5	815
1,2,3,4,7,8-HxCDF	0.541		0.071		0.612		0.1	83.4
1,2,3,6,7,8-HxCDF	0.553		0.066		0.619		0.1	24.7
2,3,7,8-TCDF	0.116		0.108		0.224		0.1	35.5
1,2,3,7,8-PeCDF	0.144		0.076		0.220		0.05	15.25
2,3,4,7,8-PeCDF	0.807		0.081		0.888		0.5	775
1,2,3,4,7,8-HxCDF	0.551		0.067		0.618		0.1	77.3
1,2,3,6,7,8-HxCDF	0.578		0.061		0.639		0.1	23.5

Note: *J* – The amount detected is below the Lower Calibration Limit of the instrument.

[a] Mean of body weights from study days 1, 7, 15, 22, and 30

Table D-5. Tissue concentrations in control group composite samples

Analyte	Group 1 Composite Feed Control		Group 2 Composite Oil Control	
	Liver (pg/g)	Fat (pg/g)	Liver (pg/g)	Fat (pg/g)
2,3,7,8-TCDD	0.172 *U*[a]	0.298 *J*	0.193 *U*[a]	0.283 *U*[a]
1,2,3,7,8-PeCDD	0.768 *J*	0.642 *J*	0.824 *J*	0.518 *J*
1,2,3,4,7,8-HxCDD	0.358 *J*	0.232 *U*	0.396 *J*	0.200 *U*
1,2,3,6,7,8-HxCDD	1.04 *J*	0.365 *J*	1.31 *J*	0.326 *J*
1,2,3,7,8,9-HxCDD	0.554 *J*	0.208 *J*	0.606 *J*	0.206 *J*
1,2,3,4,6,7,8-HpCDD	5.24	0.832 *J*	6.54	0.836 *J*
OCDD	17.6 *B*	2.56 *J,B*	23.6 *B*	2.45 *J,B*
2,3,7,8-TCDF	0.724 *J*	0.539 *J*	0.728 *J*	0.472 *J*
1,2,3,7,8-PeCDF	0.127 *U*[a]	0.234 *U*	0.166 *U*[a]	0.260 *U*
2,3,4,7,8-PeCDF	1.13 *J*	0.235 *U*	1.41 *J*	0.274 *U*
1,2,3,4,7,8-HxCDF	0.375 *J*	0.0810 *U*	0.534 *J*	0.0665 *U*
1,2,3,6,7,8-HxCDF	0.374 *J*	0.0778 *U*	0.374 *J*	0.0613 *U*
2,3,4,6,7,8-HxCDF	0.277 *J*	0.0868 *U*	0.282 *J*	0.0726 *U*
1,2,3,7,8,9-HxCDF	0.0838 *U*	0.132 *U*	0.0693 *U*	0.105 *U*
1,2,3,4,6,7,8-HpCDF	1.85 *J*	0.278 *U*	2.83 *J*	0.242 *J*
1,2,3,4,7,8,9-HpCDF	0.194 *J*	0.349 *U*	0.270 *J*	0.241 *U*
OCDF	1.34 *J*	0.483 *U*	2.42 *J*	0.463 *U*
TEQ[b]	**1.96**	**1.26**	**2.26**	**1.12**

Note: *B* – This compound was also detected in the method blank.
J – The amount detected is below the Lower Calibration Limit of the instrument.
U – Not detected; value represents the sample-specific detection limit, unless noted otherwise.

[a] Nondetect reported to the EMPC (Estimated Maximum Possible Concentration).

[b] Toxicity equivalence concentration (TEQ) calculated using the World Health Organization (WHO) toxicity equivalence factors.

Table D-6. Rat liver microsomal EROD activities

Entrix Sample ID	Exponent Group	Exponent Rat ID	Statistics			Group Statistics	
			Mean	SD	CV (%)	Mean	SD
S17	Gp-1	17	31.5	0.43	1.37		
S18	Gp-1	18	25.4	0.82	3.21		
S20	Gp-1	20	32.3	0.38	1.18	33.2	6.13
S44	Gp-1	44	34.1	0.40	1.17		
S46	Gp-1	46	42.4	2.29	5.40		
S32	Gp-2	32	33.5	1.04	3.10		
S35	Gp-2	35	33.4	0.88	2.64		
S38	Gp-2	38	44.2	0.45	1.01	40.6	7.15
S40	Gp-2	40	49.9	0.85	1.69		
S54	Gp-2	54	42.2	0.88	2.10		
S22	Gp-3	22	42.3	1.25	2.95		
S24	Gp-3	24	49.3	1.38	2.79		
S37	Gp-3	37	54.3	0.52	0.95	53.6	8.07
S47	Gp-3	47	61.2	1.99	3.25		
S50	Gp-3	50	61.2	0.99	1.62		
S14	Gp-4	14	73.3	2.52	3.43		
S23	Gp-4	23	83.6	4.53	5.42		
S39	Gp-4	39	109.9	8.26	7.52	80.8	17.9
S43	Gp-4	43	74.7	2.03	2.71		
S53	Gp-4	53	62.6	1.91	3.05		
S15	Gp-5	15	115.1	4.84	4.21		
S26	Gp-5	26	119.8	4.04	3.37		
S27	Gp-5	27	116.8	6.76	5.79	106.4	16.6
S29	Gp-5	29	100.1	3.54	3.53		
S36	Gp-5	36	80.0	3.55	4.43		
S30	Gp-6	30	82.0	1.89	2.31		
S41	Gp-6	41	118.2	4.67	3.95		
S42	Gp-6	42	142.9	8.34	5.84	110.1	24.1
S48	Gp-6	48	116.3	0.73	0.63		
S51	Gp-6	51	91.1	1.00	1.09		

Note: SD – standard deviation
CV – coefficient of variability

Table D-7. Rat liver microsomal MROD activities

Entrix Sample ID	Exponent Group	Exponent Rat ID	Statistics			Group Statistics	
			Mean	SD	CV (%)	Mean	SD
S17	Gp-1	17	26.9	2.26	8.18		
S18	Gp-1	18	27.7	1.03	3.76		
S20	Gp-1	20	26.6	1.08	3.87	25.7	2.2
S44	Gp-1	44	22.0	1.05	4.89		
S46	Gp-1	46	25.3	1.05	2.89		
S32	Gp-2	32	29.3	1.18	4.09		
S35	Gp-2	35	26.5	2.16	8.14		
S38	Gp-2	38	24.4	0.30	1.09	26.9	1.8
S40	Gp-2	40	26.9	1.63	6.22		
S54	Gp-2	54	27.5	1.43	5.12		
S22	Gp-3	22	36.3	1.56	4.56		
S24	Gp-3	24	36.1	2.27	6.42		
S37	Gp-3	37	34.8	2.47	7.26	33.3	3.6
S47	Gp-3	47	31.5	1.87	5.94		
S50	Gp-3	50	28.0	0.97	3.50		
S14	Gp-4	14	31.3	1.30	4.29		
S23	Gp-4	23	51.2	0.30	0.38		
S39	Gp-4	39	36.5	0.58	1.56	34.9	10.0
S43	Gp-4	43	24.8	1.36	5.52		
S53	Gp-4	53	30.9	1.76	5.65		
S15	Gp-5	15	52.0	2.78	5.24		
S26	Gp-5	26	36.6	2.40	6.58		
S27	Gp-5	27	39.3	1.32	3.54	41.9	7.4
S29	Gp-5	29	47.0	3.59	7.68		
S36	Gp-5	36	34.5	2.62	7.61		
S30	Gp-6	30	33.6	2.67	7.97		
S41	Gp-6	41	39.0	1.02	2.50		
S42	Gp-6	42	30.1	1.43	4.70	34.5	5.5
S48	Gp-6	48	41.2	1.93	4.68		
S51	Gp-6	51	28.7	1.37	4.86		

Note: SD – standard deviation
CV – coefficient of variability

Table D-8. Summary of relative bioavailability estimates for the follow-up rat study

	Fraction of Administered Dose Retained									RBA Estimates					
	Liver			Adipose			Liver + Adipose			Liver		Adipose		Liver + Adipose	
Analyte	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
Tittabawassee River Floodplain Soil (Group 6)															
2,3,7,8-TCDF	0.065	0.006	10%	0.065	0.007	11%	0.130	0.012	9%						
1,2,3,7,8-PeCDF	0.079	0.008	11%	0.044	0.003	8%	0.123	0.011	9%						
2,3,4,7,8-PeCDF	0.432	0.035	8%	0.049	0.004	7%	0.481	0.037	8%						
1,2,3,4,7,8-HxCDF	0.295	0.022	7%	0.042	0.005	12%	0.337	0.026	8%						
1,2,3,6,7,8-HxCDF	0.331	0.030	9%	0.048	0.007	15%	0.379	0.035	9%						
Oil Reference 0.2X (Group 3)										**Soil vs. Oil Reference 0.2X**					
2,3,7,8-TCDF	0.118	0.012	11%	0.155	0.006	4%	0.273	0.009	3%	55%	14%	42%	11%	48%	10%
1,2,3,7,8-PeCDF	0.123	0.009	7%	0.091	0.004	4%	0.213	0.006	3%	65%	13%	49%	9%	58%	9%
2,3,4,7,8-PeCDF	0.656	0.010	2%	0.100	0.011	11%	0.756	0.012	2%	66%	8%	49%	13%	64%	8%
1,2,3,4,7,8-HxCDF	0.435	0.016	4%	0.083	0.010	12%	0.518	0.019	4%	68%	8%	51%	17%	65%	9%
1,2,3,6,7,8-HxCDF	0.446	0.009	2%	0.081	0.006	8%	0.526	0.010	2%	74%	9%	60%	17%	72%	9%
Oil Reference 0.5X (Group 4)										**Soil vs. Oil Reference 0.5X**					
2,3,7,8-TCDF	0.109	0.016	15%	0.130	0.014	11%	0.239	0.030	13%	59%	18%	50%	15%	54%	16%
1,2,3,7,8-PeCDF	0.137	0.017	12%	0.089	0.005	5%	0.226	0.021	10%	58%	16%	49%	9%	55%	13%
2,3,4,7,8-PeCDF	0.681	0.077	11%	0.091	0.005	6%	0.772	0.080	10%	63%	14%	54%	9%	62%	13%
1,2,3,4,7,8-HxCDF	0.470	0.064	14%	0.077	0.005	7%	0.547	0.066	12%	63%	16%	54%	14%	62%	14%
1,2,3,6,7,8-HxCDF	0.494	0.067	14%	0.073	0.003	5%	0.568	0.067	12%	67%	16%	65%	16%	67%	15%
Oil Reference 0.8X (Group 5)										**Soil vs. Oil Reference 0.8X**					
2,3,7,8-TCDF	0.109	0.007	6%	0.099	0.013	13%	0.208	0.019	9%	59%	11%	66%	17%	62%	13%
1,2,3,7,8-PeCDF	0.143	0.007	5%	0.074	0.007	9%	0.218	0.014	6%	55%	12%	59%	12%	57%	11%
2,3,4,7,8-PeCDF	0.778	0.020	3%	0.080	0.003	4%	0.859	0.021	2%	55%	8%	61%	8%	56%	8%
1,2,3,4,7,8-HxCDF	0.532	0.020	4%	0.068	0.002	3%	0.600	0.020	3%	55%	8%	62%	12%	56%	8%
1,2,3,6,7,8-HxCDF	0.562	0.014	2%	0.062	0.003	5%	0.624	0.014	2%	59%	9%	77%	16%	61%	10%

Notes: RBA – relative bioavailability, calculated as: Fraction of administered dose retained $_{\text{test material}}$ / Fraction of administered dose retained $_{\text{reference material}}$

S.D. – standard deviation

C.V. – coefficient of variability

For fraction of administered dose retained: C.V. = Standard Deviation / Mean

For RBA estimates: C.V. = $(CV_{soil}^{2} + CV_{reference}^{2})^{0.5}$

Attachment E-4

Additional Supporting Material

Soil Adherence Factor for Recreational Visitors

APPENDIX E, E-4: SOIL ADHERENCE FACTOR FOR RECREATIONAL VISITORS IN THE PROBABILISTIC RISK ASSESSMENT (PRA)

The human health risk assessment (HHRA) distinguishes between "regular" events and "muddy hands" or "muddy feet" events. The former are events that probably happen on every exposure occasion due to contact with soil under normal conditions. The latter two are special cases, where relatively abnormal situations arise — losing a shoe in a swamp, falling in mud and getting hands covered in mud, and so forth. This appendix discusses the methodological approach that will be taken in the HHRA to evaluate the soil adherence factor in these circumstances.

For the probabilistic assessment, long-term average mean values will be estimated from the measurements of Kissel *et al.* (1996) and Holmes *et al.* (1999), as also reported in U.S. Environmental Protection Agency (USEPA) (1997). There are insufficient data to evaluate whether long term mean soil adherence factors differ between individuals, so no variability is incorporated in the analysis.

For "regular" events for hunters and fishers, the measurements of groundskeepers were considered appropriately conservative. Mean values for the skin loadings were obtained from the distributions implied by the reports cited. The measurements were all of people wearing their normal clothing for the activities concerned, and were referred to the bare surface area of the body part concerned. Thus no correction for assumed different fractions of the skin surface being exposed is appropriate.

It is assumed that each individual measurement of groundskeepers reported by Kissel *et al.* (1996) and Holmes *et al.* (1999) represented individual events, with the distribution of values equivalent to the differences that would occur for any individual during different events. Since each of the five sets of measurements was reported to have a distribution of values consistent with lognormal, all the groundskeeper measurements were accumulated to obtain a grand lognormal distribution for all groundskeepers for each body part. The mean values for that lognormal distribution were then used to estimate the long-term average soil adherence factor (averaged over many events).

The accumulated distributions were obtained by convolving the reported distributions for each of the five sets of groundskeepers for each body part separately. Where no measurement was reported for a particular body part for a particular set of groundskeepers, the convolution was performed over just the sets that did provide that body part measurement. Where no standard deviation was reported for a particular body part for a particular set of groundskeepers, its square was estimated as the average of the variances over the other sets for that body part, weighted by their degrees of freedom. No standard deviations were reported for measurements on feet — their squares were estimated as the average over the other body parts of the within-set degree-of-freedom-weighted mean variances. The convolution was performed analytically using the logarithms of the measurements, since they are normally distributed. That is, for each set *j* of

measurements we have a mean w_{ij} of the logarithm of skin loading for body part i (the logarithm of the reported median skin loading) and a within-set unbiased standard deviation estimate s_{ij} (the logarithm of the reported geometric standard deviation, estimated as just described if necessary), together with the number of samples n_j within the set. Convolving these gives the following estimates for mean w_i and standard deviation s_i of the combined set:

$$w_i = \frac{\sum_j n_j w_j}{\sum_j n_j}$$

$$s_i^2 = \frac{\sum_j \left(\left(n_j - 1 \right) s_{ij}^2 + n_j \left(w_{ij} - w_i \right)^2 \right)}{\left(\sum_j n_j \right) - 1}$$

The estimated mean skin loading was then obtained by transforming back from the resulting estimates for the mean w_i and standard deviation s_i of the lognormal distribution, as

$$\exp\left(w_i + s_i^2 / 2 \right)$$

Table Appendix E-4-1 shows the original data, the estimated overall distribution, and the estimated mean values.

For the "muddy hand" events, assumed to take place every other day during exposure, an additional soil loading to the hands alone was assumed, corresponding to the values reported by Kissel *et al.* (1996) for measurements on the hands of reed gatherers. Once again, the reported values were assumed to correspond to individual events from a distribution common to all participants, and the mean value of the assumed lognormal distribution is to be used. The geometric mean and geometric standard deviation for measurements on the hands of the four reed gatherers were 0.66 mg/cm^2 and 1.8, leading to the mean estimate of 0.78 mg/cm^2 to be used for this type of event.

For the "muddy feet" events, the a skin loading to the feet corresponding to that of the reed gathers reported by Kissel *et al.* (1996) was added to the above exposures. One of the four reed gatherers lost a shoe during the activity measured by Kissel *et al.* (1996), so the possibility of shoe loss is incorporated in this distribution. Once again, the same approach as used for the other two cases was used. The geometric mean and geometric standard deviation for measurements on the feet of the four reed gatherers were 0.63 mg/cm^2 and 7.1, leading to the mean estimate of 4.30 mg/cm^2 used here for this type of event.

Table E-4-1 Geometric mean (GM) and geometric standard deviation (GSD) of skin soil loading, in mg/cm^2, for various body parts (data from USEPA, 1997), for groundskeepers						
Set	Number in set	Hands	Arms	Legs	Faces	Feet
		GM GSD	GM GSD	GM GSD	GM GSD	GM GSD
1	2	0.15 (-)	0.005 (-)		0.0021 (-)	0.018 (-)
2	5	0.098 2.1	0.0021 2.6	0.001 1.5	0.01 2	
3	7	0.03 2.3	0.0022 1.9	0.0009 1.8	0.0044 2.6	0.004 (-)
4	7	0.045 1.9	0.014 1.8	0.0008 1.9	0.0026 1.6	0.018 (-)
5	8	0.032 1.7	0.022 2.8	0.001 1.4	0.0039 2.1	
Overall		0.046 2.29	0.0068 3.65	0.00092 1.63	0.0041 2.30	0.0093 2.74
Mean		0.0651	0.0158	0.00104	0.00581	0.0155

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Evaluation of Exposures to PCDD/Fs in Human Milk

APPENDIX HHRA E, E-4: EVALUATION OF EXPOSURES TO POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS (PCDD/Fs) IN HUMAN MILK IN THE HUMAN HEALTH RISK ASSESSMENT (HHRA)

This memorandum describes the proposed approach to consideration of the human breast milk exposure pathway for polychlorinated dibenzo-p-dioxins (PCDD/Fs) in the Human Health Risk Assessments (HHRAs) for the Midland Soils and Tittabawassee River. Human milk is a potential exposure pathway for site-related dioxin and furans for nursing infants. However, quantification and inclusion of potential incremental site-related exposure due to human milk ingestion by a nursing infant is inconsistent with the basis of existing toxicity criteria for PCDD/Fs for the following reasons:

- Current non-cancer toxicity criteria for TCDD are based on maintenance of *maternal* body concentrations at levels considered to be safe for the infant following exposures both in utero *and* via lactation. Thus, explicit quantification of infant ingestion via human milk is redundant- the available toxicity criteria explicitly address infant ingestion via human milk through maintenance of maternal body concentrations at safe levels.

- Current approaches to cancer toxicity criteria for TCDD and other dioxin and furan congeners are under discussion. The appropriate dose metric(s) for cancer risk assessments are also under discussion. To the extent that body or tissue concentrations are of relevance to the cancer risk assessment, infant human milk ingestion contributes little to lifetime average body or tissue concentration due to far more rapid elimination of these compounds by infants and children compared to adults and due to dilution by growth. Likewise, to the extent that intake is the appropriate dose metric for cancer risk assessment, a pharmacokinetic adjustment to infant intake rates to reflect the far more rapid elimination observed in infants compared to adults would need to be applied in the cancer risk assessment process.

Moreover quantification and inclusion of potential incremental site-related exposure due to human milk ingestion by a nursing infant introduces unwarranted uncertainties into the risk assessment process. Specifically:

- Assessment of incremental site-related human milk ingestion by a nursing infant requires congener-specific pharmacokinetic models relating maternal body concentrations of specific congeners to maternal intakes, as well as relating human milk concentrations of specific congeners to current and historical congener-specific maternal exposures, both site-related and background. Validated models for such exposure assessments do not exist for any congeners other than TCDD, and available data indicate substantial variability in pharmacokinetic behavior (absorption, distribution among body tissues, and partitioning to human milk stores) among dioxin and furan congeners.

Given the substantial quantitative uncertainties associated with estimation of site- and congener-specific infant exposures due to pharmacokinetic uncertainties, the variations in elimination rates between infants and adults, and the redundancy in assessment of infant intakes due to the basis of

the available non-cancer toxicity criteria, quantification of this exposure pathway for the local site-specific risk assessments is inappropriate and unjustified.

Finally, from a public health perspective, to the extent that such a theoretical and uncertain exercise could lead to a reduction in breastfeeding among local residents (either in frequency or duration), very real harm could result from such a focus of the risk assessment due to the known, demonstrated benefits of breastfeeding on infant health and development. Such benefits have been observed in every study of human infants, including those purporting to demonstrate subclinical associations between dioxin intakes from human milk and alterations of clinical chemistry or other developmental endpoints.

The following sections discuss the scientific and risk assessment issues that arise in consideration of inclusion of estimates of incremental, site-related breast milk exposure in the human health risk assessment. The data requirements and practical considerations involved in such an effort are discussed. In addition, the relevance of such exposure estimates to risk assessments using the existing available toxicity criteria for dioxins is assessed for non-cancer and cancer risk assessment.

Non-Cancer Risk Assessment

In order to include breast milk exposures in non-cancer risk assessment for dioxins and furans in a scientifically valid way, several requirements must be satisfied:

1. The incremental contribution of site-related dioxins to breast milk dioxin concentrations and infant intakes must be able to be estimated separately from background dioxins already present.

2. The rationale, scientific database, and assumptions underlying current non-cancer toxicity criteria must be fully understood.

3. The incremental infant exposure must be compared to appropriate non-cancer toxicity criteria using assumptions that are consistent with the basis of those criteria.

The first requirement can be satisfied in theory by conducting pharmacokinetic modeling that predicts the contribution of site-related maternal exposures to maternal body burden and the relationship between maternal body burden and breast milk concentrations. However, in practice, this exercise is complicated because the bulk of pharmacokinetic data that are available for dioxins and furans address only TCDD, while furan congeners predominate in the flood plain. Estimates of half-life of elimination for other congeners vary widely, and any estimate of body burden associated with exposure to these other congeners would introduce substantial uncertainties into the risk assessment. In addition, body distribution varies widely by congener, with some congeners displaying markedly higher affinity for liver tissue compared to adipose tissue (see, for example, Kitamura et al. 2001). Such hepatic sequestration would result in lower proportions of body burden being available to breast milk for some congeners than others, introducing additional complexity and uncertainty into the risk assessment. Finally, Wittsiepe et al. (2007) demonstrated that the partitioning of dioxins and furans into breast milk from maternal stores displays congener-specific variations, with higher molecular weight compounds

partitioning less efficiently from maternal blood into milk. Thus, such modeling will introduce substantial uncertainties into the risk assessment process.

The second requirement can be satisfied by review of the documentation of currently available non-cancer toxicity criteria. Several non-cancer toxicity criteria are available for TCDD. Each of these values is conventionally applied to all PCDD/Fs by use of the Toxicity Equivalency (TEQ) method. Table 1 summarizes each of these criteria and describes the basis for the values. Key elements applicable to all of the criteria are:

- The developing offspring, exposed in utero and postnatally through lactation, are the most sensitive receptors identified in laboratory studies of non-cancer effects of dioxin.
- This was explicitly recognized by all of the agencies that have derived non-cancer criteria for TCDD and related compounds.
- Each of these criteria was derived based on observed effects in offspring exposed to TCDD while in utero and postnatally via lactation.
- The criteria were all derived for chronic exposure scenarios with the goal of maintaining adult maternal exposures and body burdens below levels that could result in unacceptable exposures to the fetus in utero and the nursing infant.

Table 1: Current non-cancer toxicity criteria available for TCDD and related compounds

Organization	Value	Toxicity Study/Endpoint
Great Lakes Acceptable Daily Exposure (ADE) (USEPA 1995)	1.3 pg/kg-d	Bowman et al. (1989). Reproductive toxicity in rhesus monkeys chronically exposed in diet and developmental effects in the offspring of these monkeys exposed in utero and lactationally
ATSDR Minimal Risk Level (MRL) (1998)	1 pg/kg-d	Schantz et al. (1992). Neurobehavioral changes in rhesus monkey offspring following in utero and lactational exposure after chronic maternal dietary exposure.
WHO/FAO JECFA (2001) Provisional Tolerable Monthly Intake (PTMI)	70 pg/kg-m (2.3 pg/kg-d)	Effects on the development of the male rat reproductive system following in utero and lactational exposure; several studies.
ECSCF (2001)	14 pg/kg-wk (2 pg/kg-d)	Effects on the development of the male rat reproductive system following in utero and lactational exposure; several studies.
UKCOT (2001)	2 pg/kg-d	Effects on the development of the male rat reproductive system following in utero and lactational exposure; several studies.

The third requirement listed above is that infant exposures through breast milk be compared in an appropriate way to current non-cancer toxicity criteria, recognizing the basis for those criteria. In each case, the criteria were derived in order to prevent maternal body burdens from exceeding

levels that were safe for the infant (due both to in utero and to lactational exposures for the infant). Therefore, infant exposures via breast milk have already been anticipated and accounted for in these criteria: if the mother's chronic average exposures do not exceed the criteria, then the infant's in utero and breast milk exposures will be safe. From this point of view, no modeling of infant breast milk exposures is necessary if maternal exposure estimates are within the identified levels.

The only issue that remains to be accounted for is the possible contribution of an infant's breast milk exposure to its own adult body burdens. That is, to what extent could an infant's exposure contribute to elevated body burdens during its adult, childbearing years? Given the long half-life for elimination of dioxins, it is conceivable that infant exposures could contribute to adult body burdens. However, a robust set of data developed over the last decade now shows that infants and young children eliminate dioxins and furans at greatly elevated rates compared to adults (Leung et al., 2005; Leung et al., 2006; Kerger et al., 2005; Lorber and Phillips, 2002).

US EPA scientists conducted wide-ranging modeling of infant breast milk exposures to dioxin. The combination of this more rapid elimination with the substantial rate of growth during childhood (with accompanying dilution of body burdens) results in no discernible impact of breastfeeding on body burden after about age 10 (Figure 1) (Lorber and Phillips, 2002). This was true regardless of duration of breastfeeding (0 months through 2 years) and concentration of dioxins in breast milk (up to and including 50 ppt lipid basis). This conclusion held true when comparisons were made to formula fed infants as well as among the various breastfeeding scenarios, and when average intake rates for the first year for breastfed infants were as much as 87 times higher than the intake rates for formula fed infants. As noted by US EPA (2003):

- "In all …scenarios [formula-fed, or breast feeding for 6 weeks, 6 months,1 year, or 2 years], the lipid concentrations merged at about 10 years of age at a concentration of about 13 ppt TEQ_{DFP}-WHO_{98}. Lipid and body burdens declined slightly from age 10 to about age 20 and then rose gradually through adulthood." (US EPA, 2003, Part III, p. 4-22).

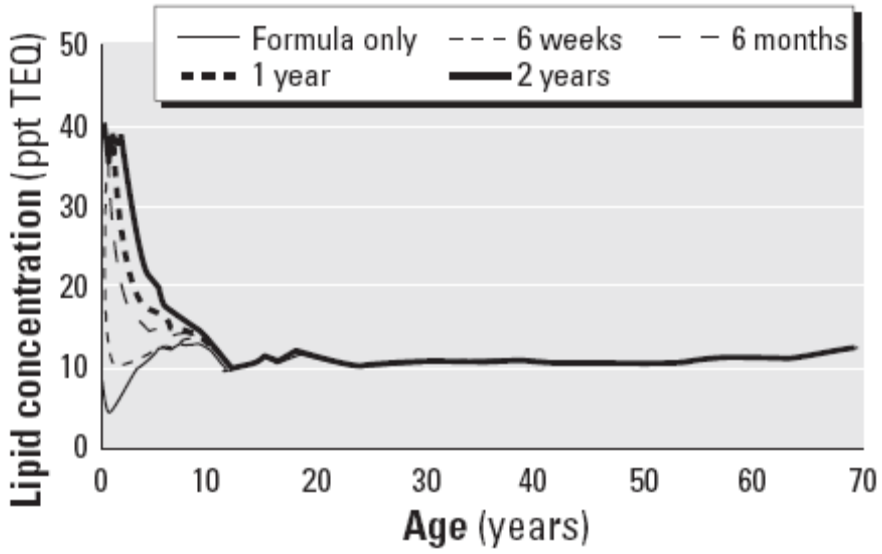

Figure 1: Effect of breastfeeding on serum lipid TEQ concentrations under different scenarios (Figure 3 from Lorber and Phillips, 2002).

This modeling used relatively modest adjustments of elimination rate to represent the more rapid dilution and elimination of dioxin intakes in infants compared to adults. However, more recent assessments of the available data (Leung et al. 2006, 2007) demonstrate that more rapid assumptions on elimination are justified for infants, which reinforces the conclusions reached in the USEPA modeling effort. So, while modeling of infant exposures to dioxin via the breast milk pathway could be accomplished on a site-specific basis, such exposures would not contribute to the key exposure metric, adult maternal body burden, which is already accounted for in the existing toxicity criteria, and would add undue uncertainty to the process given the complexity associated with such an effort.

Cancer Risk Assessment

For cancer risk assessment conducted under the traditional paradigm, assessment of the total amount of lifetime site-related exposure to a chemical of concern is divided by the assumed number of days in a lifetime to derive a lifetime average daily dose. For dioxins, approaches to cancer risk assessment involving body burden assessment have also been proposed. Thus, the requirements for conducting a valid assessment of the contribution of site-related contaminants to infant exposure via breast milk and cancer risk are:

1. The incremental contribution of site-related dioxins to breast milk dioxin concentrations and infant intakes must be able to be estimated separately from background dioxins already present.

2. To the extent required by the cancer risk assessment approach used, the contribution of these exposures to lifetime average body burden (or other dose metric) must be able to be assessed.

As discussed above, the first requirement can be satisfied in theory by conducting pharmacokinetic modeling that predicts the contribution of site-related maternal exposures to maternal body burden and the relationship between maternal body burden and breast milk concentrations. However, in practice, this exercise is somewhat complicated because the bulk of pharmacokinetic data that are available for dioxins and furans address only TCDD, while furan congeners predominate in the flood plain. Wittsiepe et al. (2007) demonstrated that the partitioning of dioxins and furans into breast milk from maternal stores displays congener-specific variations, with higher molecular weight compounds partitioning less efficiently from maternal blood into milk. Thus, such modeling will introduce substantial uncertainties into the risk assessment process.

Similarly, the second requirement will entail substantial pharmacokinetic modeling, which will be complicated due to the mix of congeners associated with the site. Furthermore, as discussed above, exposures of infants to dioxins in breast milk lead to only small elevations in body burdens for a short period during infancy and early childhood, and do not contribute measurably to adult body burdens. Thus, the impact of the modeling effort on the site-related cancer risk calculations under a body burden approach is likely to be minimal. Given the level of effort, numerous assumptions, and added complexity and uncertainties involved, such calculations are unlikely to be of substantial value in the process.

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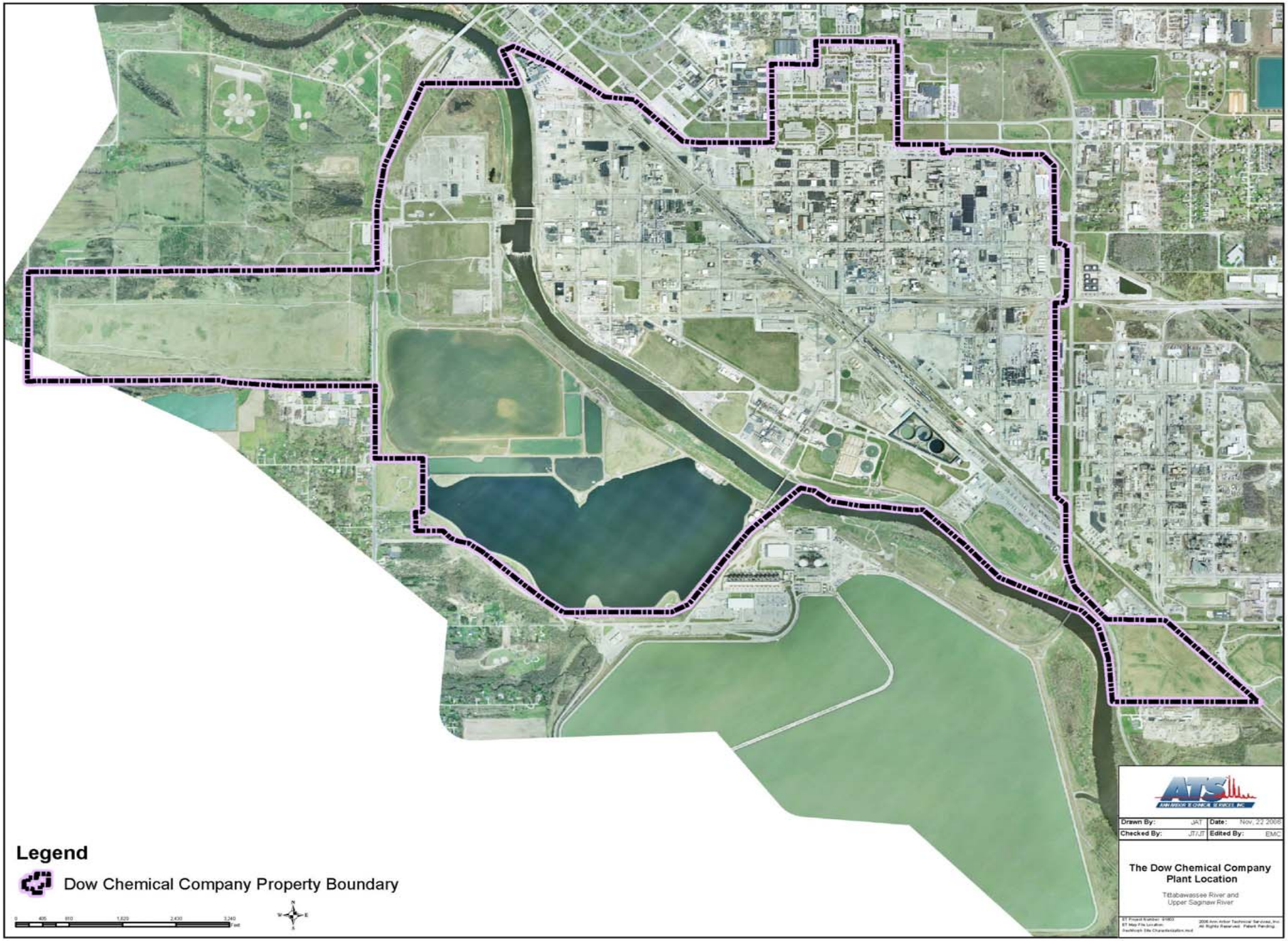
Attachment E-5

Summary of University of Michigan Dioxin Exposure Study

Included in "attachments" folder on same CD as this PDF.

Appendix F
Site History Attachments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Date: Nov. 22 2006
Checked By: JTJT
Edited By: EMC
The Dow Chemical Company
Plant Location
Tittabawassee River and
Upper Saginaw River
ST Project Number: 91807
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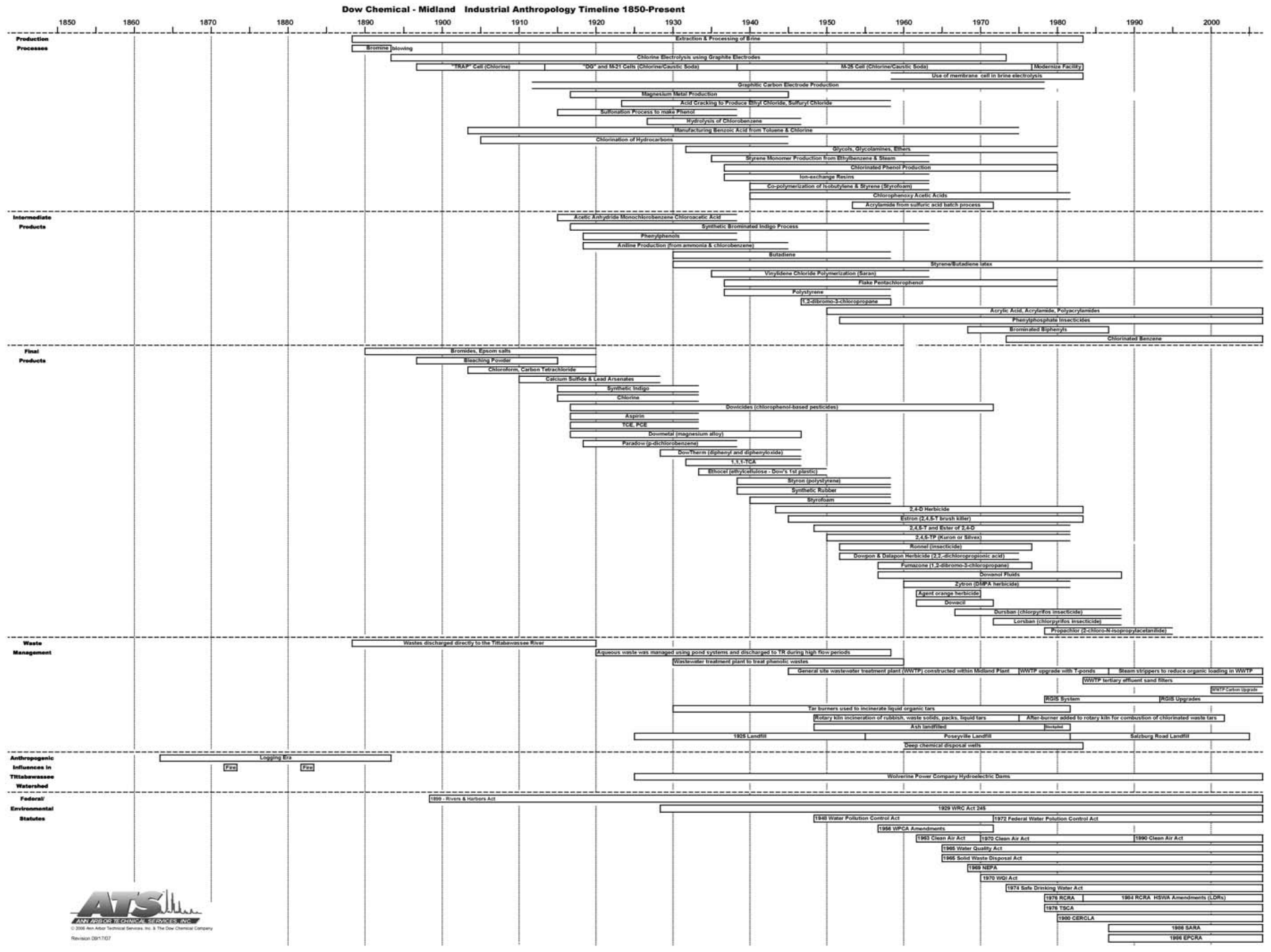
Dow Chemical - Midland Industrial Anthropology Timeline 1850-Present



ANN ARBOR TECHNICAL SERVICES, INC.

Revision 09/17/07

Appendix G
Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils (Pre-RI Study Report)

CH2M HILL
1111 Washington Street
Midland, MI 48640
Tel 989.638.8114
Fax 517.347.3793

March 22, 2007

Mr. George Bruchman
Chief Waste and Hazardous Materials Division
Michigan Department of Environmental Quality
Constitution Hall
525 West Allegan
Lansing MI 48933-1502

Subject: Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils

Dear: Mr. Bruchman

CH2M HILL is submitting the *Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils, March 2007* on behalf of The Dow Chemical Company. The report provides the evaluation of soil physical and chemical data collected in accordance with the *Sampling and Analysis Plan in Support of Bioavailabilty Study, Midland Area Soils, June 2006 (Revised November 2006)*. You may contact me at 989-638-8114 or Ben Baker of The Dow Chemical Company at 989-636-0787 if you have any questions.

Sincerely,

Gary Dyke
CH2M HILL

c: Greg Rudloff, Environmental Protection Agency
Terry Walkington, Michigan Department of Environmental Quality
Ben Baker, The Dow Chemical Company

Data Evaluation Report in Support of Bioavailability Study, Midland Area Soils

Prepared for

The Dow Chemical Company

March 2007

CH2MHILL

Contents

Tables (located at the end of each section, following text)

Figures (located at the end of each section, following tables)

Appendices

Abbreviations and Acronyms

µg/kg	micrograms per kilogram
µm	micrometer
bgs	below ground surface
CV	coefficient of variation
dioxin	polychlorinated dibenzo-p-dioxin
Dow	The Dow Chemical Company
FTCH	Fishbeck, Thompson, Carr, and Huber
furan	polychlorinated dibenzo-p-furans
IDW	investigation-derived waste
MDEQ	Michigan Department of Environmental Quality
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
ppt	parts per trillion
QC	quality control
RBSL	Risk-Based Screening Level
SAP	sampling and analysis plan
SVOC	semivolatile organic compound
TEF	toxic equivalency factor
TEQ	toxic equivalent, used to report the *toxicity-weighted masses* of mixtures of furans and dioxins
TIC	tentatively identified compound
TOC	total organic carbon
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WHO	World Health Organization

SECTION 1

Introduction

This report presents the sampling results for physical and chemical parameters measured in soil samples collected in the vicinity of The Dow Chemical Company (Dow) Plant in Midland, Michigan. The Study Area includes the portion of the city of Midland and the surrounding community that may have been impacted by historic aerial releases of chemical substances from the Dow Midland Plant. The Study Area encompasses residential, commercial, industrial, and undeveloped properties surrounding the Midland Plant (Figure 1-1).

1.1 Objectives and Approach

The objectives of this study include the following:

- Characterize the distribution of physical and chemical parameters of soil that are reported to influence bioavailability to identify ranges of soils to be used for potential future bioavailability studies
- Develop additional information on the nature and extent of polychlorinated dibenzo-p-dioxins (dioxins) and polychlorinated dibenzo-p-furans (furans) in Midland area soils
- Determine whether additional Dow-related hazardous substances are present in Midland area soil

1.2 Background

This report was prepared in accordance with the *Midland Representative Soils Sampling and Analysis Plan in Support of Bioavailability Study* (SAP) (CH2M HILL 2006). Dow, the Michigan Department of Environmental Quality (MDEQ), and the U.S. Environmental Protection Agency (USEPA) collaborated to develop a consensus approach to meet the stated SAP objectives. The investigation approach was based on the preliminary conceptual site model of release, aerial transport, and deposition of potentially hazardous constituents from the Midland Plant.

1.3 Report Organization

This report is organized as follows:

- **Section 1** presents an introduction to the Midland area soils study and summarizes the project objectives and background.
- **Section 2** describes the data collection procedures including sampling design, sample collection, and sample analysis.
- **Section 3** summarizes the evaluation of the soil physical and chemical data.

- **Section 4** presents the summary and conclusions of the Midland area soils study.
- **Section 5** lists references cited in this report.

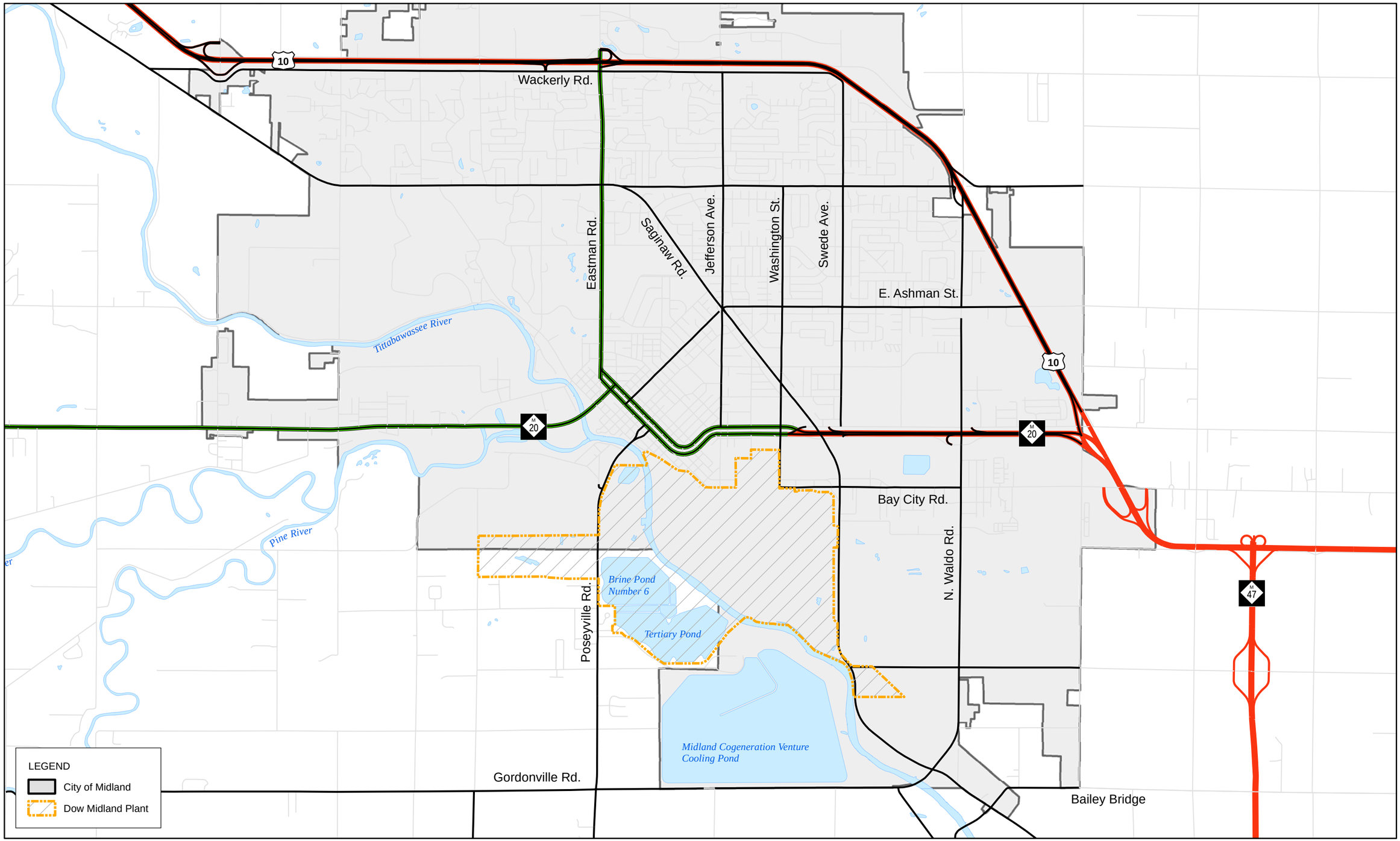


Figure 1-1
Midland Area Map
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SECTION 2

Data Collection

This section documents the data collection activities for the Midland area soil investigation. Unless otherwise noted, the investigation approach and field sampling procedures were conducted in accordance with the approved SAP. An overview of the sampling design, target analytes, sample collection procedures, and sample management processes are presented below; specific details and informational background presented in the SAP are not reproduced in this document.

2.1 Sample Parcels and Stations

Sampling stations were located on radial transects extending from the Midland Plant site into the surrounding community (Figure 2-1). There were between one and 12 stations in each transect. Generally, each station was approximately 300 feet by 300 feet and included one or more property parcels. One to five parcels were sampled from each station.

A written request for access was sent to the owner of each parcel within a station. If written approval for access to the property was not received before the start of sampling activities, the property owner was contacted by phone or visited onsite to facilitate obtaining access to the property.

Written approval from a minimum number of parcels within a station was required before any parcels within that station could be sampled. Sample stations with one or two parcels required that at least one access approval be provided prior to sampling. Stations with three or more parcels required at least three access approvals prior to sampling. Multiple parcels owned by a single entity within a station were considered a single parcel during this process. A total of 136 of the 145 stations (Figure 2-1) met these minimum requirements and were sampled. No parcel was sampled where written approval was not provided.

2.2 Sample Collection and Analysis

From October 23 through November 20, 2006, soil samples were collected at 136 stations (Figure 2-1). The number of samples collected for each analytical suite, sample depth intervals, and the number quality control (QC) samples are summarized in Table 2-1. Figure 2-2 identifies the analytical suites and depths associated with samples from each station. As previously indicated, samples were collected in accordance with the approved SAP with few exceptions. Table A-1 of Appendix A summarizes these exceptions from the approved protocols.

2.2.1 Soil Sampling Procedure

As specified in the SAP, soil samples were collected from a composite of 15 subsamples equally spaced around the perimeter of a 6-foot-diameter circle. The volatile organic compound (VOC) fraction of the additional chemicals sample was not composited and was

taken directly from one randomly selected subsample. The geographic location, field-interpreted land use, and parcel-specific features where the sample was taken (level of disturbance, recently sodded lawn, etc.) were recorded at the time of sampling. Land areas that had been recently disturbed were avoided, if possible. Care was taken to minimally disturb the area where sampling occurred and to return it to its original condition by filling sample holes with topsoil and replacing turf plugs.

Surface soil (0 to 1 inch below ground surface [bgs]) samples were collected at all locations and subsurface soil samples (1 to 6 inches bgs) were collected at selected stations near the Midland Plant (typically, the first two stations along each transect nearest the Midland Plant). All samples were analyzed for dioxin and furan congeners, and soil parameters were analyzed at most stations (Table 2-2). Soil parameters were not analyzed from sample stations that consist of fully developed industrial or commercial properties because the surface soils in these areas are highly disturbed or are not present (SAP; CH2M HILL 2006). Selected stations near the Midland Plant were analyzed for additional chemicals, which include a variety of VOCs, semivolatile organic compounds (SVOCs), metals, pesticides, and polychlorinated biphenyls (PCBs). The constituents in the dioxin and furan, soil parameter, and additional chemical analytical suites and a summary of detections are in Appendices C, D, and E. Analytical results from the sampling are presented and discussed in Section 3.

Sample equipment was decontaminated before sampling at each parcel as specified in the SAP. Residual soil from sampling was returned to the soil sample holes when possible immediately after sampling was completed. Soil samples that were collected but not submitted for laboratory analysis were transferred under chain-of-custody procedures to Fishbeck, Thompson, Carr, and Huber (FTCH), a third-party firm retained by the independent third party to blind and relabel the samples prior to laboratory submittal. Non-location-specific soil investigation-derived waste (IDW) that resulted from sample processing at the field office was managed with similar Dow waste. Solid IDW (such as gloves and paper towels) were disposed of as municipal waste. Decontamination water was segregated and managed as IDW for offsite disposal.

2.2.2 Quality Control Sampling

QC samples, as specified in the SAP, included field duplicates, matrix spike/matrix spike duplicates (MS/MSD), collocated samples collected from the same parcel, equipment blanks, temperature blanks, trip blanks, and sample splits with MDEQ (Table 2-1). Duplicates and MS/MSD samples were collected for laboratory QC evaluation. Collocated samples were collected at randomly determined locations at the same parcel to evaluate the variability of sample results within a given parcel. MDEQ split samples were collected and provided to MDEQ for independent verification of sample results. Equipment blank samples were collected to evaluate decontamination procedures. Locations where QC samples were collected are summarized in Appendix B. Equipment and trip blank analytical results also are presented in Appendix B.

2.2.3 Sample Blinding

Sample results for dioxins and furans and additional chemicals were blinded (SAP Attachments A and B; CH2M HILL 2006) to maintain the anonymity of the property owners. All dioxin/furan and additional chemical samples were field managed using strict chain-of-

custody procedures during sample collection. Sample custody was field transferred to FTCH. FTCH randomly selected one sample from one of the parcels in each station, blinded the sample (changed the sample identifier), and submitted the sample to the laboratory (for standard and most QC samples) or MDEQ (for sample split samples). To ensure that the sample results were blind to all entities but the managing third party, samples were grouped in time periods that ranged from 2 days to 1 week. Due to the blinding protocol and operation procedures (Appendices A and B in the SAP), the geographic locations of sample results for the dioxin/furan and additional chemical constituents are not known to Dow or MDEQ. Soil parameter samples were not blinded, and sample splits for soil parameters were provided directly to MDEQ by CH2M HILL.

TABLE 2-1
Sample Summary
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Samples Submitted for Blinding			
		Analytical Suite	
Interval (inch bgs)	Type	Dioxin/Furan	Additional Chemicals
0-1"	Samples	352	62
	Duplicates[a]	352	10
	MS/MSD[a]	352	10
	Splits[b]	352	16
	Collocates[c]	56	11
1-6"	Samples	62	62
	Duplicates[a]	62	10
	MS/MSD[a]	62	10
	Splits[b]	62	16
	Collocates[c]	11	11

Non-Blinded Samples		
Interval (inch bgs)	Type	Soil Parameters
0-1"	Samples	337
	Duplicates	36
	MS/MSD	-
	Splits[d]	42
	Collocates[c]	-
1-6"		-

[a] Number of QC samples analyzed unknown due to blinding protocol

[b] Split samples submitted to MDEQ after blinding

[c] Collocate samples were collected at randomly determined locations at a random distance from the primary sampling

[d] Split samples submitted directly to MDEQ.

Additional chemicals = VOCs, SVOCs, metals, herbicides, pesticides, PCBs, and general chemistry parameters.

MS/MSD = matrix spike/matrix spike duplicate
bgs = below ground surface
- = not applicable

TABLE 2-2
Summary of Sample Intervals and Analytical Suites by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Station ID	Parcels Per Station	Parcels Sampled Per Station	Number of Samples				
			0-1 inch bgs[a]			1-6 inch bgs	
			Dioxins and Furans	Soil Parameters	Additional Chemicals	Dioxins and Furans	Additional Chemicals
A-01	1	1	1	-	1	1	1
A-02	2	2	2	2	2	2	2
A-03	8	3	3	3	-	-	-
A-04	10	4	4	4	-	-	-
A-05	8	4	4	4	-	-	-
A-06	9	3	3	3	-	-	-
A-07	11	5	5	5	-	-	-
A-08	11	5	5	5	-	-	-
A-09	8	4	4	4	-	-	-
A-10	7	3	3	3	-	-	-
A-11	1	1	1	1	-	-	-
A-12	1	1	1	1	-	-	-
A-13	13	5	5	5	-	-	-
B-01	4	1	1	1	1	1	1
B-03	10	5	5	5	-	-	-
B-04	10	5	5	5	-	-	-
B-05	8	5	5	5	-	-	-
B-06	2	2	2	2	-	-	-
B-07	10	3	3	3	-	-	-
B-08	8	3	3	3	-	-	-
B-09	10	5	5	5	-	-	-
B-10	1	1	1	1	-	-	-
B-11	1	1	1	1	-	-	-
C-01	3	3	3	3	3	3	3
C-02	4	3	3	-	3	3	3
C-03	13	5	5	5	-	-	-
C-04	11	5	5	5	-	-	-
C-05	10	5	5	5	-	-	-
C-06	10	4	4	4	-	-	-
C-07	11	4	4	4	-	-	-
C-08	1	1	1	1	-	-	-
C-10	13	5	5	5	-	-	-
C-11	10	3	3	3	-	-	-
C-13	11	3	3	3	-	-	-
D-01	1	1	1	-	1	1	1
D-02	9	5	5	5	5	5	5
D-03	14	4	4	4	-	-	-
D-04	10	5	5	5	-	-	-
D-05	10	5	5	5	-	-	-
E-01	2	1	1	1	1	1	1
E-02	1	1	1	1	1	1	1
E-03	7	4	4	4	-	-	-
E-04	9	5	5	5	-	-	-
E-05	1	1	1	1	-	-	-
E-06	1	1	1	1	-	-	-
E-07	12	5	5	5	-	-	-
E-08	13	5	5	5	-	-	-
E-09	11	5	5	5	-	-	-
E-10	1	1	1	1	-	-	-
E-11	12	5	5	5	-	-	-
F-01	1	1	1	1	1	1	1

TABLE 2-2
Summary of Sample Intervals and Analytical Suites by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Station ID	Parcels Per Station	Parcels Sampled Per Station	Number of Samples				
			0-1 inch bgs[a]			1-6 inch bgs	
			Dioxins and Furans	Soil Parameters	Additional Chemicals	Dioxins and Furans	Additional Chemicals
F-02	1	1	1	1	1	1	1
F-04	12	5	5	5	-	-	-
F-05	14	5	5	5	-	-	-
G-01	1	1	1	-	1	1	1
G-02	1	1	1	1	1	1	1
G-03	1	1	1	1	-	-	-
G-04	1	1	1	1	-	-	-
G-05	10	5	5	5	-	-	-
G-06	1	1	1	1	-	-	-
G-07	1	1	1	1	-	-	-
G-08	11	5	5	5	-	-	-
G-09	13	5	5	5	-	-	-
G-10	9	5	5	5	-	-	-
G-11	8	4	4	4	-	-	-
G-12	11	4	4	4	-	-	-
H-02	1	1	1	1	1	1	1
H-03	1	1	1	1	1	1	1
H-04	1	1	1	1	-	-	-
H-05	1	1	1	1	-	-	-
I-01	1	1	1	1	1	1	1
I-02	1	1	1	1	1	1	1
I-04	1	1	1	1	-	-	-
I-05	1	1	1	1	-	-	-
I-06	1	1	1	1	-	-	-
I-07	1	1	1	1	-	-	-
I-08	1	1	1	1	-	-	-
I-09	1	1	1	1	-	-	-
I-10	1	1	1	1	-	-	-
J-01	1	1	1	-	1	1	1
J-02	7	4	4	-	4	4	4
K-01	1	1	1	1	1	1	1
K-03	1	1	1	1	-	-	-
K-04	15	5	5	5	-	-	-
K-05	14	5	5	5	-	-	-
K-06	8	3	3	3	-	-	-
K-07	10	4	4	4	-	-	-
K-08	12	5	5	5	-	-	-
K-09	1	1	1	1	-	-	-
K-10	1	1	1	1	-	-	-
K-11	1	1	1	1	-	-	-
L-01	1	1	1	-	1	1	1
L-02	1	1	1	1	1	1	1
L-03	1	1	1	1	-	-	-
L-04	1	1	1	1	-	-	-
L-05	1	1	1	1	-	-	-
M-01	2	1	1	1	1	1	1
M-02	1	1	1	1	1	1	1
M-03	1	1	1	1	-	-	-
M-04	1	1	1	1	-	-	-
M-05	1	1	1	1	-	-	-
M-06	1	1	1	1	-	-	-

TABLE 2-2
Summary of Sample Intervals and Analytical Suites by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Station ID	Parcels Per Station	Parcels Sampled Per Station	Number of Samples				
			0-1 inch bgs[a]			1-6 inch bgs	
			Dioxins and Furans	Soil Parameters	Additional Chemicals	Dioxins and Furans	Additional Chemicals
M-07	1	1	1	1	-	-	-
M-08	1	1	1	1	-	-	-
M-09	1	1	1	1	-	-	-
M-10	1	1	1	1	-	-	-
M-11	1	1	1	1	-	-	-
N-01	1	1	1	-	1	1	1
O-01	1	1	1	-	1	1	1
R-02	9	5	5	5	5	5	5
R-03	1	1	1	1	-	-	-
R-04	11	4	4	4	-	-	-
S-01	1	1	1	1	1	1	1
S-02	9	3	3	3	3	3	3
S-03	3	3	3	3	-	-	-
S-04	7	4	4	4	-	-	-
T-01	6	5	5	5	5	5	5
T-02	1	1	1	1	1	1	1
T-03	10	4	4	4	-	-	-
T-04	9	3	3	3	-	-	-
U-01	1	1	1	1	1	1	1
U-02	1	1	1	1	1	1	1
U-03	1	1	1	1	-	-	-
U-04	1	1	1	1	-	-	-
V-02	1	1	1	-	1	1	1
V-04	10	5	5	5	-	-	-
V-05	9	5	5	5	-	-	-
V-06	10	3	3	3	-	-	-
V-08	1	1	1	1	-	-	-
V-09	1	1	1	1	-	-	-
V-10	9	5	5	5	-	-	-
W-01	1	1	1	1	1	1	1
W-03	13	5	5	5	5	5	5
W-04	9	5	5	5	-	-	-
W-05	1	1	1	1	-	-	-
W-06	11	5	5	5	-	-	-
Totals (by Parcel)	**-**	**352**	**352**	**337**	**62**	**62**	**62**
Totals (by Station)	**-**	**136**	**136**	**126**	**36**	**36**	**36**

[a] No soil parameter samples were collected in the 1-6 inch interval

Additional chemicals = VOCs, SVOCs, metals, herbicides, pesticides, PCBs, and general chemistry parameters.

bgs = below ground surface

- = not applicable

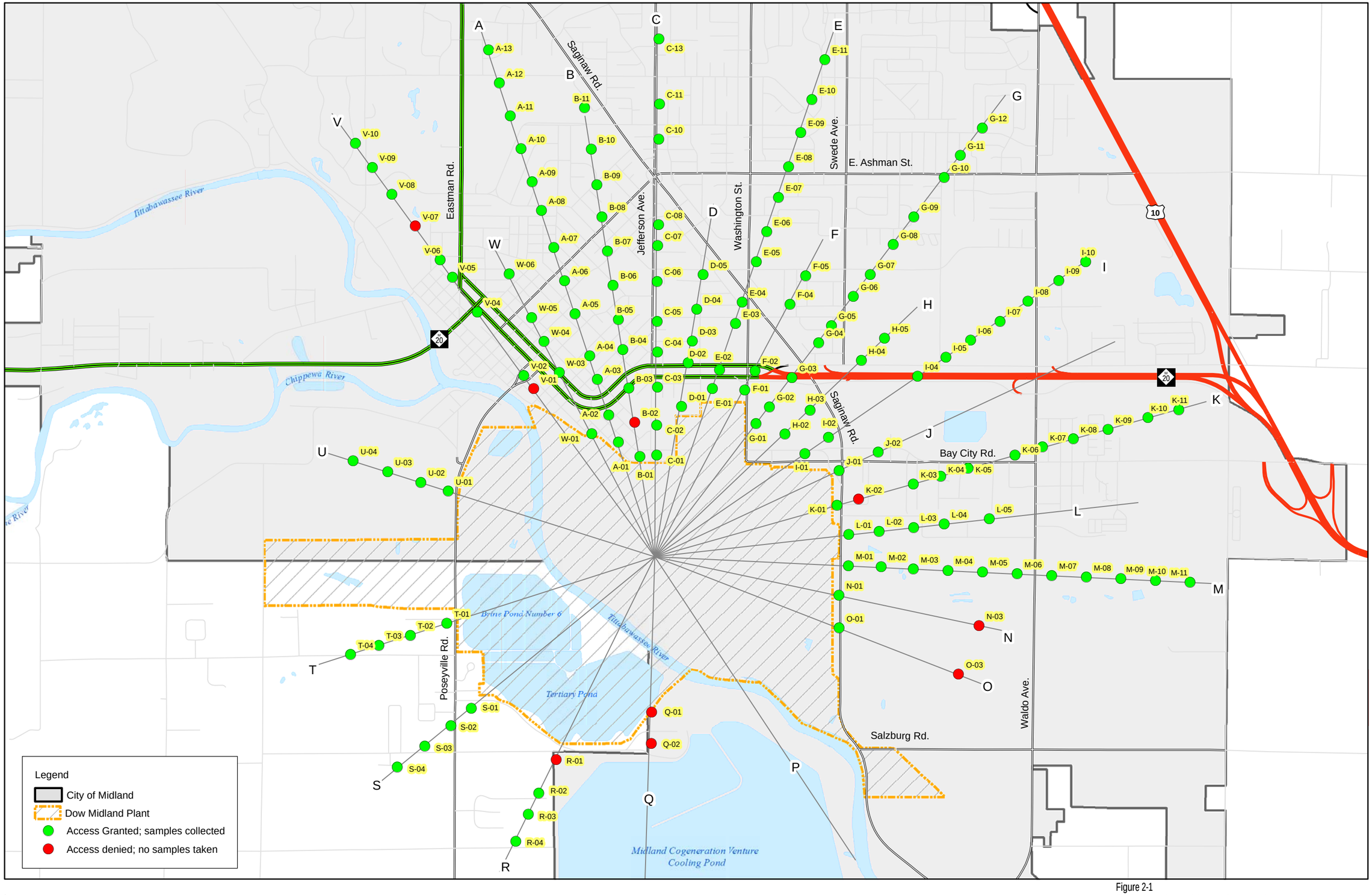


Figure 2-1
Station Location and Access Summary Map
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

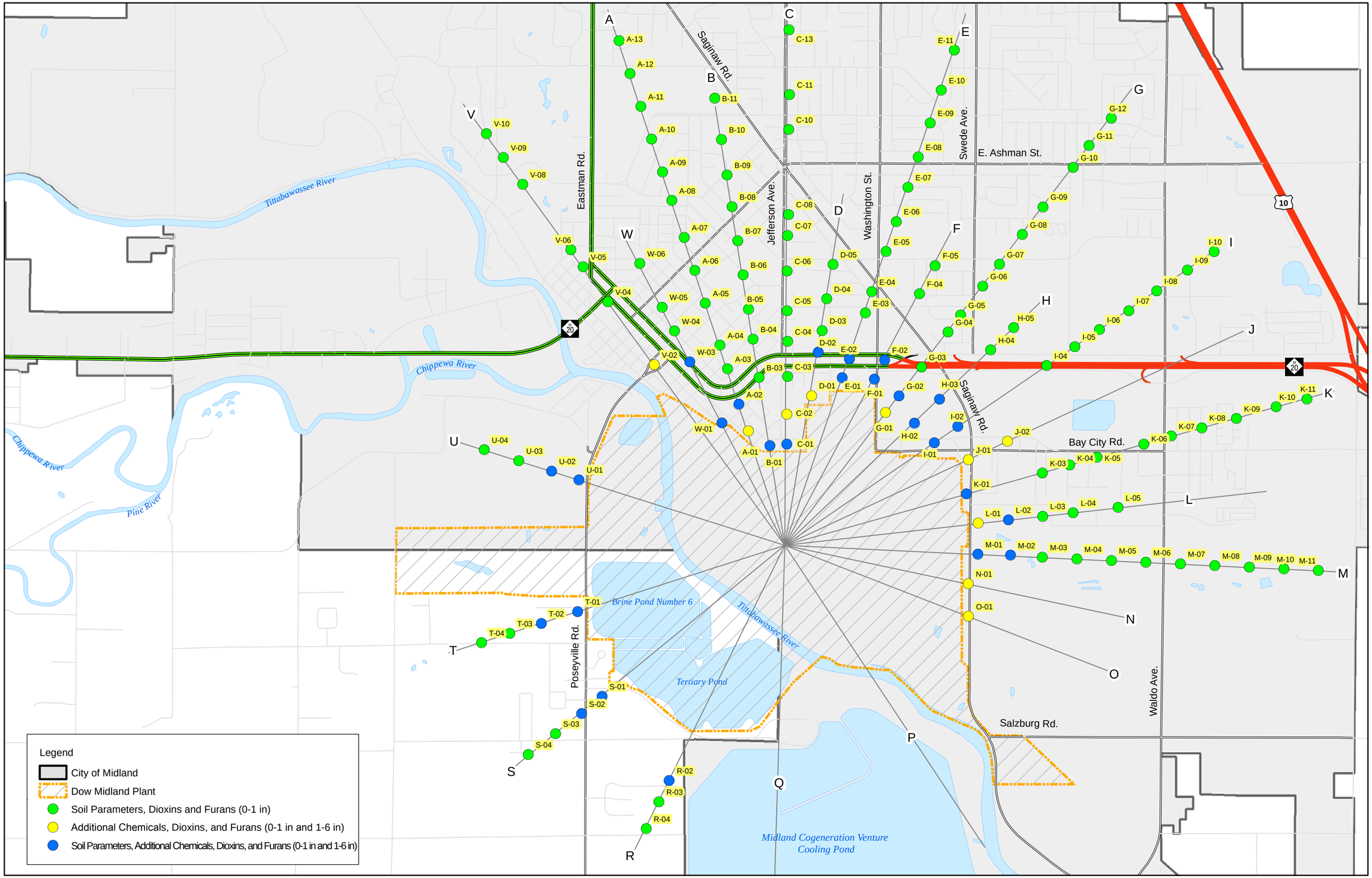


Figure 2-2
Station Analytical and Depth Summary
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SECTION 3

Data Evaluation

3.1 Dioxins and Furans

A total of 199 soil samples were analyzed for dioxins and furans from 136 primary and 22 collocated sampling locations throughout the Study Area, including samples from multiple depth intervals (0 to 1 inch bgs and 1 to 6 inches bgs). In addition, 19 field duplicate samples were analyzed. Toxic equivalent (TEQ) concentrations were calculated using the dioxin and furan congener concentrations and the 2005 mammalian toxic equivalency factor (TEF) developed by the World Health Organization (WHO) (van den Berg et al. 2006). For report purposes, only TEQ concentrations are discussed. As previously indicated, all dioxin and furan data presented in this report are blinded to maintain the anonymity of the property owners (Section 2-2).

3.1.1 Comparison to MDEQ Generic Criteria

TEQ concentrations were compared to MDEQ's Part 201 Residential Direct Contact Criteria and Risk-Based Screening Level (RBSL) for soil which represents the most conservative MDEQ RBSL for dioxin and furan TEQ (90 parts per trillion [ppt]). A total of 110 out of 199 (55 percent) surface and subsurface soil samples exceeded the RBSL (Table 3-1). None of the sample results exceeded the agreed upon interim action level of 1,000 ppt TEQ.

3.1.2 Concentrations and Summary Statistics

Statistical measures reported for each analyte include number of samples; number of detected results; frequency of detections (ratio of detected results to total number of samples); range of detected concentrations; range of method detection limits for nondetected results; and standard summary statistics of mean, median, standard deviation, coefficient of variation, and the upper 95 percent confidence interval on the mean value (calculated using nondetect values at the method detection limit). A summary of descriptive statistical information for the dioxin and furan congener data set is provided in Table C-1 in Appendix C.

The calculated TEQ concentrations for the data set range from a minimum of 2.4 ppt to a maximum of 950 ppt. The average and median TEQ concentration of the data set are 157 and 110 ppt, respectively. The upper 95 percent confidence interval of the data set is 177 ppt. A box plot of the statistical results is shown on Figure 3-1. Analytical results for each dioxin and furan congener and calculated TEQs are presented in Table C-2 of Appendix C.

3.1.3 Sample Interval Comparison

Eighty-two of the 199 total samples were collected for dioxin and furan analysis from 36 primary and 5 collocated sampling locations proximal to the Midland Plant from both a surface (0- to 1-inch) and subsurface (1- to 6-inch) intervals.

Surface and subsurface TEQ results were statistically compared to determine if the concentrations in the two intervals are significantly different. A pooled comparison of all surface versus all subsurface TEQ concentrations yielded no significant difference in the populations. In addition, no significant difference between the paired surface and subsurface TEQ concentrations was noted (Figure 3-2).

3.2 Other Additional Chemicals

A total of 82 soil samples from 36 primary and 5 collocated sampling locations proximal to the Midland Plant were analyzed for a suite of additional chemicals from both a surface (0- to 1-inch) and subsurface (1- to 6-inch) interval. Proximal locations were generally the first two sample stations along each transect beginning at the Midland Plant (Figure 2-1). Five additional field duplicate samples also were analyzed for additional chemicals.

3.2.1 Comparison to MDEQ Generic Criteria

Additional chemical concentrations, with the exception of three metals, were compared to the most conservative of four MDEQ Residential RBSLs for soil. These RBSLs include the following:

- Drinking Water Protection Criteria
- Groundwater-Surface Water Interface Protection Criteria
- Soil Volatilization to Indoor Air Inhalation Criteria
- Direct Contact Criteria

The selected RBSLs are included in MDEQ's *Table 2, Soil: Residential and Commercial I Part 201 Generic Cleanup Criteria and Screening Levels* (MDEQ 2006). They were selected on the basis of applicability to the overall objectives of the Midland area soils study and, in general, are the most conservative soil RBSLs published by MDEQ. Three metals (mercury, selenium, and silver) were compared to the Statewide Default Background Levels in accordance with the footnotes for generic cleanup tables published by MDEQ. A comprehensive list of published screening levels for the selected RBSLs is included in Table 3-1.

Seventeen additional chemicals exceeded the most conservative screening level, including one general chemistry parameter, eight metals, four SVOCs, and four VOCs (Table 3-2). Eight analytes were detected but have no published screening level (Table 3-3). Seventeen were not detected, but had laboratory method detection limits that were above the applicable screening criteria (Table 3-4). The reasons that some method detection limits did not achieve the screening levels include the following:

- For most VOCs, SVOCs, pesticides, and herbicides, the elevated detection limits were caused by the moisture content of the samples.
- For some VOCs and SVOCs, the elevated detection limits were due to dilution during analysis because of high concentrations of other detected analytes.
- In a few cases, the analytical method was not capable of meeting the screening level.

Results for the comparison of each analyte group to RBSLs are as follows:

General Chemistry Parameters

- Thirty-two of 82 soil samples exceeded the screening level for total cyanide, representing 39 percent of all results.

Herbicides

- No samples exceeded the screening levels.

Metals

- One sample exceeded the screening levels for mercury, antimony, and lead. In the case of antimony and lead, this exceedance occurred at the same sample location.
- Two samples exceeded the screening level for silver.
- Five samples from five different locations exceeded the screening level for selenium. Laboratory method detection limits for selenium are consistently greater than the applicable screening level (Statewide Default Background Level), resulting in 77 of 82 samples with method detection limits above this value (410 micrograms per kilogram [µg/kg]).
- Twenty-nine samples exceeded the screening level for arsenic (4,600 µg/kg). Nineteen of these samples also exceeded the Statewide Default Background Level of 5,800 µg/kg.
- Seventy-six samples exceeded the screening level for cobalt (800 µg/kg); however, only two of these samples exceeded the Statewide Default Background Level of 6,800 µg/kg. These two sample exceedances occurred at one sampling location (0- to 1-inch and 0-to 6-inch sampling depths).
- Seventy-seven samples exceeded the screening level for chromium (3,300 µg/kg). This screening level was established by MDEQ for chromium (VI) and represents the most conservative of the chromium screening criteria. It is important to note that the laboratory data represents total chromium concentrations, which include all of the valence states of chromium. The data also were compared to the total chromium Statewide Default Background Level of 18,000 µg/kg. Five samples exceeded this level at three sample locations (two sample locations had exceedances in both the 0- to 1-inch and 1- to 6-inch sampling intervals).
- No other metals exceeded their respective screening levels.

Polychlorinated Biphenyls

- No samples exceeded the screening level.

Pesticides

- No samples exceeded the screening levels.

Semivolatile Organic Compounds

- One sample exceeded the screening level for benzo(a)pyrene, fluoranthene, and phenanthrene. All three exceedances occurred at the same sample location.
- Five samples exceeded the screening level for pentachlorophenol at three sample locations (two sample locations had exceedances in both the 0- to 1-inch and 1- to 6-inch sampling intervals). Laboratory method detection limits for pentachlorophenol also are consistently greater than the applicable screening level, resulting in 77 of 82 samples with method detection limits above this value (22 µg/kg). The method detection limit was 40 to 100 times greater than the screening level for samples where pentachorophenol was not detected.
- No other SVOCs exceeded their respective screening levels.

Volatiles

- One sample exceeded the screening level for total xylenes.
- Two samples exceeded the screening level for methylene chloride. The method detection limit for one other sample exceeded the screening level.
- Four samples exceeded the screening level for acrylonitrile. The method detection limit for two other samples exceeded the screening level.
- Fourteen samples exceeded the screening level for toluene. It is thought that the presence of toluene in samples in most cases may be a field or laboratory artifact and not representative of actual soil conditions.

3.2.2 Concentration and Summary Statistics

A summary of descriptive statistical information for the additional chemical data set is provided in Table D-1 in Appendix D. Additional chemical analytical results are presented in Table D-2 of Appendix D.

3.2.3 Sample Interval Comparison

Of the 17 additional chemicals that exceeded screening levels, no significant differences between the surface and subsurface concentrations were noted with the exception of methylene chloride. Due to the low detection frequency (three samples), however, it is not conclusive that methylene chloride concentrations in the surface and subsurface are actually different.

Statistical box plots of the surface and subsurface data for 15 of 17 additional chemicals that exceeded screening criteria are presented in Figures 3-3A, 3-3B, 3-4, and 3-5. These figures do not include two additional chemicals (selenium and pentachlorophenol) where a majority of laboratory method detection limits exceeded the screening criteria.

3.2.4 Tentatively Identified Compounds

Non-target compounds having peak areas equal to or greater than 10 percent of the nearest internal standards (retention time) were reported by the laboratories as tentatively

identified compounds (TICs). These peaks were compared to referenced spectra in the current National Institute of Standards and Technology library, using a computer search routine. If the spectral match had a fit of 80 percent or better, the substance name representing the best fit was reported as the tentative identity of the compound. If the spectral fit was less than 80 percent, the peak was reported as "Unknown RRT x.xxx", where x.xxx is the relative retention time in minutes. In either case, an estimated concentration was calculated by comparing the peak area to that of the internal standard, using a response factor of 1.00.

A total of 663 records were identified as TICs; of these, 375 TICs had a spectral match of 80 percent or greater and were identified as known chemicals while the remaining 288 TICs had a spectral fit of less than 80 percent and were reported as unknown compounds. Of the 375 TICs identified, 119 were unique chemicals with three compounds being incorrectly reported as TICs (ethylbenzene, styrene, and benzo(k)fluoranthene). None of these three compounds exceeded the applicable screening levels. Of the remaining 288 TICs, 174 were unique compounds. All identified TICs and their estimated concentrations are summarized in the laboratory data report and Table E-1 of Appendix E.

3.3 Soil Parameters

3.3.1 Background

Sample results for physical and chemical soil parameters were evaluated to identify and characterize representative soils that may be used in potential dioxin and furan bioavailability studies. Samples were collected from 337 unique locations at 26 stations and analyzed for grain size distribution, total organic carbon (TOC), black carbon, and specific surface area.

Grain size data are reported as percent sand, silt, and clay fractions. In addition, the sand fraction retained on the 250 micrometer (μm) sieve size also is reported as a subgroup of the sand fraction. The sand fraction passing the 250 μm sieve (which is calculated by subtracting the fraction retained on the 250 μm sieve from the total) is of interest because it is a factor in evaluating bioavailability.

TOC is reported as a percent of the total mass of the sample, and includes the subfractions black carbon and organic carbon (which sum to the TOC). The hydrogen and nitrogen components of TOC and black carbon also were analyzed; however, these components were not evaluated further because available literature indicates that they do not meaningfully represent TOC and black carbon in bioavailability evaluations.

Specific surface area (referred to hereafter as surface area) is a measure of the total surface area of the soil particles for a given volume and, in general, higher surface areas are associated with finer grained (silt, clay) soils. As outlined in the SAP, finer grain size, higher TOC, and higher surface area generally indicate lower bioavailability. Conversely, coarse grain size (sand), lower TOC, and lower surface area generally indicate higher bioavailability.

The soil parameter data collected in the Study Area were analyzed using spatial analysis and statistical techniques. The spatial distribution information was used to identify

large-scale trends and potential sample groups based on the physical and chemical parameters outlined above. Statistical analyses were used to characterize concentration ranges and relationships between soil parameters, and to identify and characterize potential groups of representative soils based on these parameters.

A statistical summary of soil parameter data is presented in Table 3-5. Complete soil parameter results are provided in Appendix F, Table F-1 and are discussed below.

3.3.2 Grain Size Distribution Evaluation

A statistical summary of the grain size distribution data is provided in Table 3-5. Plan view maps showing the spatial distribution of each grain size fraction are provided in Figures 3-6 through 3-9. Each map also includes a probability distribution and box plot for each grain size fraction, along with summary statistics. A trigram plot that displays the 337 samples based on the relative percentages of the three grain size classes (sand, clay, and silt) is presented in Figure 3-10. The statistical and spatial analyses of grain size data indicate the following:

- The sand fraction dominates the grain size distribution within the Study Area. Sand represents between 28 and 92 percent of the sample by weight, and averages 77 percent (Table 3-5). The portion of sand retained on a 250 μm sieve has a similar distribution and correlation characteristics as the entire sand fraction.
- Variability in grain size is comparatively low across the Study Area. Variability is evaluated by examining the coefficient of variation (CV), which is the ratio of standard deviation and mean value. CV values of less than 1.00 indicate comparatively reduced variability. CVs for the soil characteristics range from 0.14 (sand) to 0.77 (clay).
- The spatial distribution maps indicate that well-defined regions of a specific grain size percentile class do not occur in the Study Area, although localized areas of similar grain size are apparent.
- The trigram plot of grain size distribution indicates that the predominant soil type in the Study Area is loamy sand using the U.S. Department of Agriculture (USDA) soil classification system (USDA 1995). This plot also demonstrates that the grain size distribution is broadly similar throughout the Study Area. Low sand content samples (less than 50 percent sand) are limited to eight of the 337 sample locations.

3.3.3 Total Organic Carbon Evaluation

A statistical summary of the TOC data, including the black carbon and organic carbon fractions, is provided in Table 3-5. Plan view maps showing the spatial distribution, probability distribution, and statistical summary for TOC and black carbon distribution are provided in Figures 3-11 and 3-12, respectively. Relationships among TOC and other soil parameters were evaluated through correlation analyses, conditioning plots, and trigrams. Correlations between TOC, black carbon, sand, silt, clay, and surface area are presented in Figures 3-13A and 3-13B. The conditioning plots presented in Figures 3-14A to 3-14D show the relationship between TOC or black carbon relative to different levels of sand, clay, and surface area. Conditioning relationships are used to evaluate whether TOC or black carbon content vary as a function of the physical characteristics of the soil (sand, clay, surface area).

The spatial distribution of the ratio of black carbon to TOC is presented in Figure 3-15, and a triplot diagram of sand, clay, and the ratio of black carbon to TOC is provided in Figure 3-16. The statistical and spatial analyses of TOC data indicate the following:

- TOC, black carbon, and organic carbon (Table 3-5) exhibit relatively low variability, as indicated by CVs of less than 1.
- The spatial distribution maps indicate that well-defined regions of a specific TOC or black carbon percentile class do not occur in the Study Area, although localized areas of similar TOC and black carbon content are apparent (Figures 3-11 and 3-12).
- TOC, black carbon, and silt levels are positively correlated (Figure 3-13A). This indicates that, in general, higher levels of TOC correspond to higher levels of black carbon and silt.
- The relationship between black carbon and TOC is consistent, regardless of changes in the physical characteristics of the soil (Figures 3-14A through 3-14D). This is represented on the conditioning plots as parallel lines on the panels. Different slopes within the panels would suggest that changes in the physical characteristics affect the relationship between black carbon and TOC.
- The distribution plot and triplot diagram (Figures 3-15 and 3-16) corroborates the results from the conditioning plots and shows that these factors are tightly associated. This indicates that the distribution of TOC and black carbon is similar regardless of grain size.

3.3.4 Surface Area Evaluation

A statistical summary of the surface area data is provided in Table 3-5. A plan view map showing the spatial distribution, probability distribution, and statistical summary for surface area is provided in Figure 3-17. The statistical and spatial analyses of surface area data indicate the following:

- There is comparatively low variability in surface area across the Study Area. The CV for the surface area is 0.92.
- The spatial distribution map indicates that well-defined regions of a specific surface area percentile class do not occur in the Study Area, although localized areas of similar surface area are apparent.

3.3.5 Multivariate Analysis

As discussed above, the spatial and statistical distributions of the individual soil parameters measured in this study indicate that the overall variability of each parameter is comparatively low. Although localized areas of similar characteristics are apparent, different percentile classes of each parameter are scattered throughout the area.

Multivariate analysis of the soil parameter data was performed to evaluate whether spatially distinct sub-areas or groups of samples could be identified based on relationships between parameters. A detailed discussion of the multivariate analysis with supporting figures and tables is provided in Appendix F and summarized below. This analysis groups

the most similar observations into a defined number of clusters, which represent statistically similar groupings of soil parameter data. The identified clusters were then mapped to evaluate the spatial distribution of the samples within each cluster. The results of these analyses show the following:

- Average concentrations of black carbon and TOC have tight distributions and are similar across the identified clusters (Table 3-6).
- Average grain size exhibits slightly greater differences across different clusters (Table 3-6).
- The spatial distributions of the samples in the various clusters identified in the analysis are similar to the distributions for the individual parameters. No clusters are localized exclusively in one portion of the Study Area (that is, they are not geographically contiguous), and local variability in soil types is evident.

These results indicate that different soils within the Study Area are not strongly localized in discrete areas. Therefore, the Study Area is not readily stratified into subsections where different levels of bioavailability would be expected. There are, however, groups of soil samples that exhibit unique statistical distributions. These "groups" are not necessarily geographically contiguous. The basis for the grouping is dominated by the relative abundance of grain size classes, and is less influenced by either black carbon or TOC content.

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Dioxin	2005 WHO Mammalian CALCULATED TEQ	ng/kg	E1613B	**--**	**--**	**--**	**--**	90	90
GEN	CYANIDE, TOTAL	µg/kg	SW9012A	390	4,000	**100**	--	12,000	100
GEN	SULFIDE	mg/Kg	SW9034	**--**	**--**	**--**	**--**	**--**	--
GEN	TOTAL ORGANIC CARBON	mg/kg	SW9060	**--**	**--**	**--**	**--**	**--**	--
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/kg	SW8151A	**--**	**--**	**--**	**--**	**--**	--
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/kg	SW8151A	--	**1,400**	4,400	--	2,500,000	1,400
HERB	DINOSEB	µg/kg	SW8270C	--	300	**200**	--	66,000	200
HERB	SILVEX (2,4,5-TP)	µg/kg	SW8151A	--	3,600	**2,200**	--	1,700,000	2,200
MET	ANTIMONY	µg/kg	SW6010B	--	**4,300**	94,000	--	180,000	4,300
MET	ARSENIC	µg/kg	SW6010B	5,800	**4,600**	70,000	--	7,600	4,600
MET	BARIUM	µg/kg	SW6010B	75,000	**1,300,000**	--	--	37,000,000	1,300,000
MET	BERYLLIUM	µg/kg	SW6010B	--	**51,000**	--	--	410,000	51,000
MET	CADMIUM	µg/kg	SW6010B	1,200	**6,000**	--	--	550,000	6,000
MET	CHROMIUM, TOTAL	µg/kg	SW6010B	--	30,000	**3,300**	--	2,500,000	3,300
MET	COBALT	µg/kg	SW6010B	6,800	**800**	2,000	--	2,600,000	800
MET	COPPER	µg/kg	SW6010B	32,000	**5,800,000**	--	--	20,000,000	5,800,000
MET	LEAD	µg/kg	SW6010B	21,000	700,000	--	--	**400,000**	400,000
MET	MERCURY	µg/kg	SW7471A	**130**	1,700	50	48,000	160,000	130
MET	NICKEL	µg/kg	SW6010B	20,000	**100,000**	--	--	40,000,000	100,000
MET	SELENIUM	µg/kg	SW6010B	**410**	4,000	400	--	2,600,000	410
MET	SILVER	µg/kg	SW6010B	**1,000**	4,500	100	--	2,500,000	1,000
MET	THALLIUM	µg/kg	SW6010B	--	**2,300**	4,200	--	35,000	2,300
MET	TIN	µg/kg	SW6010B	**--**	**--**	**--**	**--**	**--**	--
MET	VANADIUM	µg/kg	SW6010B	--	**72,000**	190,000	--	750,000	72,000
MET	ZINC	µg/kg	SW6010B	47,000	**2,400,000**	--	--	170,000,000	2,400,000
PCB	PCB-1016 (AROCLOR 1016)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1221 (AROCLOR 1221)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1232 (AROCLOR 1232)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1242 (AROCLOR 1242)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1248 (AROCLOR 1248)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1254 (AROCLOR 1254)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1260 (AROCLOR 1260)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1262 (AROCLOR 1262)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	PCB-1268 (AROCLOR 1268)	µg/kg	SW8082	**--**	**--**	**--**	**--**	**--**	--
PCB	SUMMED PCB	µg/kg	SW8082	--	--	--	--	--	3,000,000
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/kg	SW8260B	--	**10**	--	1,200	1,200	10
PEST	4,4'-DDD	µg/kg	SW8081A	--	--	--	--	**95,000**	95,000
PEST	4,4'-DDE	µg/kg	SW8081A	--	--	--	--	**45,000**	45,000
PEST	4,4'-DDT	µg/kg	SW8081A	--	--	--	--	**57,000**	57,000
PEST	ALDRIN	µg/kg	SW8081A	--	--	--	1,300,000	**1,000**	1,000

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PEST	ALPHA BHC	µg/kg	SW8081A	--	**18**	--	30,000	2,600	18
PEST	BETA BHC	µg/kg	SW8081A	--	**37**	--	--	5,400	37
PEST	CHLORDANE	µg/kg	SW8081A	--	--	--	11,000,000	**31,000**	31,000
PEST	DELTA BHC	µg/kg	SW8081A	**--**	**--**	**--**	**--**	**--**	--
PEST	DIELDRIN	µg/kg	SW8081A	--	--	--	140,000	**1,100**	1,100
PEST	DIMETHOATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	DISULFOTON	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	ENDOSULFAN I	µg/kg	SW8081A	**--**	**--**	**--**	**--**	**--**	--
PEST	ENDOSULFAN II	µg/kg	SW8081A	**--**	**--**	**--**	**--**	**--**	--
PEST	ENDOSULFAN SULFATE	µg/kg	SW8081A	**--**	**--**	**--**	**--**	**--**	--
PEST	ENDRIN	µg/kg	SW8081A	--	--	--	--	**65,000**	65,000
PEST	ENDRIN ALDEHYDE	µg/kg	SW8081A	**--**	**--**	**--**	**--**	**--**	--
PEST	FAMPHUR	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	GAMMA BHC (LINDANE)	µg/kg	SW8081A	--	**20**	**20**	--	8,300	20
PEST	HEPTACHLOR	µg/kg	SW8081A	--	--	--	350,000	**5,600**	5,600
PEST	HEPTACHLOR EPOXIDE	µg/kg	SW8081A	--	--	--	--	**3,100**	3,100
PEST	KEPONE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	METHOXYCHLOR	µg/kg	SW8081A	--	**16,000**	--	--	1,900,000	16,000
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	(THIONAZIN)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	PARATHION, ETHYL (PARATHION)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	PARATHION, METHYL	µg/kg	SW8270C	--	**46**	--	--	56,000	46
PEST	PHORATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
PEST	TOXAPHENE	µg/kg	SW8081A	--	24,000	**860**	--	20,000	860
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/kg	SW8270C	--	1,500,000	**3,400**	--	77,000,000	3,400
SVOC	1,3-DINITROBENZENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	1,4-DIOXANE	µg/kg	SW8270C	--	**1,700**	56,000	--	530,000	1,700
SVOC	1,4-NAPHTHOQUINONE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	1-NAPHTHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2,4,5-TRICHLOROPHENOL	µg/kg	SW8270C	--	**39,000**	--	--	23,000,000	39,000
SVOC	2,4,6-TRICHLOROPHENOL	µg/kg	SW8270C	--	**2,400**	--	--	710,000	2,400
SVOC	2,4-DICHLOROPHENOL	µg/kg	SW8270C	--	1,500	**380**	--	660,000	380
SVOC	2,4-DIMETHYLPHENOL	µg/kg	SW8270C	--	**7,400**	7,600	--	11,000,000	7,400
SVOC	2,4-DINITROPHENOL	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2,4-DINITROTOLUENE	µg/kg	SW8270C	--	**430**	--	--	48,000	430
SVOC	2,6-DICHLOROPHENOL	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2,6-DINITROTOLUENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--

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SVOC	2-Acetylaminofluorene	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2-CHLORONAPHTHALENE	µg/kg	SW8270C	--	**620,000**	--	--	56,000,000	620,000
SVOC	2-CHLOROPHENOL	µg/kg	SW8270C	--	900	**440**	--	1,400,000	440
SVOC	2-METHYLNAPHTHALENE	µg/kg	SW8270C	--	**57,000**	--	--	8,100,000	57,000
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2-NAPHTHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2-NITROANILINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	2-NITROPHENOL	µg/kg	SW8270C	--	**400**	--	--	630,000	400
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	3,3'-DICHLOROBENZIDINE	µg/kg	SW8270C	--	**2,000**	**2,000**	--	6,600	2,000
SVOC	3,3'-DIMETHYLBENZIDINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	3-METHYLCHOLANTHRENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	3-NITROANILINE	µg/Kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/kg	SW8270C	--	**830**	--	--	79,000	830
SVOC	4-AMINOBIPHENYL	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-CHLORO-3-METHYLPHENOL	µg/kg	SW8270C	--	5,800	**280**	--	4,500,000	280
SVOC	4-CHLOROANILINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-NITROANILINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-NITROPHENOL	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	5-NITRO-O-TOLUIDINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	ACENAPHTHENE	µg/kg	SW8270C	--	300,000	**4,400**	190,000,000	41,000,000	4,400
SVOC	ACENAPHTHYLENE	µg/kg	SW8270C	--	**5,900**	--	1,600,000	1,600,000	5,900
SVOC	ACETOPHENONE	µg/kg	SW8270C	--	**30,000**	--	1,100,000	1,100,000	30,000
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	ANILINE	µg/kg	SW8270C	--	1,100	**330**	--	330,000	330
SVOC	ANTHRACENE	µg/kg	SW8270C	--	**41,000**	--	1,000,000,000	230,000,000	41,000
SVOC	ARAMITE (TOTAL)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	BENZO(A)ANTHRACENE	µg/kg	SW8270C	--	--	--	--	**20,000**	20,000
SVOC	BENZO(A)PYRENE	µg/kg	SW8270C	--	--	--	--	**2,000**	2,000
SVOC	BENZO(B)FLUORANTHENE	µg/kg	SW8270C	--	--	--	--	**20,000**	20,000
SVOC	BENZO(G,H,I)PERYLENE	µg/kg	SW8270C	--	--	--	--	**2,500,000**	2,500,000
SVOC	BENZO(K)FLUORANTHENE	µg/kg	SW8270C	--	--	--	--	**200,000**	200,000
SVOC	BENZYL ALCOHOL	µg/kg	SW8270C	--	**200,000**	--	--	5,800,000	200,000
SVOC	BENZYL BUTYL PHTHALATE	µg/kg	SW8270C	--	310,000	**26,000**	--	310,000	26,000
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/kg	SW8270C	--	**100**	300	8,300	13,000	100

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SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/kg	SW8270C	--	--	--	--	**2,800,000**	2,800,000
SVOC	CHLOROBENZILATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	CHRYSENE	µg/kg	SW8270C	--	--	--	--	**2,000,000**	2,000,000
SVOC	DI-N-BUTYL PHTHALATE	µg/kg	SW8270C	--	760,000	**11,000**	--	760,000	11,000
SVOC	DI-N-OCTYLPHTHALATE	µg/kg	SW8270C	--	100,000,000	--	--	**6,900,000**	6,900,000
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	DIBENZ(A,H)ANTHRACENE	µg/kg	SW8270C	--	--	--	--	**2,000**	2,000
SVOC	DIBENZOFURAN	µg/kg	SW8270C	--	--	**1,700**	--	--	1,700
SVOC	DIETHYL PHTHALATE	µg/kg	SW8270C	--	110,000	**2,200**	--	740,000	2,200
SVOC	DIMETHYL PHTHALATE	µg/kg	SW8270C	--	**790,000**	--	--	**790,000**	790,000
SVOC	DIPHENYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	ETHYL METHANESULFONATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	FLUORANTHENE	µg/kg	SW8270C	--	730,000	**5,500**	1,000,000,000	46,000,000	5,500
SVOC	FLUORENE	µg/kg	SW8270C	--	390,000	**5,300**	580,000,000	27,000,000	5,300
SVOC	HEXACHLOROBENZENE	µg/kg	SW8270C	--	1,800	**350**	41,000	8,900	350
SVOC	HEXACHLOROBUTADIENE	µg/kg	SW8270C	--	26,000	**91**	130,000	100,000	91
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/kg	SW8270C	--	320,000	--	**30,000**	720,000	30,000
SVOC	HEXACHLOROETHANE	µg/kg	SW8270C	--	**430**	1,800	40,000	230,000	430
SVOC	HEXACHLOROPHENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	HEXACHLOROPROPENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/kg	SW8270C	--	--	--	--	**20,000**	20,000
SVOC	ISODRIN	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	ISOPHORONE	µg/kg	SW8270C	--	15,000	**11,000**	--	2,400,000	11,000
SVOC	ISOSAFROLE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	METHAPYRILENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	METHYL METHANESULFONATE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/kg	SW8270C	--	**330**	--	--	1,200	330
SVOC	N-NITROSODIETHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSODIMETHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSODIPHENYLAMINE	µg/kg	SW8270C	--	**5,400**	--	--	1,700,000	5,400
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSOMORPHOLINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSOPIPERIDINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	N-NITROSOPYRROLIDINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	NAPHTHALENE	µg/kg	SW8270C	--	35,000	**870**	250,000	16,000,000	870
SVOC	NITROBENZENE	µg/kg	SW8270C	--	**330**	3,600	91,000	100,000	330
SVOC	O-TOLUIDINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	P-PHENYLENEDIAMINE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--

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Group	Analyte	Units	Analytical I	Statewide Default Background Levels (Guidesheet 10)	Drinking Water Protection Criteria & RBSLs (Guidesheet 11)	Groundwater Surface Water Interface Protection Criteria & RBSLs (Guidesheet 12)	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs (Guidesheet 14)	Direct Contact Criteria and RBSLs (Guidesheet 19)	Screening Level*
SVOC	PENTACHLOROBENZENE	µg/kg	SW8270C	--	29,000	**9,500**	--	190,000	9,500
SVOC	PENTACHLORONITROBENZENE	µg/kg	SW8270C	--	**37,000**	--	120,000	1,700,000	37,000
SVOC	PENTACHLOROPHENOL	µg/kg	SW8270C	--	**22**	--	--	90,000	22
SVOC	PHENACETIN	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	PHENANTHRENE	µg/kg	SW8270C	--	56,000	**5,300**	2,800,000	1,600,000	5,300
SVOC	PHENOL	µg/kg	SW8270C	--	88,000	**4,200**	--	12,000,000	4,200
SVOC	PRONAMIDE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	PYRENE	µg/kg	SW8270C	--	**480,000**	--	1,000,000,000	29,000,000	480,000
SVOC	PYRIDINE	µg/kg	SW8270C	--	**400**	--	1,100	37,000	400
SVOC	SAFROLE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
SVOC	SYM-TRINITROBENZENE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
VOC	1,1,1,2-TETRACHLOROETHANE	µg/kg	SW8260B	--	**1,500**	--	6,200	440,000	1,500
VOC	1,1,1-TRICHLOROETHANE	µg/kg	SW8260B	--	**4,000**	**4,000**	250,000	460,000	4,000
VOC	1,1,2,2-TETRACHLOROETHANE	µg/kg	SW8260B	--	**170**	1,600	4,300	53,000	170
VOC	1,1,2-TRICHLOROETHANE	µg/kg	SW8260B	--	**100**	6,600	4,600	180,000	100
VOC	1,1-DICHLOROETHANE	µg/kg	SW8260B	--	18,000	**15,000**	230,000	890,000	15,000
VOC	1,1-DICHLOROETHENE	µg/kg	SW8260B	--	140	1,300	**62**	200,000	62
VOC	1,2,3-TRICHLOROPROPANE	µg/kg	SW8260B	--	**840**	--	--	830,000	840
VOC	1,2-DIBROMOETHANE (EDB)	µg/kg	SW8260B	--	**20**	**20**	670	92	20
VOC	1,2-DICHLOROBENZENE	µg/kg	SW8270C	--	14,000	**360**	210,000	210,000	360
VOC	1,2-DICHLOROETHANE	µg/kg	SW8260B	--	**100**	7,200	2,100	91,000	100
VOC	1,2-DICHLOROPROPANE	µg/kg	SW8260B	--	**100**	5,800	4,000	140,000	100
VOC	1,3-DICHLOROBENZENE	µg/kg	SW8270C	--	**170**	1,100	--	170,000	170
VOC	1,4-DICHLOROBENZENE	µg/kg	SW8270C	--	1,700	**290**	19,000	400,000	290
VOC	2-HEXANONE	µg/kg	SW8260B	--	**20,000**	--	990,000	2,500,000	20,000
VOC	ACETONE	µg/kg	SW8260B	--	**15,000**	34,000	110,000,000	23,000,000	15,000
VOC	ACETONITRILE	µg/kg	SW8260B	--	**2,800**	--	4,800,000	4,300,000	2,800
VOC	ACROLEIN	µg/kg	SW8260B	--	2,400	--	**410**	3,600,000	410
VOC	ACRYLONITRILE	µg/kg	SW8260B	--	**100**	**100**	6,600	16,000	100
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	BENZENE	µg/kg	SW8260B	--	**100**	4,000	1,600	180,000	100
VOC	BROMODICHLOROMETHANE	µg/kg	SW8260B	--	1,600	--	**1,200**	110,000	1,200
VOC	BROMOFORM	µg/kg	SW8260B	--	**1,600**	--	150,000	820,000	1,600
VOC	BROMOMETHANE	µg/kg	SW8260B	--	**200**	700	860	320,000	200
VOC	CARBON DISULFIDE	µg/kg	SW8260B	--	**16,000**	--	76,000	280,000	16,000
VOC	CARBON TETRACHLORIDE	µg/kg	SW8260B	--	**100**	900	190	96,000	100
VOC	CHLOROBENZENE	µg/kg	SW8260B	--	2,000	**940**	120,000	260,000	940
VOC	CHLOROETHANE	µg/kg	SW8260B	--	**8,600**	--	950,000	950,000	8,600
VOC	CHLOROFORM	µg/kg	SW8260B	--	**1,600**	3,400	7,200	1,200,000	1,600
VOC	CHLOROMETHANE	µg/kg	SW8260B	--	5,200	--	**2,300**	1,100,000	2,300

TABLE 3-1
Summary of Analytes and MDEQ Screening Levels
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Group	Analyte	Units	Analytical I	Statewide Default Background Levels (Guidesheet 10)	Drinking Water Protection Criteria & RBSLs (Guidesheet 11)	Groundwater Surface Water Interface Protection Criteria & RBSLs (Guidesheet 12)	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs (Guidesheet 14)	Direct Contact Criteria and RBSLs (Guidesheet 19)	Screening Level*
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	CIS-1,3-DICHLOROPROPENE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	DIBROMOCHLOROMETHANE	µg/kg	SW8260B	--	**1,600**	--	3,900	110,000	1,600
VOC	DIBROMOMETHANE	µg/kg	SW8260B	--	**1,600**	--	--	2,000,000	1,600
VOC	DICHLORODIFLUOROMETHANE	µg/kg	SW8260B	--	**95,000**	--	900,000	1,000,000	95,000
VOC	ETHYL BENZENE	µg/kg	SW8260B	--	1,500	**360**	87,000	140,000	360
VOC	ETHYL METHACRYLATE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	ISOBUTANOL	µg/kg	SW8260B	--	**46,000**	--	8,900,000	8,900,000	46,000
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/kg	SW8260B	--	260,000	**44,000**	27,000,000	27,000,000	44,000
VOC	METHYL IODIDE (IODOMETHANE)	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	PENTANONE)	µg/kg	SW8260B	--	**36,000**	--	2,700,000	2,700,000	36,000
VOC	METHYL METHACRYLATE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	METHYLACRYLONITRILE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	METHYLENE CHLORIDE	µg/kg	SW8260B	--	**100**	19,000	45,000	1,300,000	100
VOC	PENTOCHLORETHANE	µg/kg	SW8270C	**--**	**--**	**--**	**--**	**--**	--
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	STYRENE	µg/kg	SW8260B	--	2,700	**2,200**	250,000	400,000	2,200
VOC	TETRACHLOROETHENE (PCE)	µg/kg	SW8260B	--	**100**	900	11,000	88,000	100
VOC	TOLUENE	µg/kg	SW8260B	--	16,000	**2,800**	250,000	250,000	2,800
VOC	TRANS-1,2-DICHLOROETHENE	µg/kg	SW8260B	--	**2,000**	30,000	23,000	1,400,000	2,000
VOC	TRANS-1,3-DICHLOROPROPENE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/kg	SW8260B	**--**	**--**	**--**	**--**	**--**	--
VOC	TRICHLOROETHENE (TCE)	µg/kg	SW8260B	--	**100**	4,000	7,100	500,000	100
VOC	TRICHLOROFLUOROMETHANE	µg/kg	SW8260B	--	**52,000**	--	560,000	560,000	52,000
VOC	VINYL ACETATE	µg/kg	SW8260B	--	**13,000**	--	790,000	2,400,000	13,000
VOC	VINYL CHLORIDE	µg/kg	SW8260B	--	**40**	300	270	3,800	40
VOC	XYLENES, TOTAL	µg/kg	SW8260B	--	5,600	**700**	150,000	150,000	700

*In all cases except for mercury, selenium and silver, the sceening level corresponds to the lowest of the four risk based screening levels (RBSL) (Guidesheets 11, 12, 14, and 19). In accordance with the MDEQ generic cleanup criteria footnotes, the Statewide Default Background Level is the screening level for these metals.
µg/kg = micrograms per kilogram
g = grams
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
MDEQ = Michigan Department of Environmental Quality
TEQ = toxic equivalent factor
WHO = World Health Organization

TABLE 3-2
Summary of Results Exceeding Risk-Based Screening Levels
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
DIOXINS and FURANS																
2005 WHO Mammalian TEQ	ng/kg	172	172	1.00	--	--	2.4	950	157	110	156	0.99	177	90	97	--
GENERAL CHEMISTRY																
CYANIDE, TOTAL	µg/kg	68	82	0.83	0.0066	0.0358	12.2	1,350	153	79.3	220	1.43	194	100	32	--
METALS																
CHROMIUM, TOTAL	µg/kg	82	82	1.00	--	--	783	46,700	8,148	6,350	6,785	0.83	9,395	3,300	77	--
COBALT	µg/kg	82	82	1.00	--	--	402	7,420	2,444	2,230	1,302	0.53	2,683	800	76	--
ARSENIC	µg/kg	77	82	0.94	194	785	195	13,100	4,229	3,490	3,164	0.75	4,810	4,600	29	--
SELENIUM	µg/kg	5	82	0.06	456	1,180	918	6,850	495	510	1,069	2.16	691	410	5	77
SILVER	µg/kg	6	82	0.07	50.8	132	77.7	1,680	76.6	57.0	231	3.01	119	1,000	2	--
LEAD	µg/kg	82	82	1.00	--	--	3,360	666,000	39,163	19,350	79,248	2.02	53,727	400,000	1	--
MERCURY	µg/kg	71	82	0.87	3.89	4.27	8.64	168	42.6	36.4	30.4	0.71	48.2	130	1	--
ANTIMONY	µg/kg	16	82	0.20	208	1,610	248	4530	663	527	912	1.38	831	4,300	1	--
SEMIVOLATILE ORGANICS																
PENTACHLOROPHENOL	µg/kg	5	82	0.06	31	81.6	36.5	404	28.7	35.2	57.5	2.00	39.3	22	5	77
PHENANTHRENE	µg/kg	75	82	0.91	5.7	6.75	7.77	9,650	224	39.2	1,094	4.88	425	5,300	1	--
FLUORANTHENE	µg/kg	66	82	0.80	9.72	11.5	11.7	16,100	390	64	1,843	4.72	729	5,500	1	--
BENZO(A)PYRENE	µg/kg	51	82	0.62	8.68	10.6	9.21	5,930	163	26.2	681	4.18	288	2,000	1	--
VOLATILE ORGANICS																
TOLUENE	µg/kg	48	82	0.59	25.2	45.4	36	7,010	1,179	133	1,828	1.55	1,515	2,800	14	--
ACRYLONITRILE	µg/kg	4	82	0.05	31.1	220	189	563	37.6	39.9	75.4	2.01	51.4	100	4	2
METHYLENE CHLORIDE	µg/kg	3	82	0.04	20.9	148	87.4	456	23.0	26.7	52.0	2.27	32.5	100	2	1
XYLENES, TOTAL	µg/kg	16	82	0.20	25.6	177	32	1,470	65.9	33.2	175	2.66	98.1	700	1	--

[a] One-half the MDL was used to calcluate the mean and median where concentrations were nondetected.
[b] SL = the selected MDEQ Screening Level
-- = not applicable
µg/kg = micrograms per kilogram
ng/kg = nanograms per kilogram
MDEQ = Michigan Department of Environmental Quality
TEQ = toxic equivalent factor
WHO = World Health Organization

TABLE 3-3
Summary of Detected Analytes Without Screening Levels
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]
GENERAL CHEMISTRY														
SULFIDE	mg/kg	4	82	0.05	86	226	103	265	53.8	96	27.6	0.51	58.9	--
HERBICIDES														
2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/kg	1	82	0.01	2.13	5.58	24	24	1.50	2.39	2.52	1.68	1.97	--
METALS														
TIN	µg/kg	13	82	0.16	484	2610	532	158000	2763	559	17668	6.39	6010	--
PESTICIDES														
ENDOSULFAN SULFATE	µg/kg	6	82	0.07	0.777	78.2	3.13	46.6	3.43	0.887	8.88	2.59	5.07	--
DELTA BHC	µg/kg	4	82	0.05	0.787	80.3	0.995	4.13	1.74	0.911	5.03	2.89	2.67	--
ENDRIN ALDEHYDE	µg/kg	3	82	0.04	0.797	81.4	1.51	9.88	1.80	0.93	5.17	2.87	2.75	--
SEMIVOLATILE ORGANICS														
2,3,4,6-TETRACHLOROPHENOL	µg/kg	6	82	0.07	14.3	46.5	16	450	20.0	16.2	67.4	3.37	32.4	--
VOLATILE ORGANICS														
PROPIONITRILE, ETHYL CYANIDE	µg/kg	1	82	0.01	43.6	309	506	506	37.2	55.8	54.9	1.47	47.3	--

[a] One-half the MDL was used to calcluate the mean and median where concentrations were nondetected.
[b] SL = the selected MDEQ Screening Level
-- = not applicable
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
MDEQ = Michigan Department of Environmental Quality

TABLE 3-4
Summary of Nondetected Analytes Above Screening Levels
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
METALS																
SELENIUM	µg/kg	5	82	0.06	456	1180	918	6850	495	510	1069	2.16	691	410	5	77
PESTICIDES																
ALPHA BHC	µg/kg	6	82	0.07	0.808	82.5	0.909	10.6	1.92	0.943	5.26	2.73	2.89	18	--	2
BETA BHC	µg/kg	4	82	0.05	0.872	89	1.55	29.7	2.31	1.02	6.39	2.76	3.49	37	--	2
GAMMA BHC (LINDANE)	µg/kg	1	82	0.01	0.626	63	5.93	5.93	1.35	0.714	3.97	2.94	2.08	20	--	2
TOXAPHENE	µg/kg	--	82	0.00	9.96	1020	--	--	20.8	11.5	63.8	3.07	32.5	860	--	1
SEMIVOLATILE ORGANICS																
PENTACHLOROPHENOL	µg/kg	5	82	0.06	31	81.6	36.5	404	28.7	35.2	57.5	2.00	39.3	22	5	77
1,3-DICHLOROBENZENE	µg/kg	--	82	0.00	54.6	178	--	--	32.2	61.4	8.11	0.25	33.7	170	--	1
BIS(2-CHLOROETHYL) ETHER	µg/kg	--	82	0.00	38	124	--	--	22.4	42.7	5.64	0.25	23.4	100	--	1
HEXACHLOROBUTADIENE	µg/kg	--	82	0.00	34.1	111	--	--	20.1	38.3	5.05	0.25	21.0	91	--	1
VOLATILE ORGANICS																
ACRYLONITRILE	µg/kg	4	82	0.05	31.1	220	189	563	37.6	39.9	75.4	2.01	51.4	100	4	2
METHYLENE CHLORIDE	µg/kg	3	82	0.04	20.9	148	87.4	456	23.0	26.7	52.0	2.27	32.5	100	2	1
1,1-DICHLOROETHENE	µg/kg	--	82	0.00	15.7	111	--	--	11.3	20.0	5.86	0.52	12.3	62	--	1
1,2-DIBROMO-3-CHLOROPROPANE	µg/kg	--	82	0.00	37.8	267	--	--	27.1	48.2	14.1	0.52	29.7	10	--	82
1,2-DIBROMOETHANE (EDB)	µg/kg	--	82	0.00	6.55	46.3	--	--	4.70	8.35	2.45	0.52	5.15	20	--	3
ACROLEIN	µg/kg	--	82	0.00	102	723	--	--	73.3	130	38.2	0.52	80.3	410	--	1
BROMOMETHANE	µg/kg	--	82	0.00	65.7	465	--	--	47.2	83.8	24.5	0.52	51.7	200	--	3
VINYL CHLORIDE	µg/kg	--	82	0.00	15.3	108	--	--	11.0	19.5	5.70	0.52	12.0	40	--	3

[a] One-half the MDL was used to calcluate the mean and median where concentrations were nondetected.

[b] SL = the selected MDEQ Screening Level

-- = not applicable

µg/kg = micrograms per kilogram

MDEQ = Michigan Department of Environmental Quality

TABLE 3-5
Soil Parameter Summary Statistics
Data Evaluation Report in Support of Bioavailability Study,
Midland Area Soils

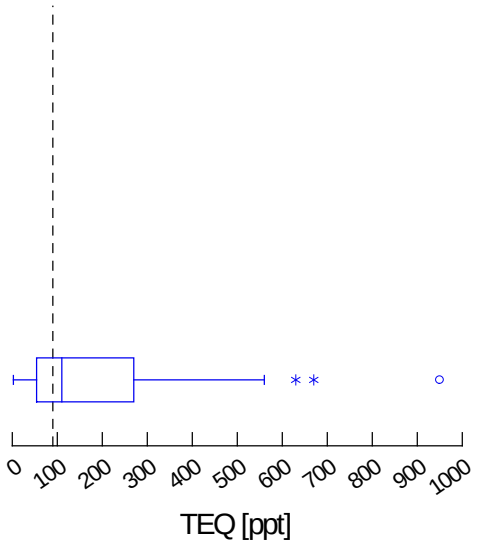
	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation
Soil Parameters												
Percent Sand[a]	%	337	337	1.00	--	--	28	92	77.36	78	10.47	0.14
Percent Silt[a]	%	337	337	1.00	--	--	4	46	16.47	16	7.14	0.43
Percent Clay[a]	%	337	337	1.00	--	--	0	40	6.17	6	4.73	0.77
Sand Retained on 250 micron sieve[b]	%	337	337	1.00	--	--	2	60.3	19.52	17.6	12.26	0.63
Total Organic Carbon (TOC) [c]	%	337	337	1.00	--	--	0.79	12.89	3.40	3.16	1.50	0.44
Black Carbon (BC) [c]	%	320	337	0.95	0.1	0.1	0.1	2.06	0.53	0.42	0.38	0.72
Organic Carbon (TOC % - BC %)[c,d]	%	320	337	0.95	0.7	5.1	-0.02	11.16	2.87	2.67	1.33	0.47
Specific Surface Area	m^2/g	337	337	1.00	--	--	0.28	15.16	1.82	1.36	1.67	0.92

[a] The sum of the percent of sand, silt, and clay equals 1
[b] Sand retained on 250 micron sieve is a subfraction of sand
[c] Black carbon and organic carbon are fractions of Total Organic Carbon
[c] Calculated value. The negative minimum value for organic carbon is an artifact of the black carbon value being slightly greater than the TOC
-- = not applicable
m^2/g = square meters per gram
% = percent

TABLE 3-6
Sample Cluster Factor Averages
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Clusters	Units	Cluster 1 Averages	Cluster 2 Averages	Cluster 3 Averages	Cluster 4 Averages	Cluster 5 Averages	Cluster 6 Averages	Cluster 7 Averages	Cluster 8 Averages
2 CLUSTERS									
No. of Samples	--	253	84						
Clay	%	0.54	0.51						
Sand	%	82.0	63.4						
Silt	%	13.3	26.1						
TOC	%	3.4	3.5						
No. of Samples	--	233	104						
Black Carbon	%	0.53	0.53						
Sand	%	82.8	65.2						
Clay	%	4.0	11.0						
TOC	%	3.4	3.5						
4 CLUSTERS									
No. of Samples	--	123	117	80	17				
Black Carbon	%	0.56	0.51	0.52	0.54				
Clay	%	2.39	6.1	9.7	17.2				
Sand	%	87.2	77.7	68.0	48.2				
TOC	%	3.3	3.5	3.5	3.5				
6 CLUSTERS									
No. of Samples	--	122	109	60	30	2	14		
Black Carbon	%	0.55	0.52	0.59	0.39	0.69	0.52		
Clay	%	2.39	5.7	9.2	11.1	32.0	15.3		
Sand	%	87.2	78.0	71.1	63.3	34.0	49.6		
TOC	%	3.2	3.5	3.6	3.2	5.6	3.2		
8 CLUSTERS									
No. of Samples	--	93	69	34	29	2	14	42	54
Black Carbon	%	0.54	0.45	0.53	0.39	0.69	0.52	0.64	0.62
Clay	%	2.3	6.3	11.4	11.2	32.0	15.3	6.2	3.3
Sand	%	88.2	77.9	72.3	63.2	34.0	49.6	71.1	82.4
TOC	%	3.2	3.2	3.1	3.2	5.6	3.2	4.0	3.8

TOC = total organic carbon



Summary of All Surface and Subsurface Soil Samples (Number of Samples = 199)

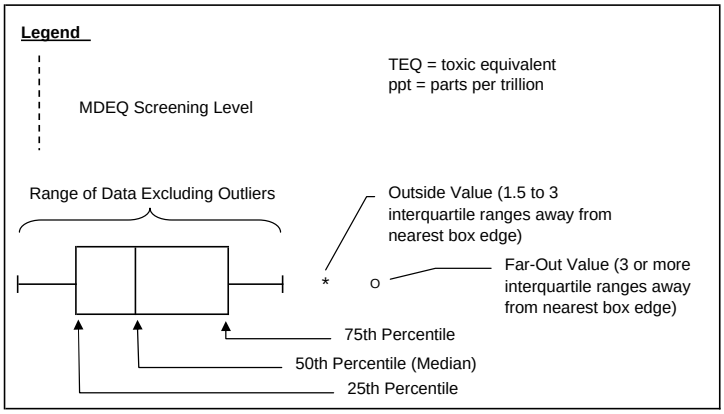
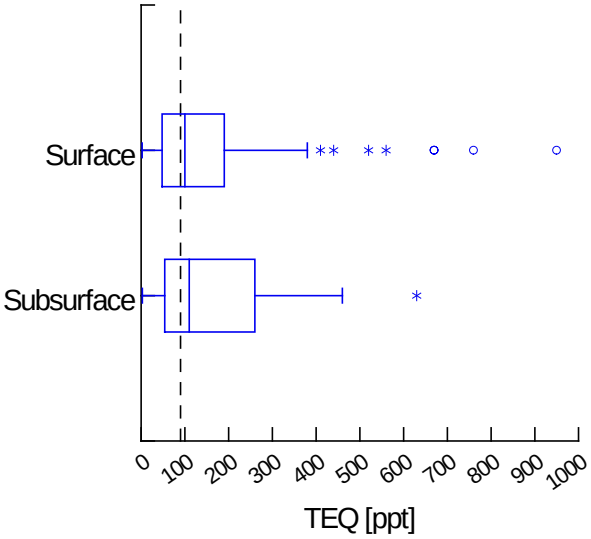
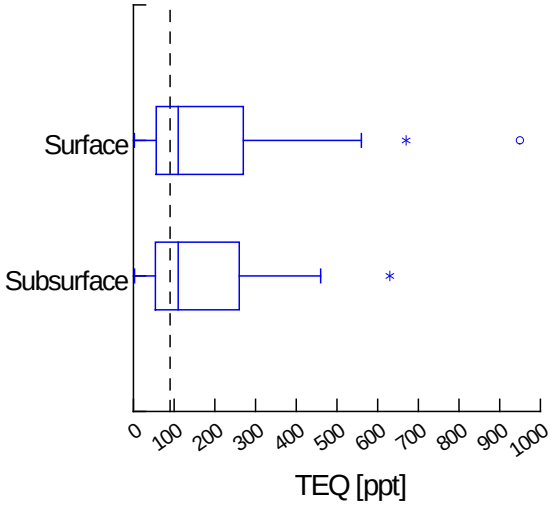


Figure 3-1
Dioxin and Furan Statistical Summary
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



Summary of Pooled Surface vs. Subsurface Soil Samples
(Surface Number of Samples = 158; Subsurface Number of Samples = 41)



Summary of Paired Surface vs. Subsurface Soil Samples
(Surface Number of Samples = 41; Subsurface Number of Samples = 41)

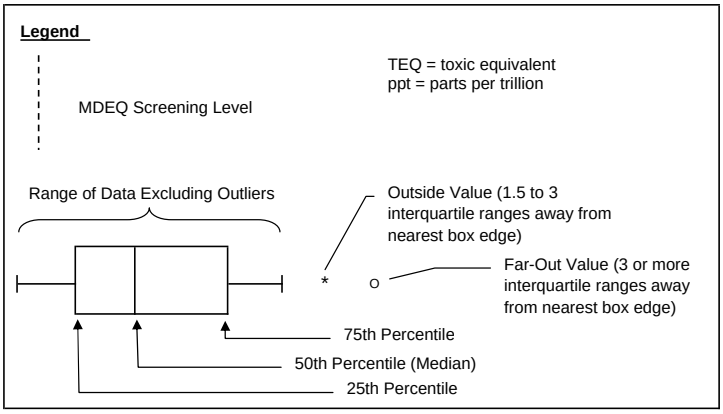
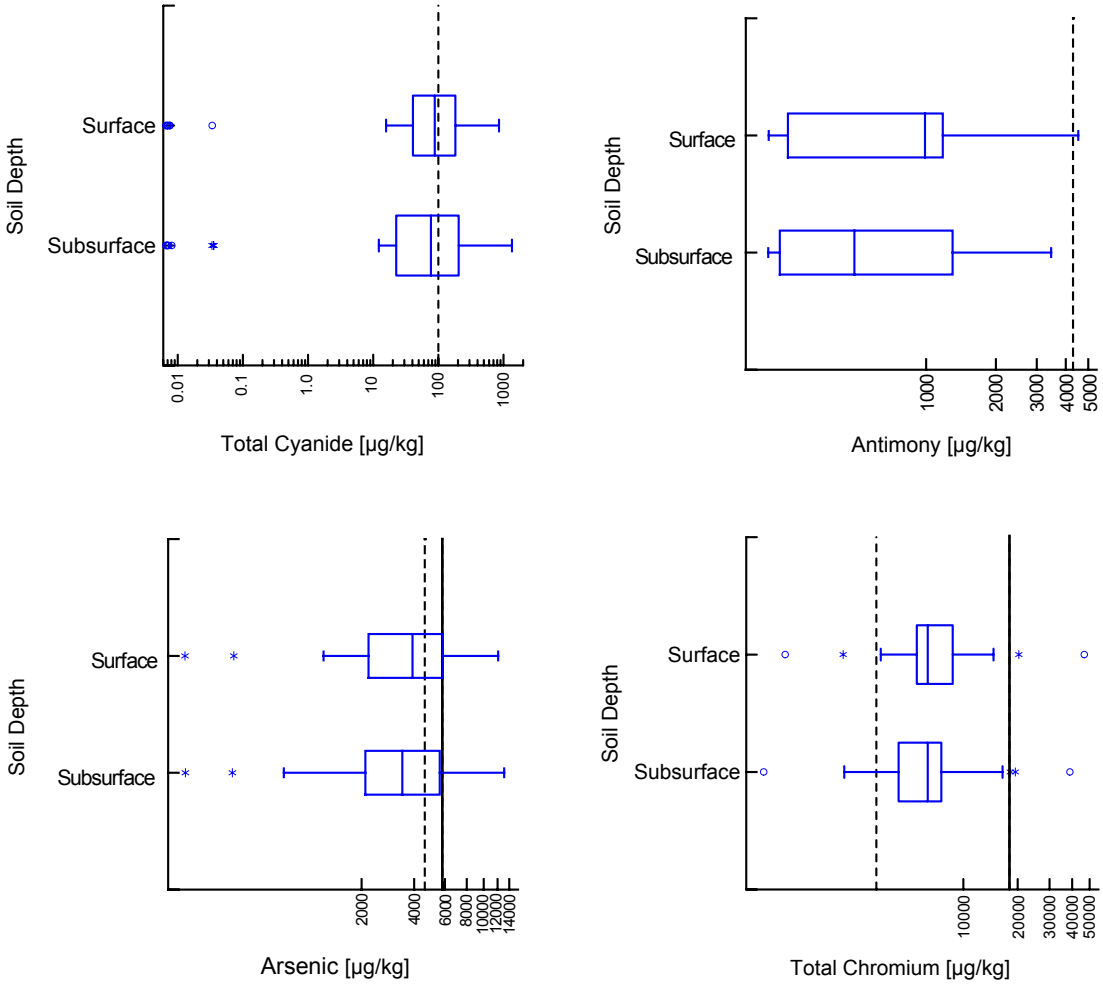
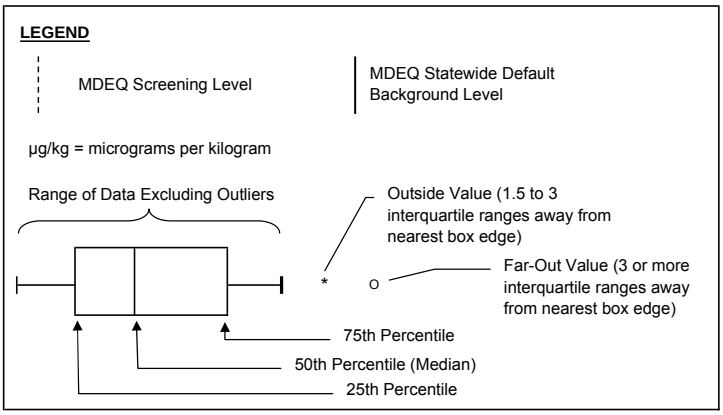


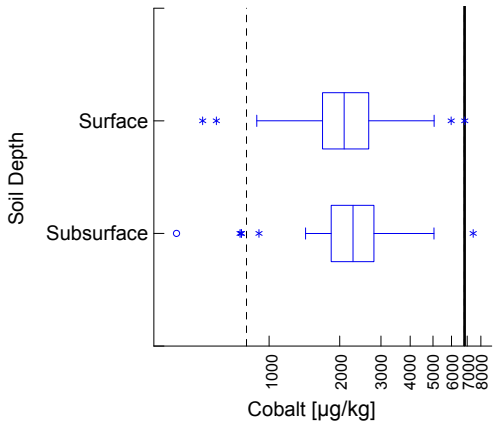
Figure 3-2
Dioxin and Furan Data Interval Comparisons
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

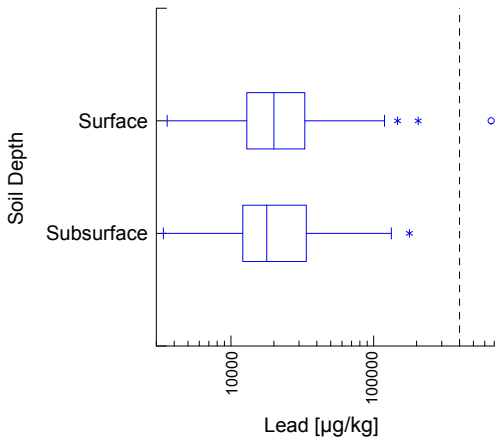


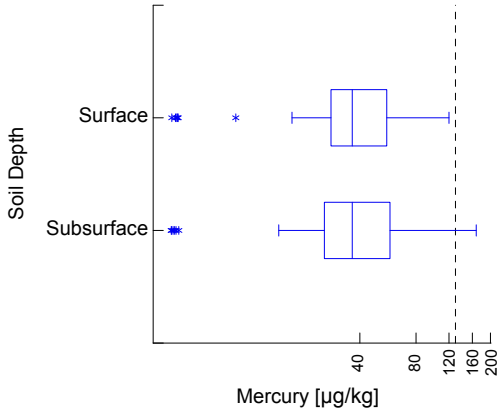


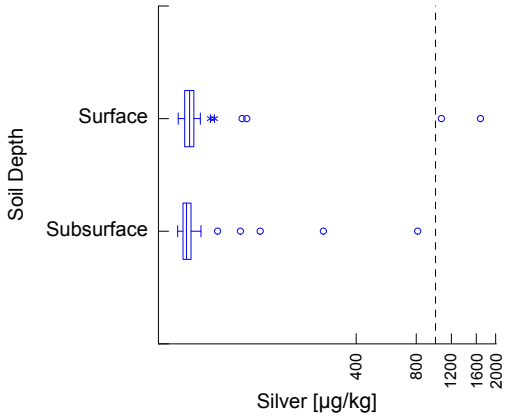
Note: Concentration axis is in logarithmic scale.

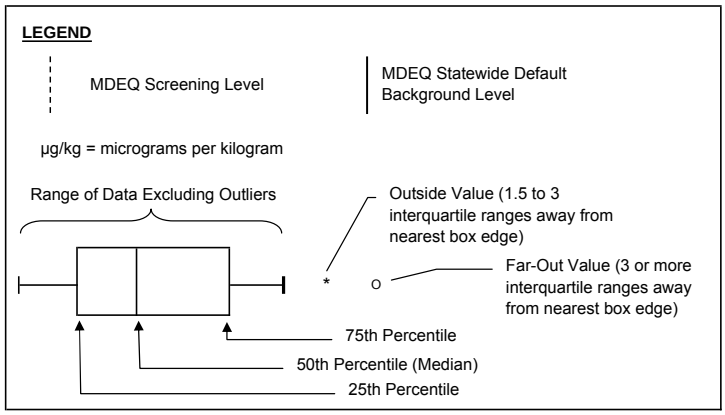
Figure 3-3A
Additional Chemicals Box Plot Results for Metals
Data Evaluation Report in Support of Bioavailability Study Midland Area Soils
Revision 1 July 6, 2007





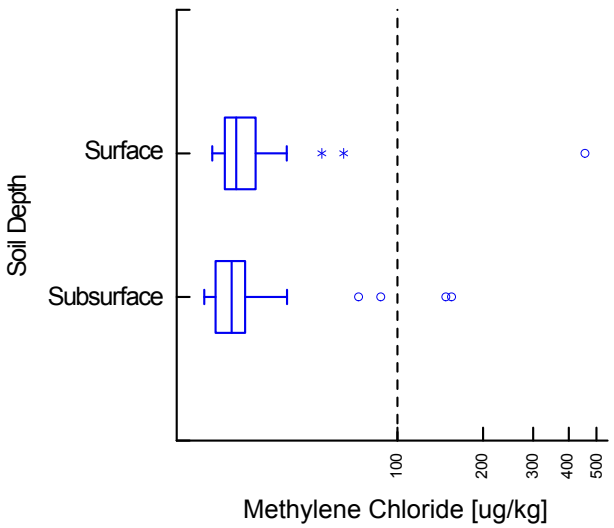


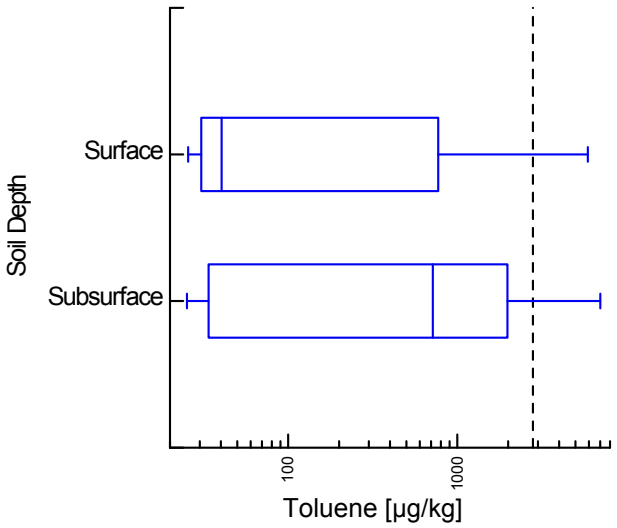


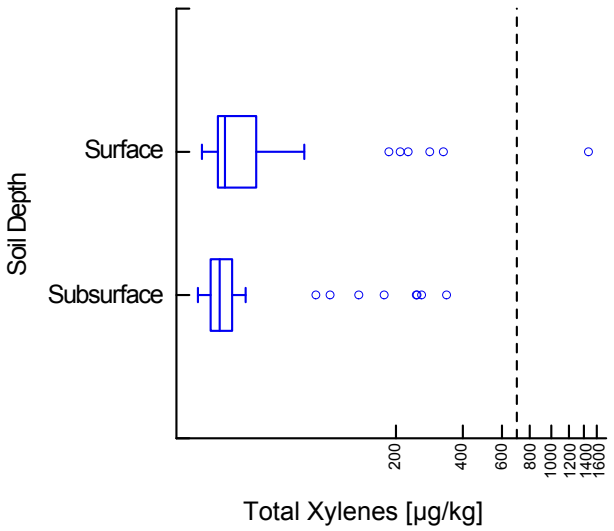


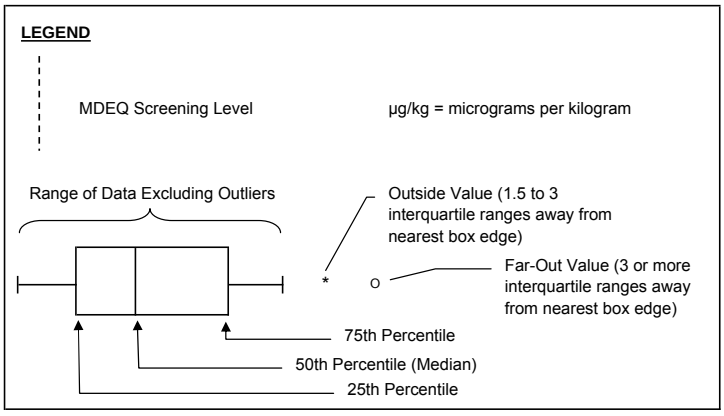
Note: Concentration axis is in logarithmic scale.

Figure 3-3B
Additional Chemicals Box Plot Results for Metals
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils









Note: Concentration axis is in logarithmic scale.

Figure 3-4
Additional Chemicals Box Plot Results for VOCs
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

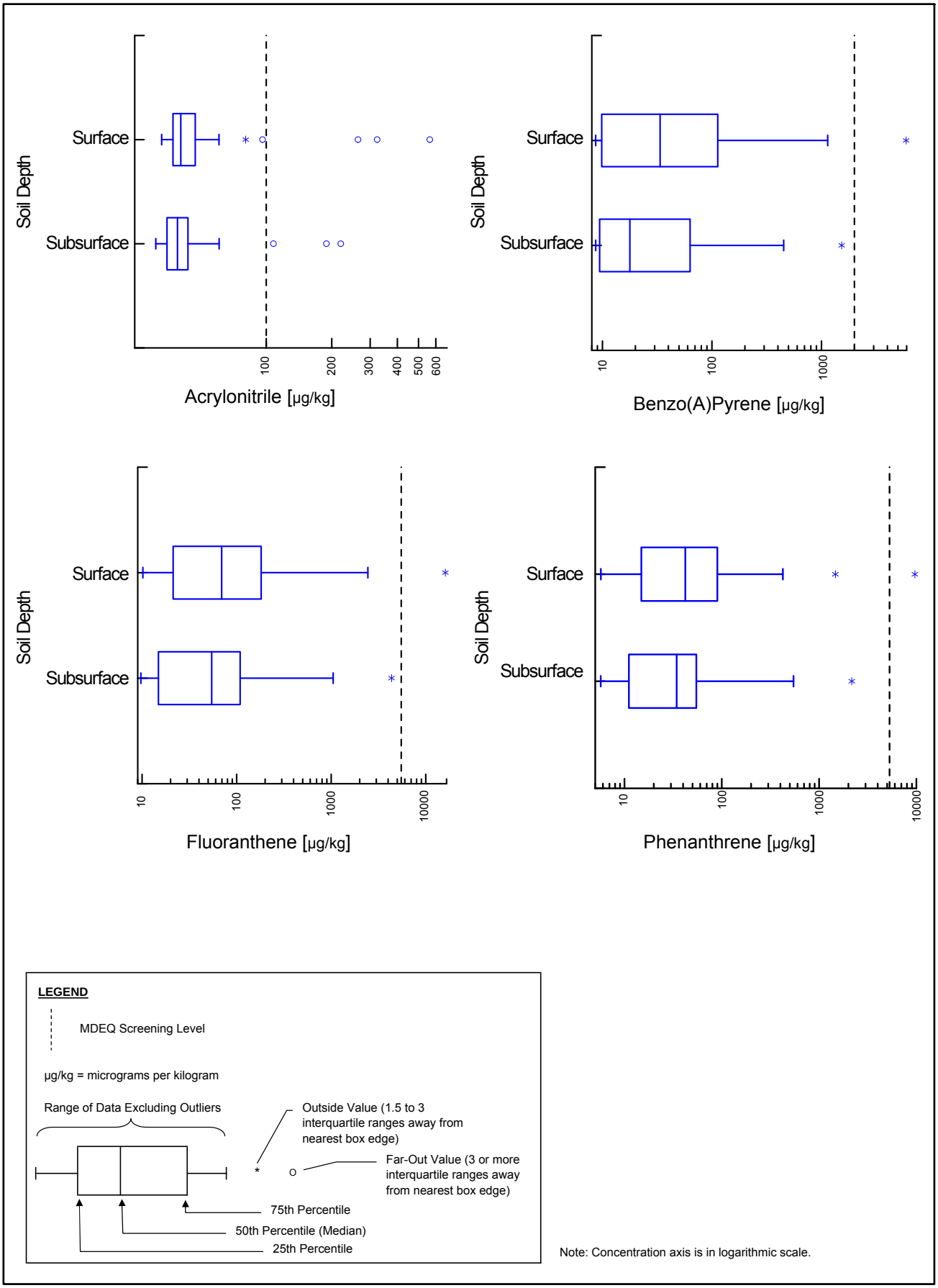
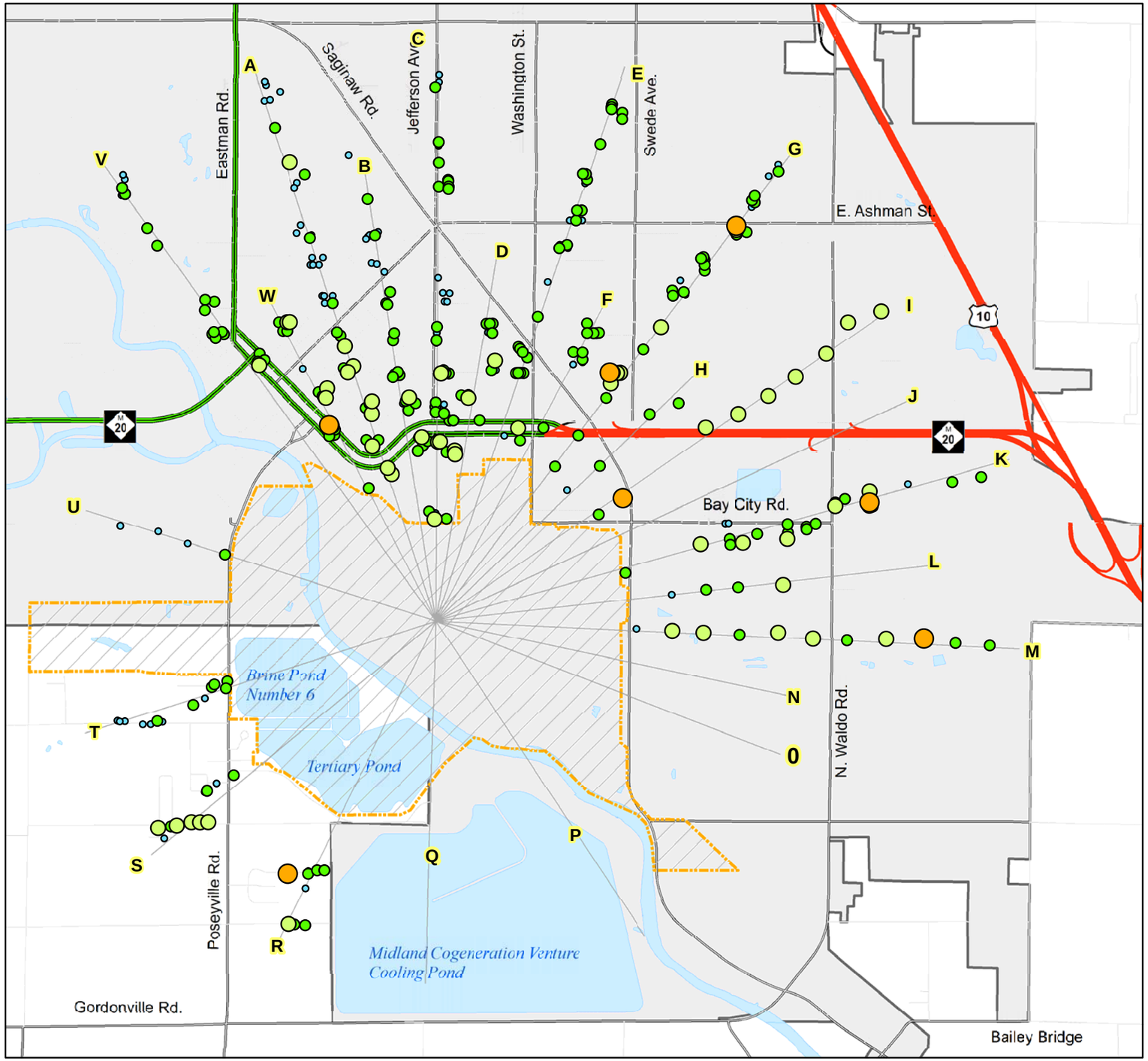
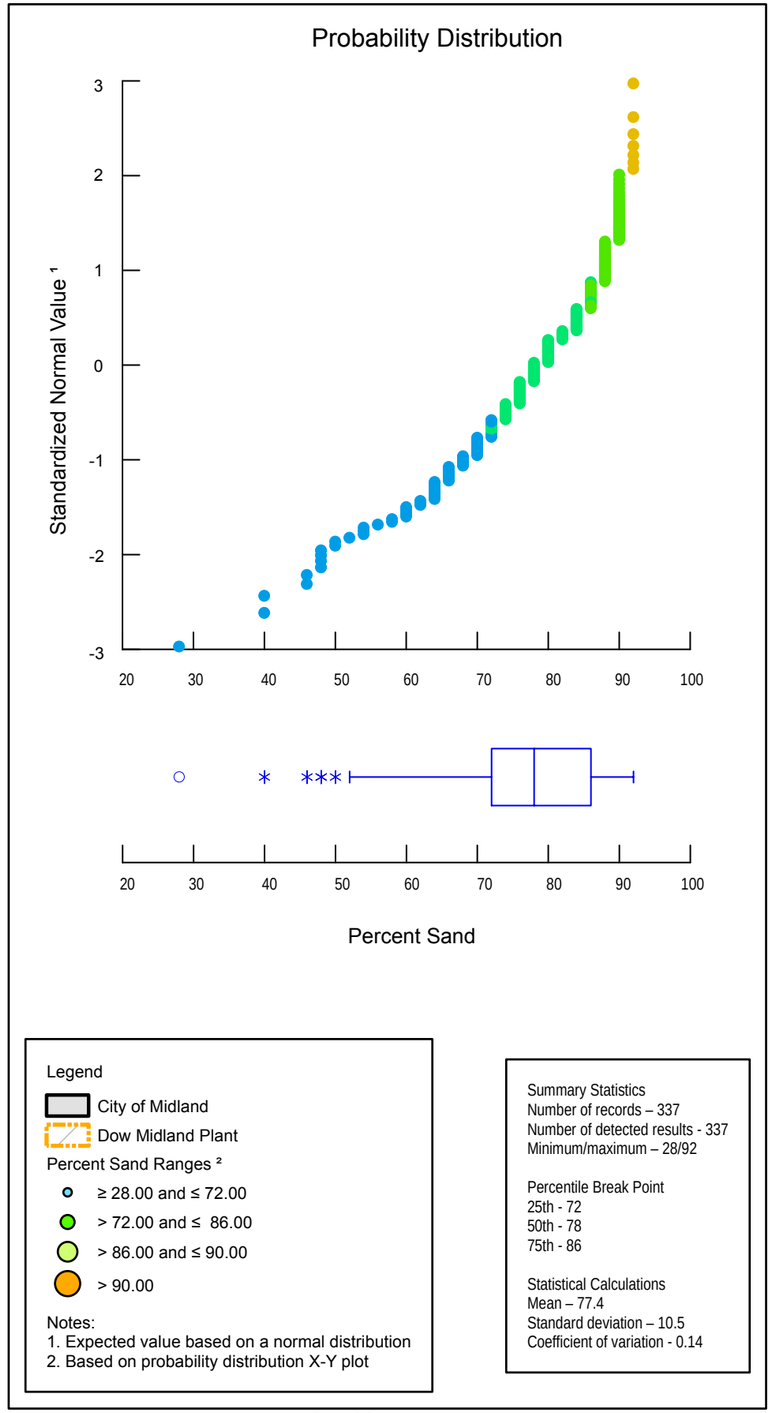


Figure 3-5
Additional Chemicals Box Plot Results for SVOCs
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils





Legend

City of Midland

Dow Midland Plant

Percent Sand Ranges ²

- ≥ 28.00 and ≤ 72.00
- > 72.00 and ≤ 86.00
- > 86.00 and ≤ 90.00
- > 90.00

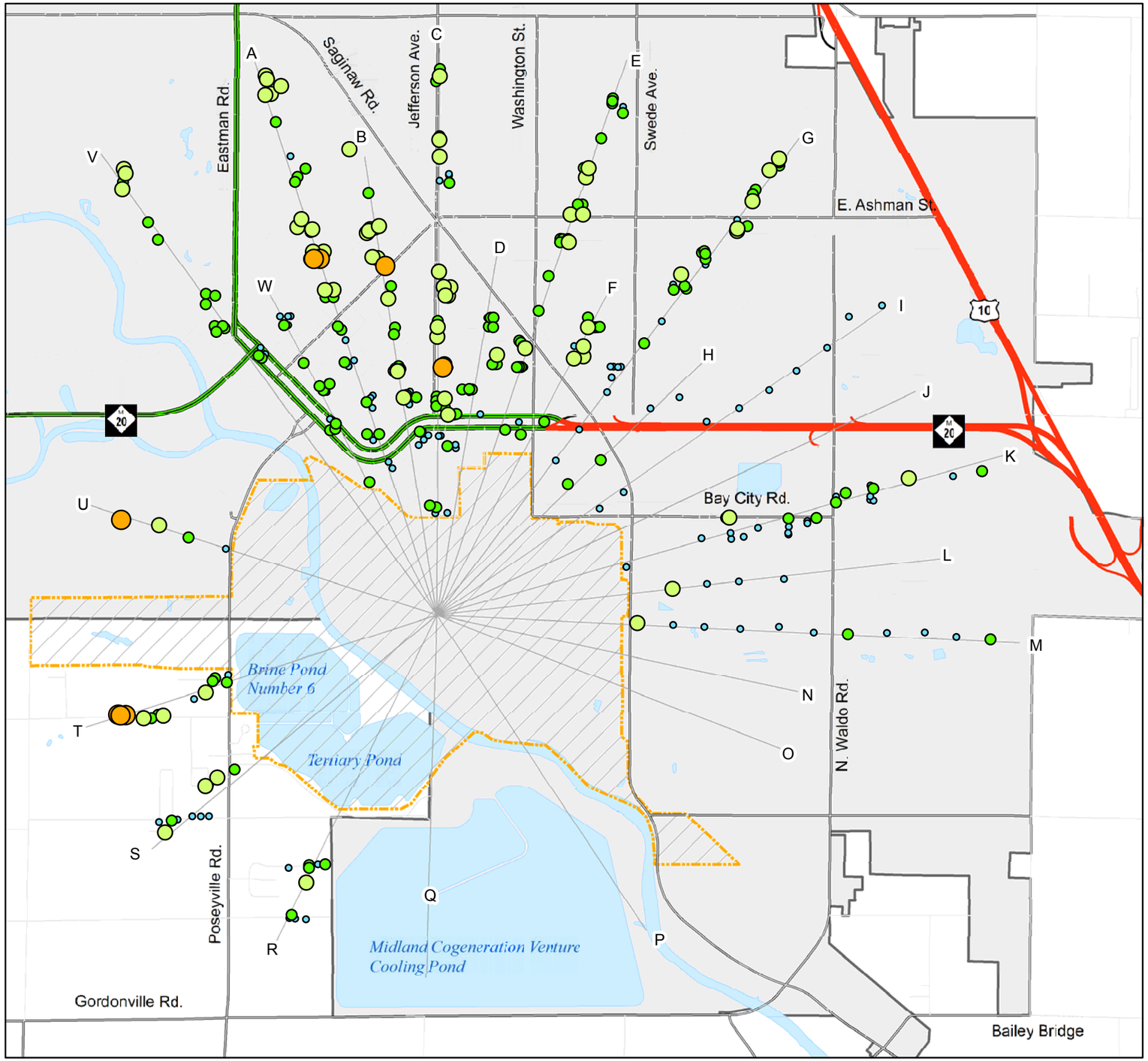
Notes:
1. Expected value based on a normal distribution
2. Based on probability distribution X-Y plot

Summary Statistics
Number of records – 337
Number of detected results - 337
Minimum/maximum – 28/92

Percentile Break Point
25th - 72
50th - 78
75th - 86

Statistical Calculations
Mean – 77.4
Standard deviation – 10.5
Coefficient of variation - 0.14

Figure 3-6
Sand Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



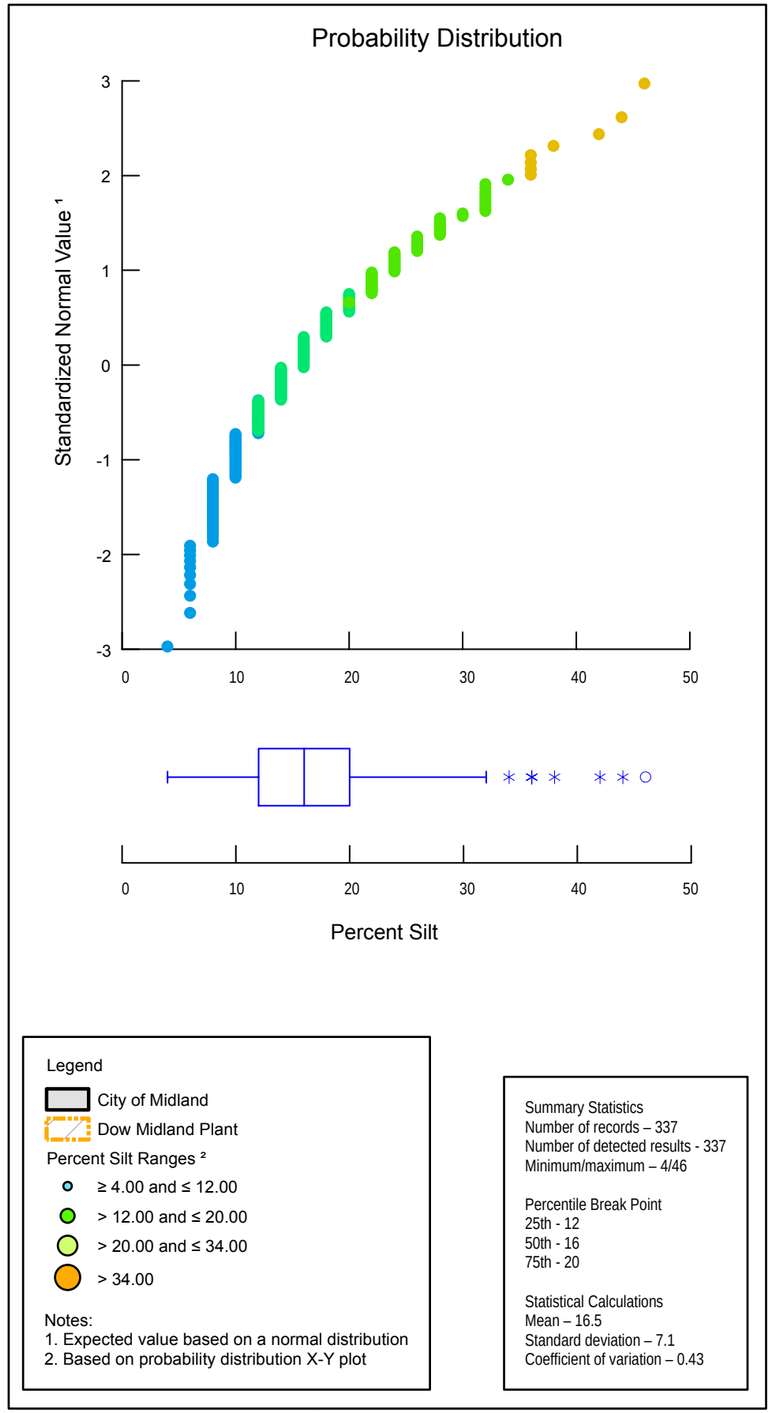
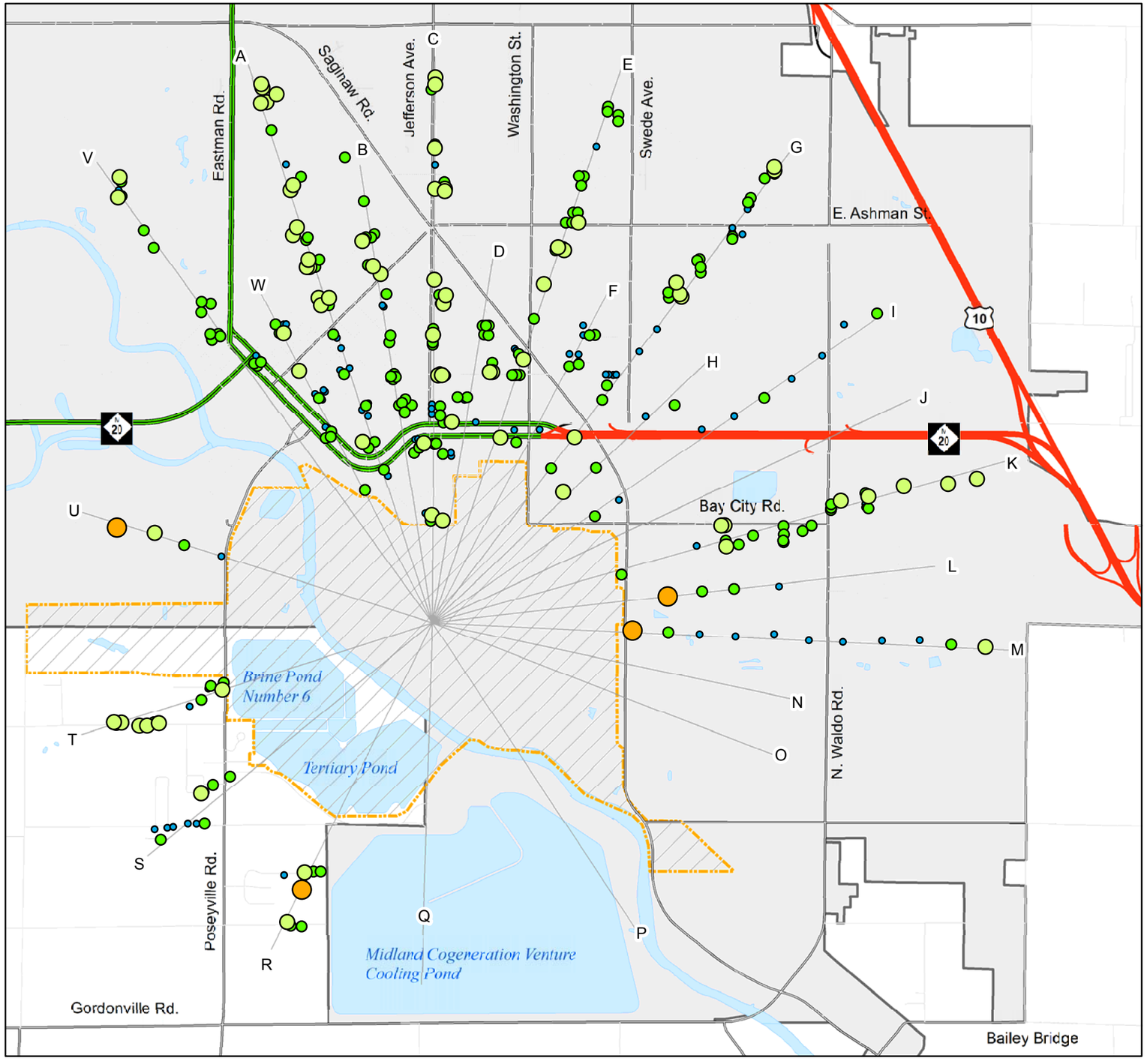


Figure 3-7
Silt Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



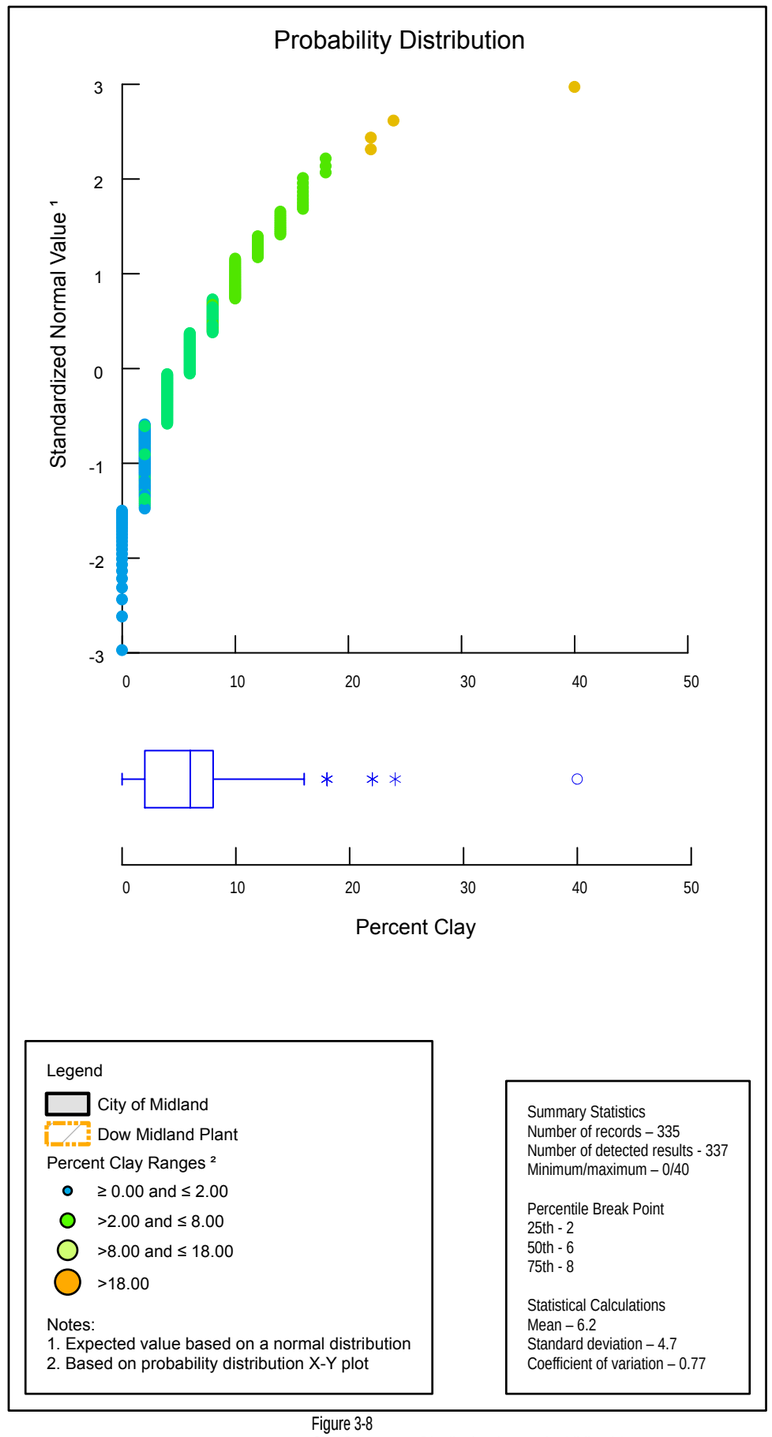
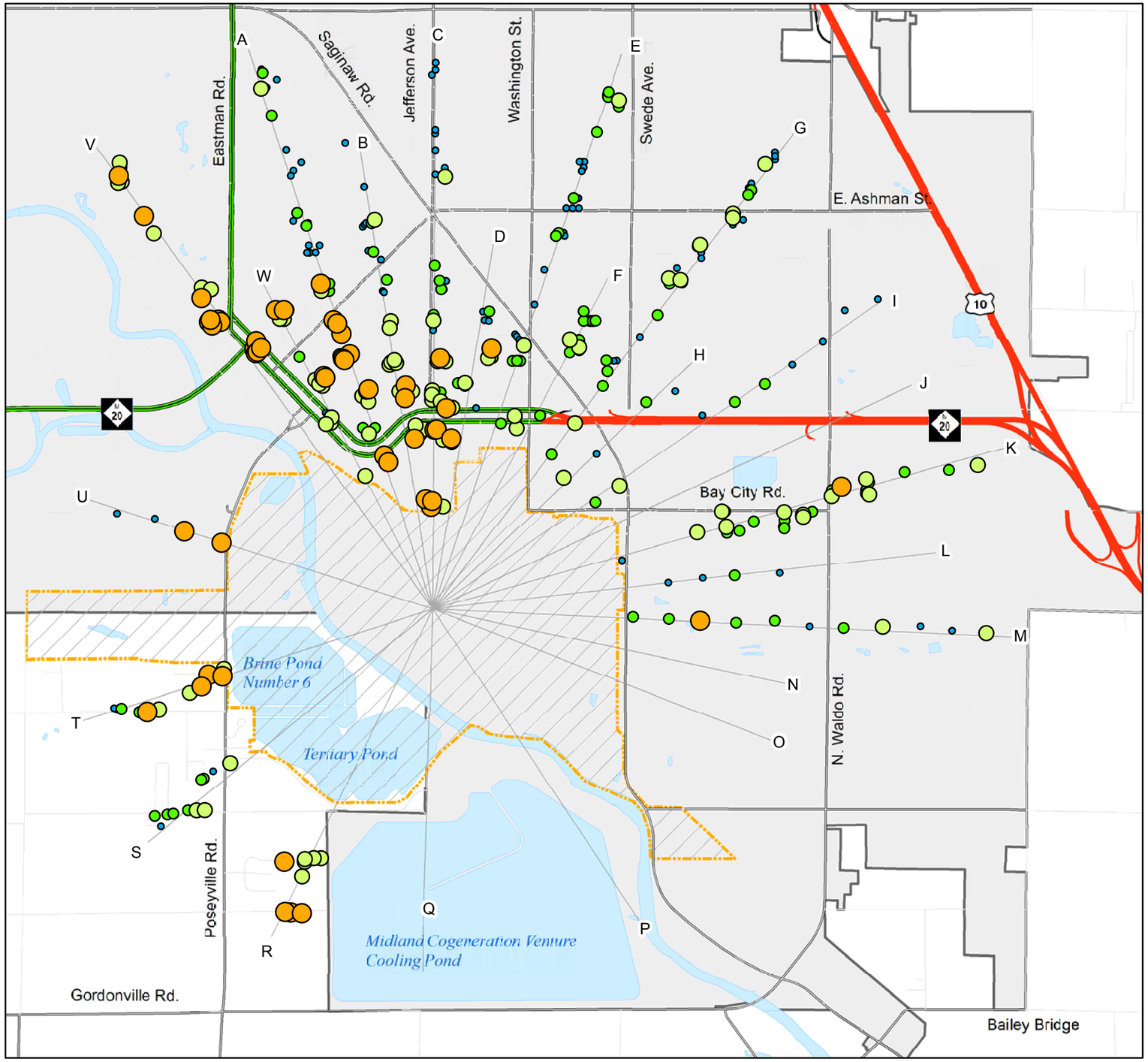
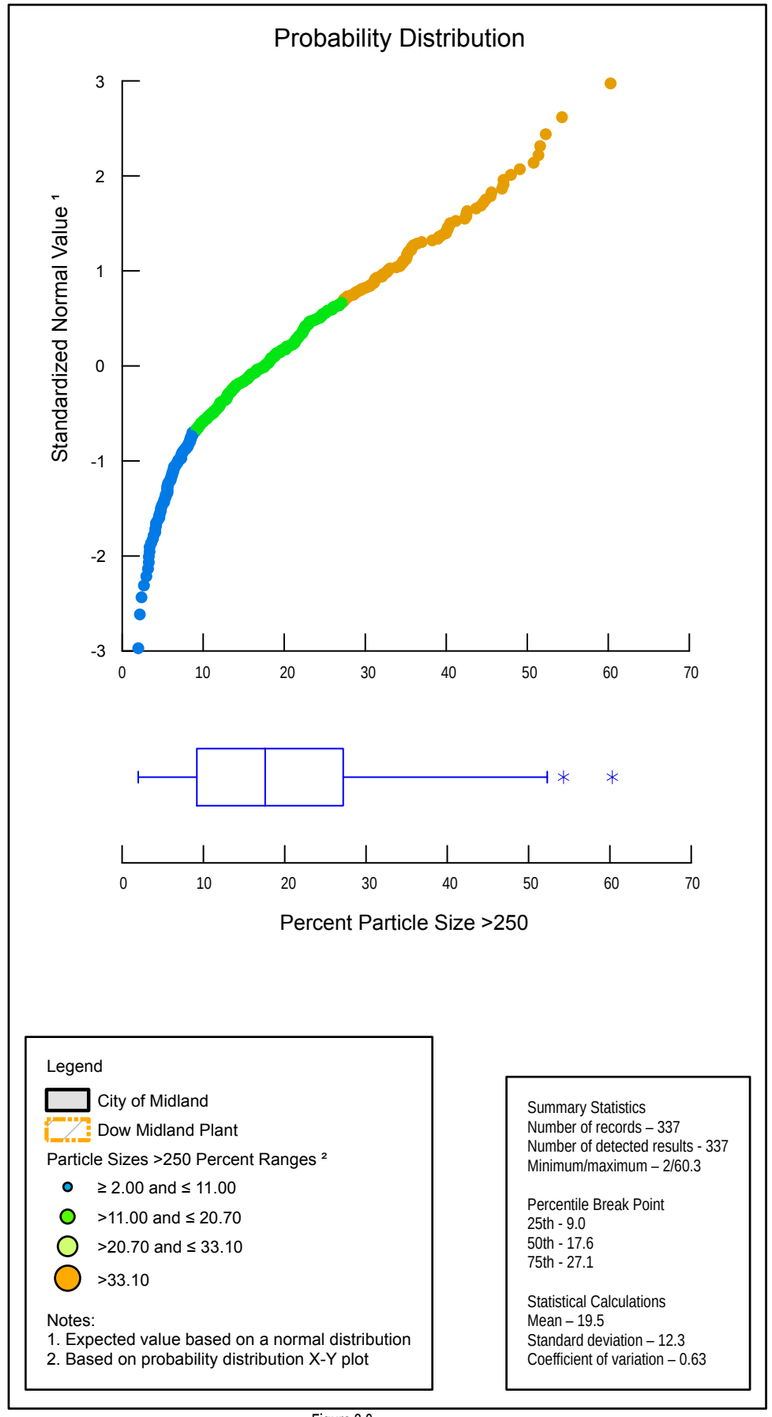


Figure 3-8
Clay Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils





Legend

City of Midland

Dow Midland Plant

Particle Sizes >250 Percent Ranges ²

- ≥ 2.00 and ≤ 11.00
- >11.00 and ≤ 20.70
- >20.70 and ≤ 33.10
- >33.10

Notes:
1. Expected value based on a normal distribution
2. Based on probability distribution X-Y plot

Summary Statistics
Number of records – 337
Number of detected results - 337
Minimum/maximum – 2/60.3

Percentile Break Point
25th - 9.0
50th - 17.6
75th - 27.1

Statistical Calculations
Mean – 19.5
Standard deviation – 12.3
Coefficient of variation – 0.63

Figure 3-9
250-sieve Sand Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

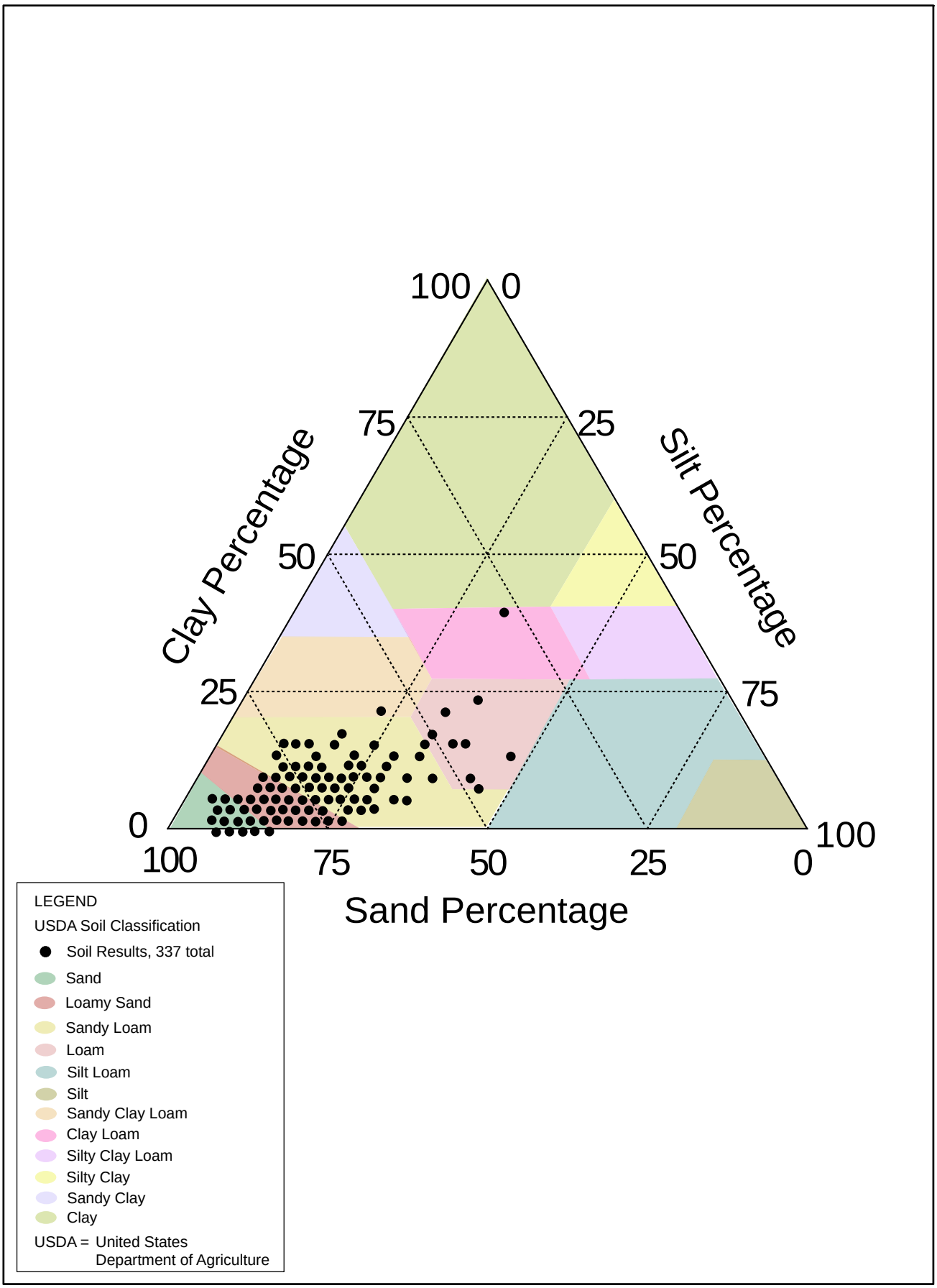
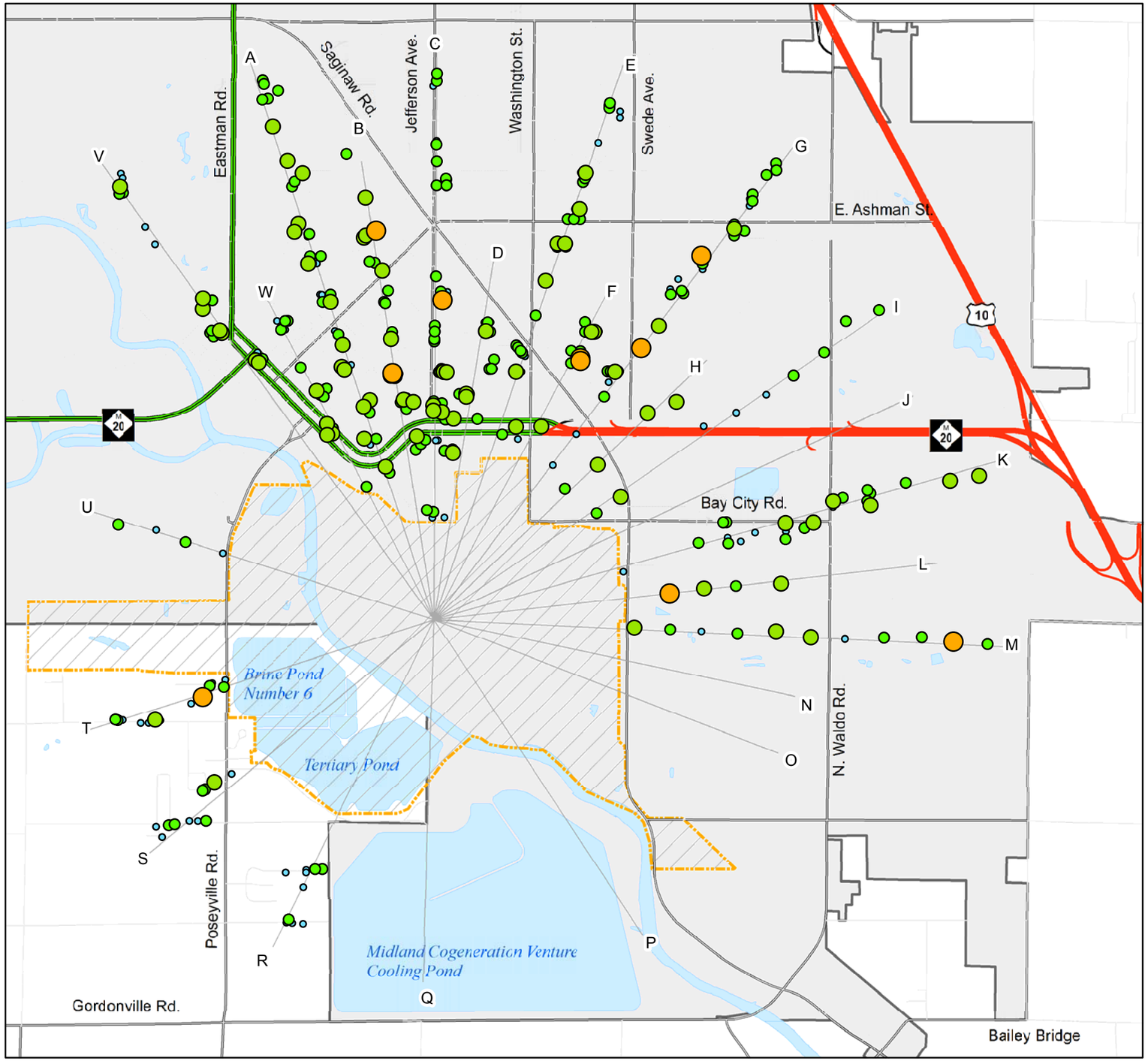


Figure 3-10
Grain Size Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



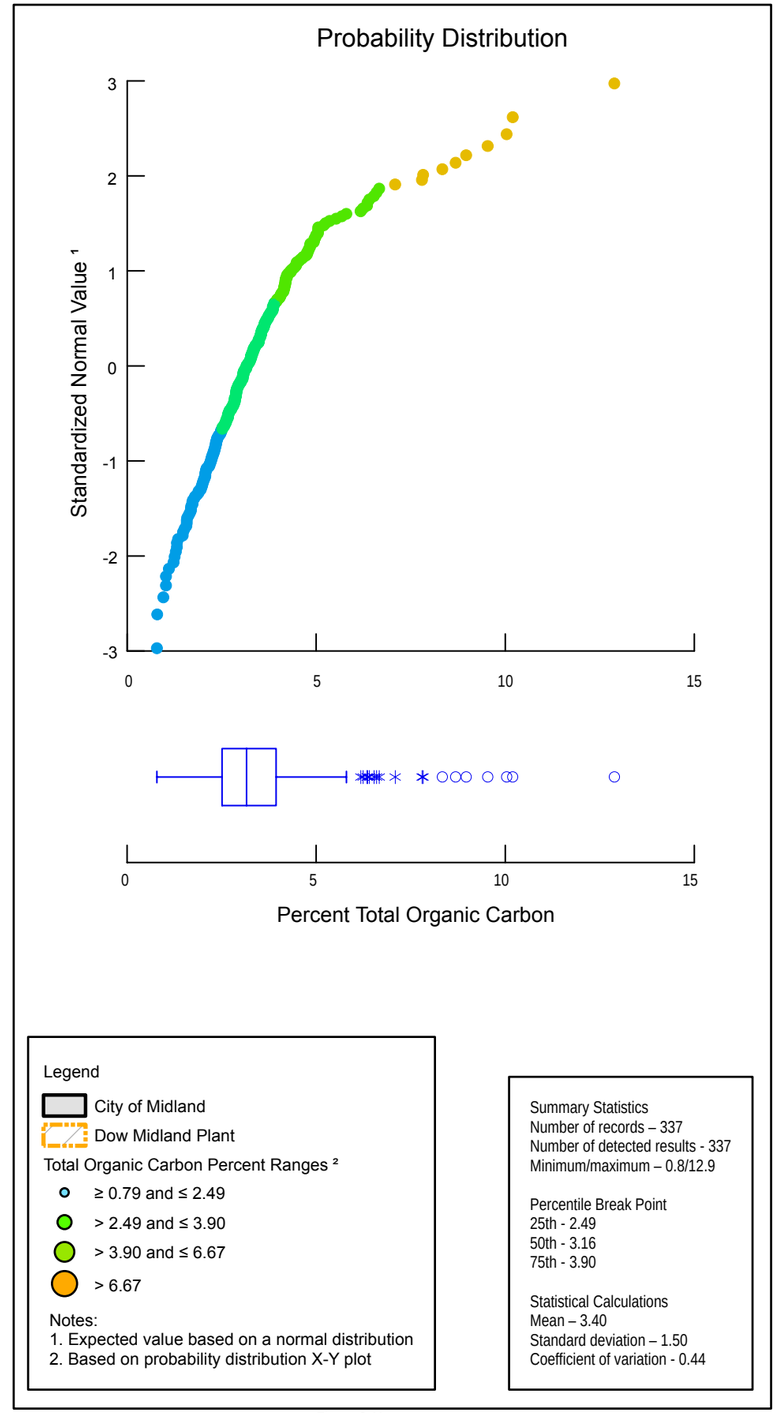
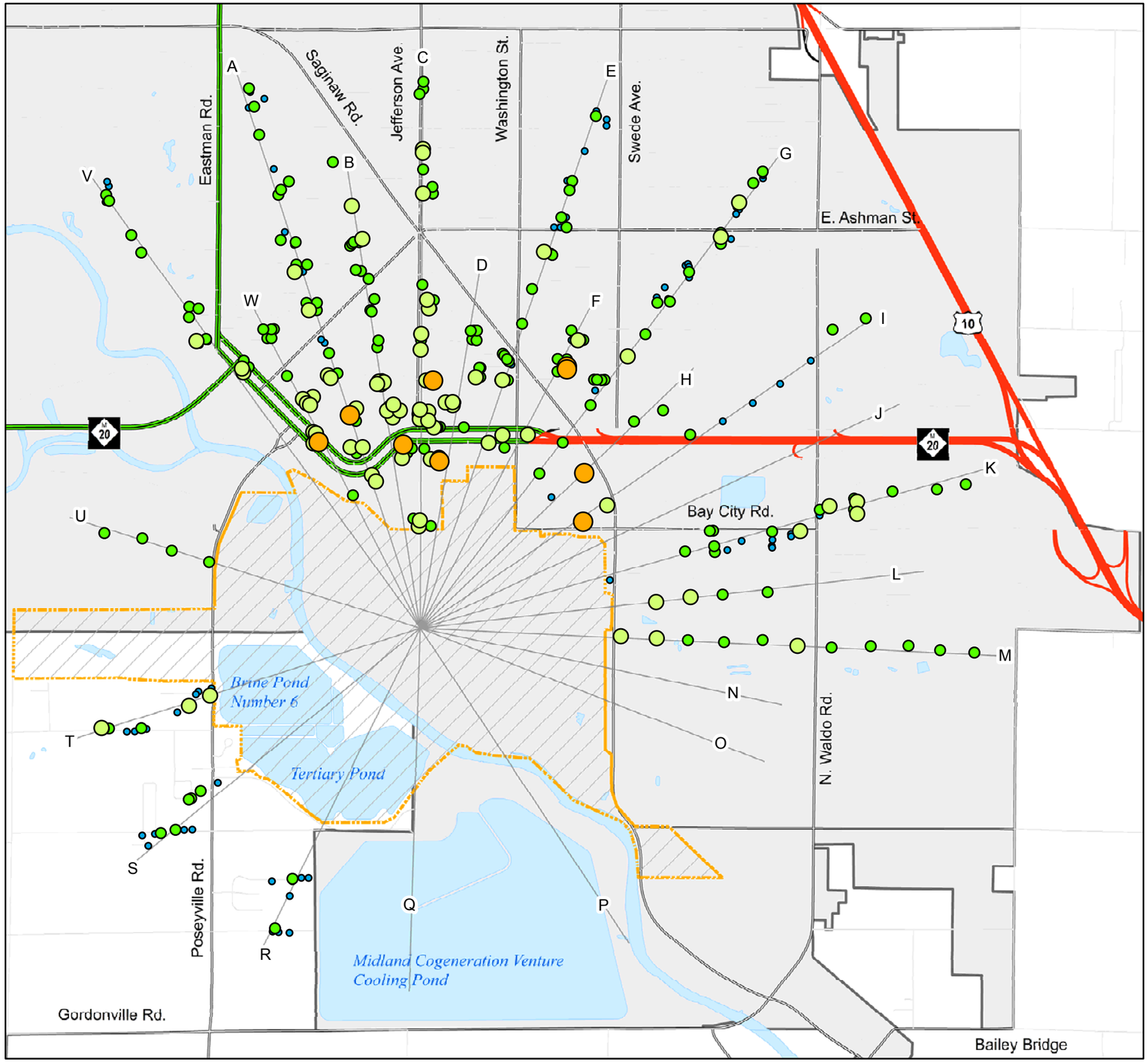


Figure 3-11
TOC Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



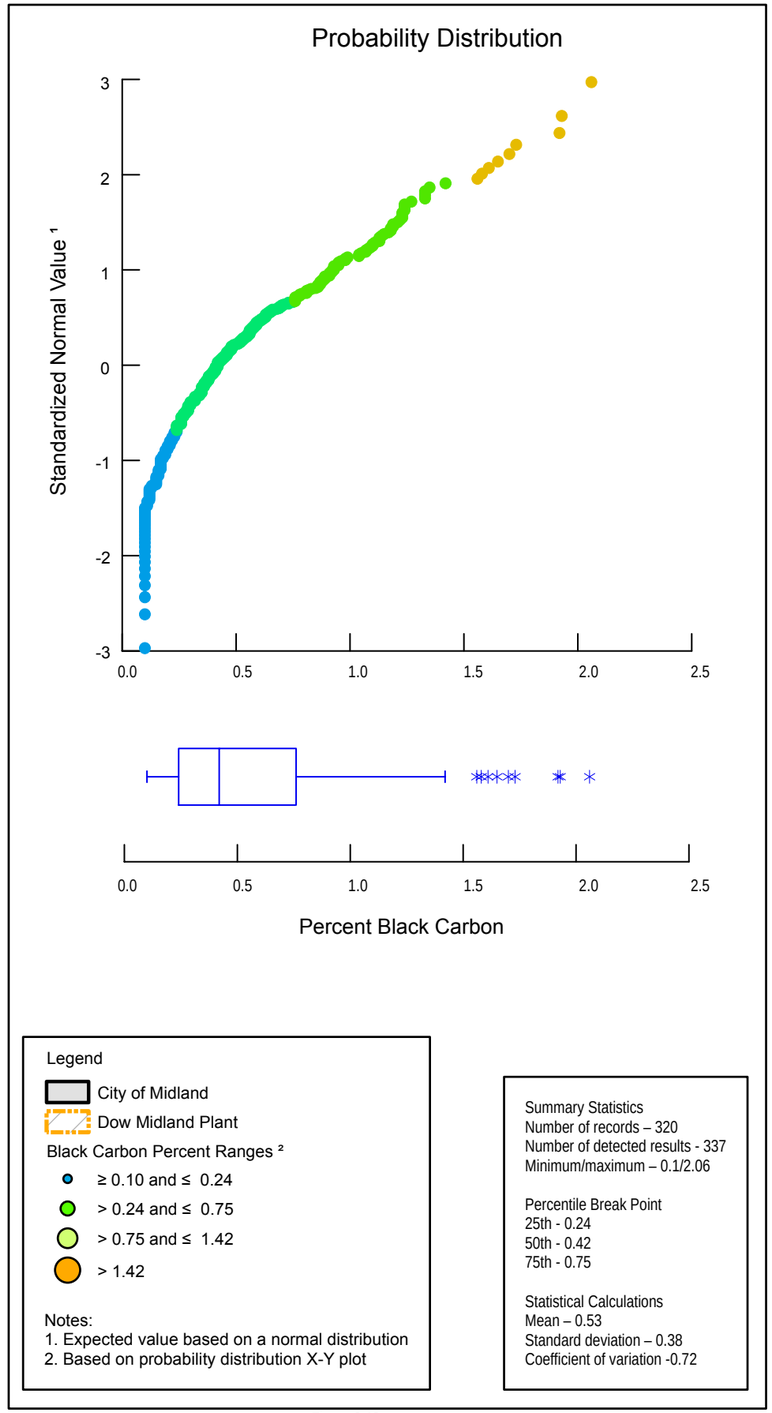
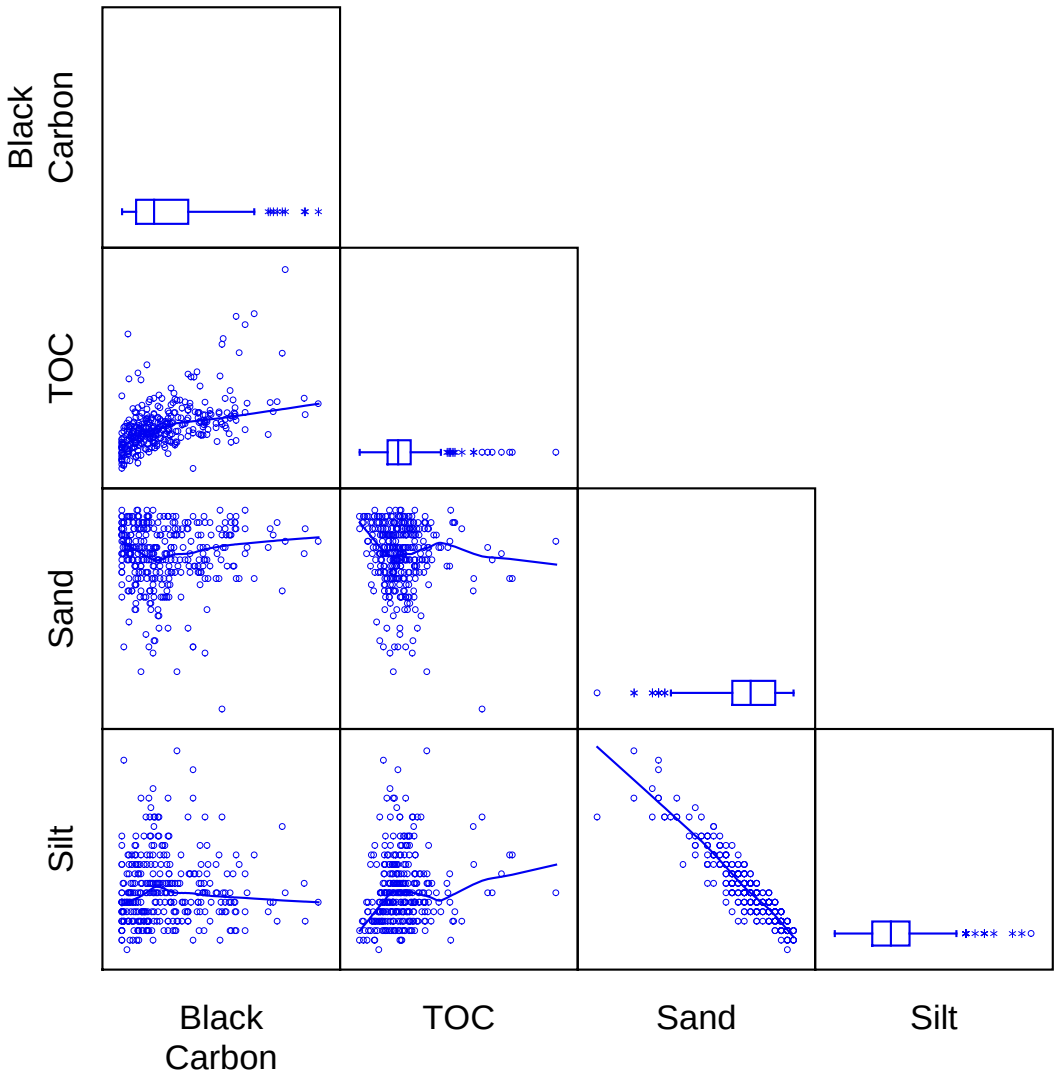


Figure 3-12
Black Carbon Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils



Legend

Best-fit trend line

TOC=Total organic carbon

Far-Out Valve (3 or more interquartile ranges away from the nearest box edge)

Outside Valve (1.5 to 3 interquartile ranges away from nearest box edge)

75th Percentile

Median 50th Percentile

25th Percentile

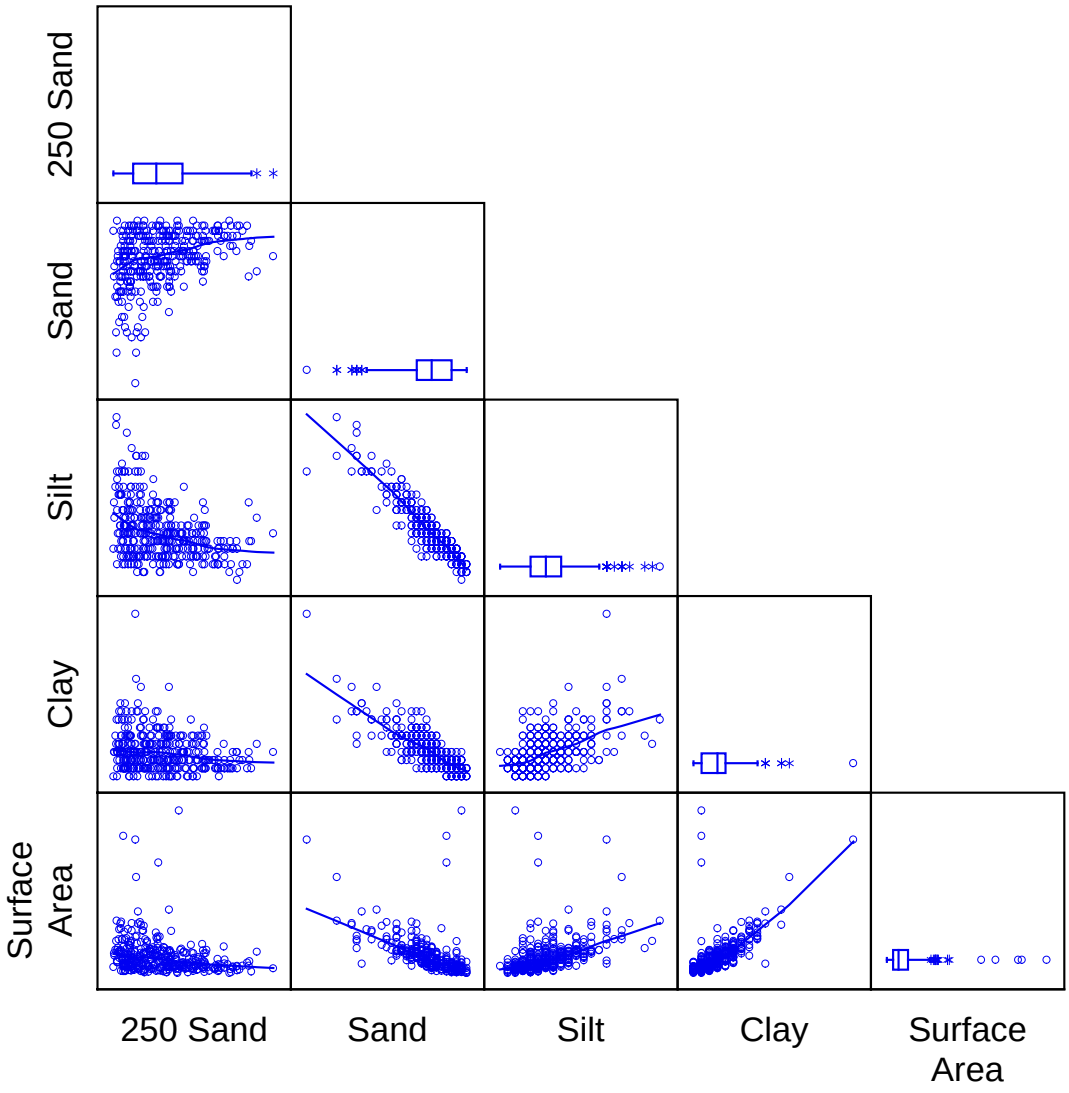
Range of Data Excluding Outliers

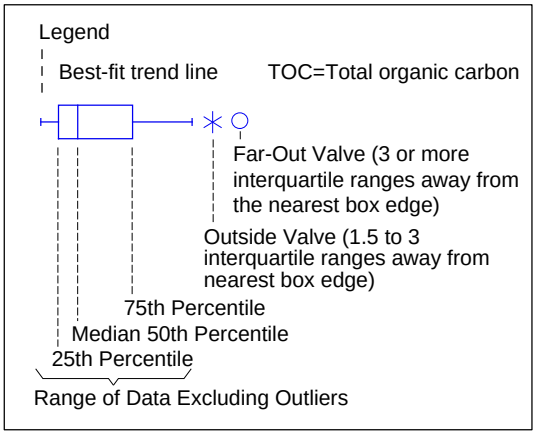
Correlation Summary

Black Carbon	na			
TOC	+	na		
sand	ns	ns	na	
Silt	ns	+	-	na
	Black Carbon	TOC	Sand	Silt

- Indicates negative correlation
+ Indicates positive correlation
ns Indicates no significant correlation
na Not applicable

Figure 3-13A
Soil Parameter Statistical Correlation Summary
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils





Correlation Summary

250 Sand	na				
Sand	+	na			
Silt	-	-	na		
Clay	-	-	+	na	
Surface Area	-	-	+	+	na
	250 Sand	Sand	Silt	Clay	Surface Area

- Indicates negative correlation
+ Indicates positive correlation
ns Indicates no significant correlation
na Not applicable

Figure 3-13B
Soil Parameter Statistical Correlation Summary
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

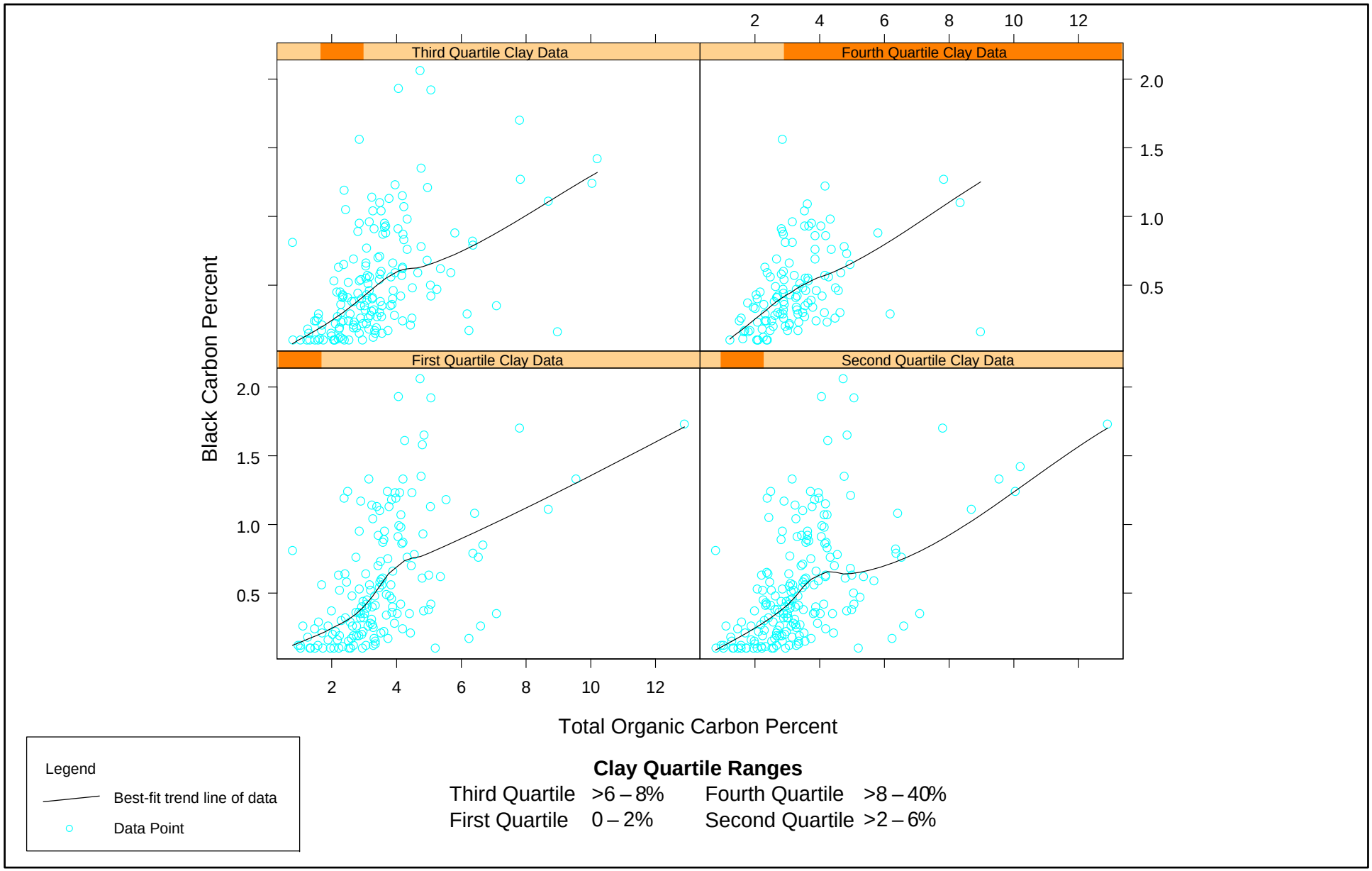


Figure 3-14A
Black Carbon vs. TOC for Clay Conditioning Plot
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

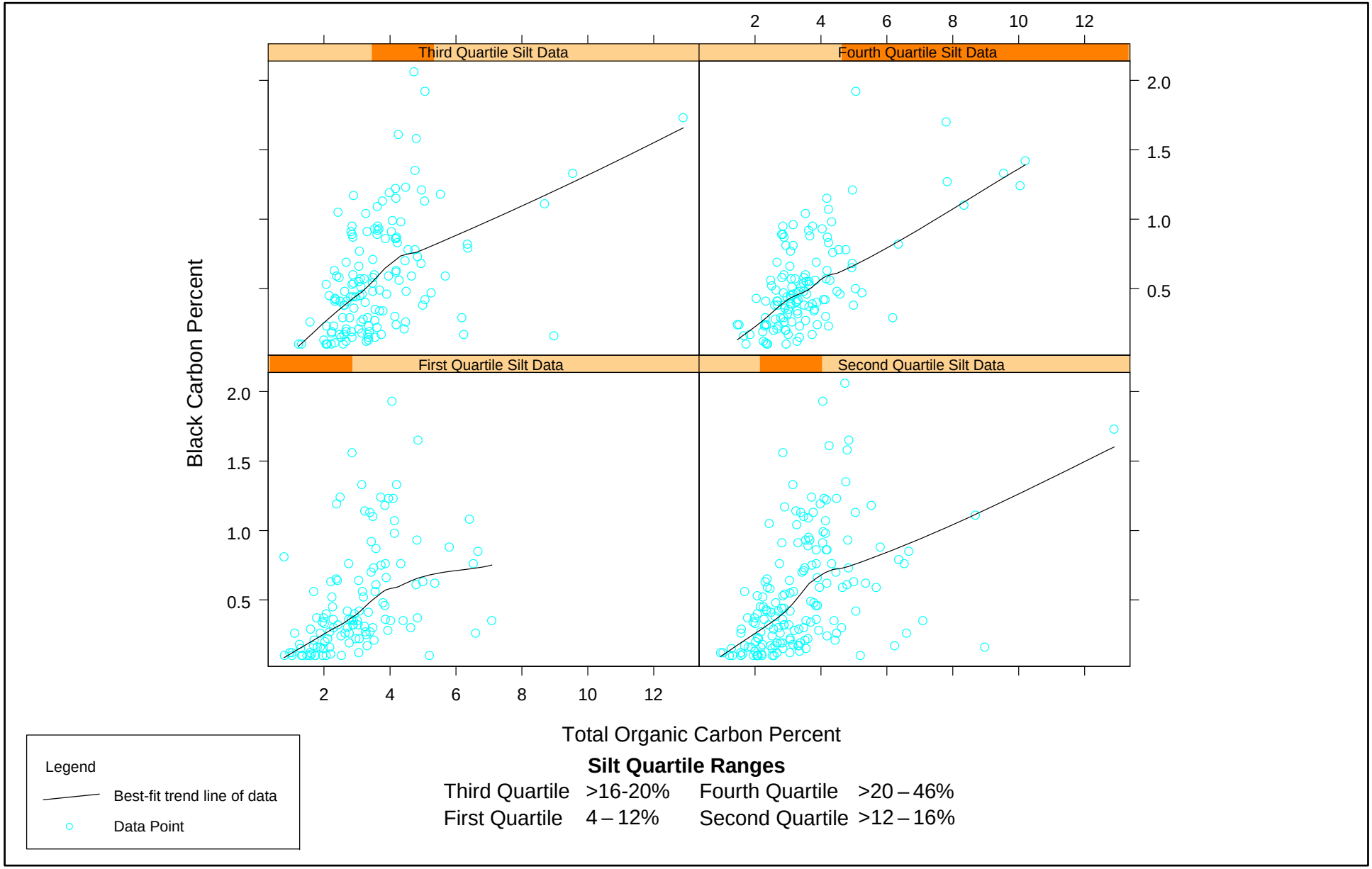


Figure 3-14B
Black Carbon vs. TOC for Silt Conditioning Plot
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

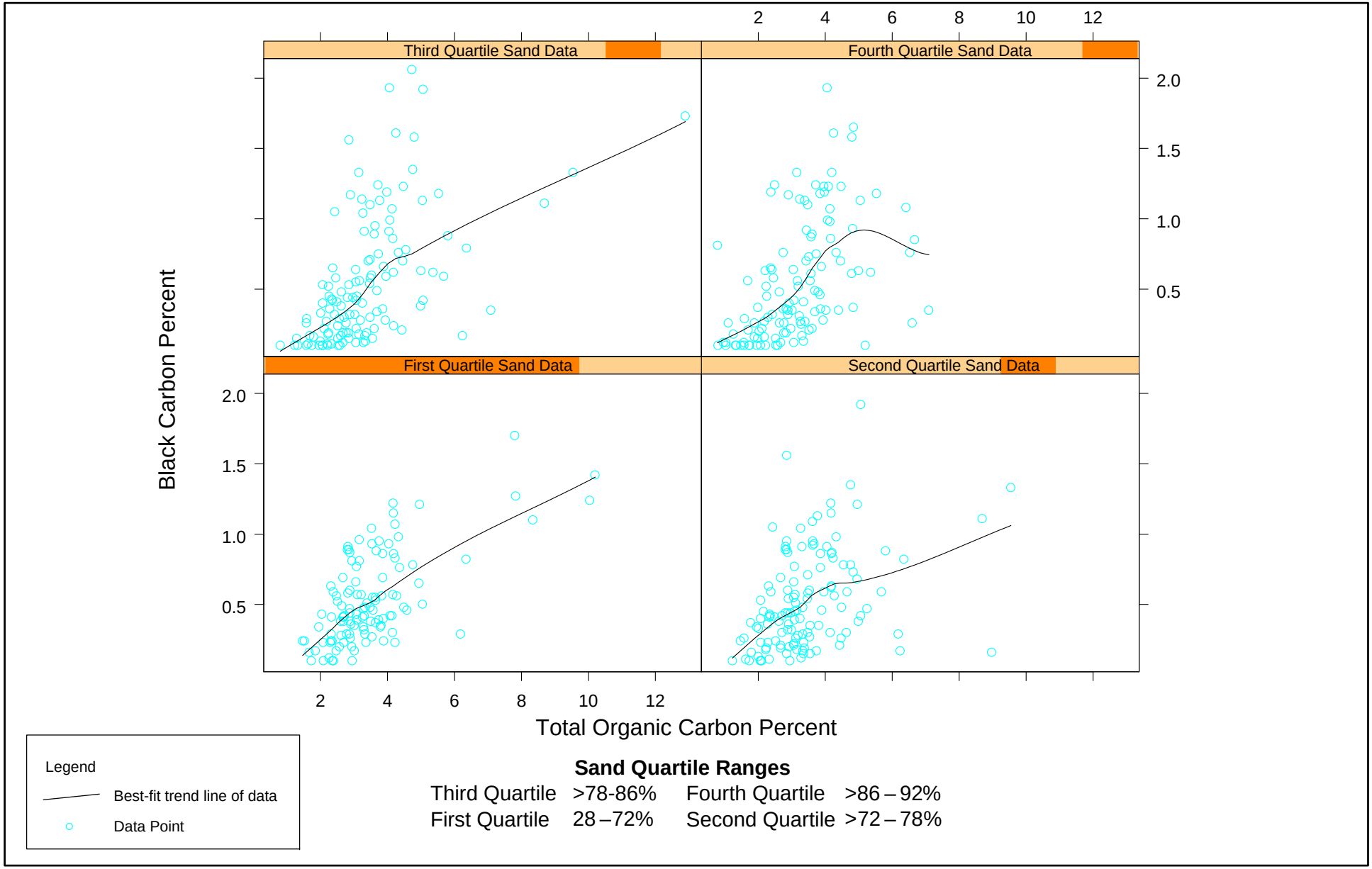


Figure 3-14C
Black Carbon vs. TOC for Sand Conditioning Plot
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

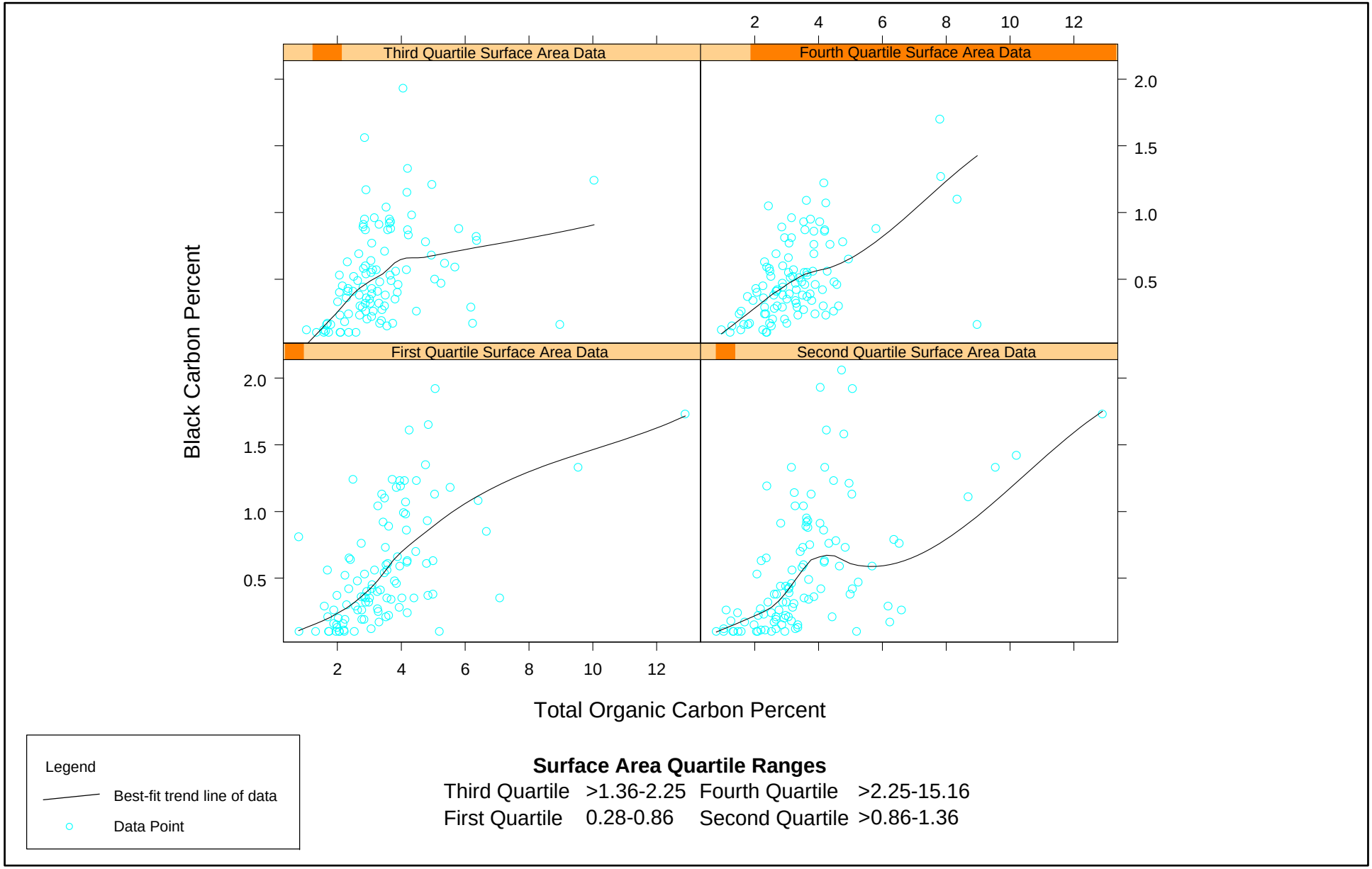
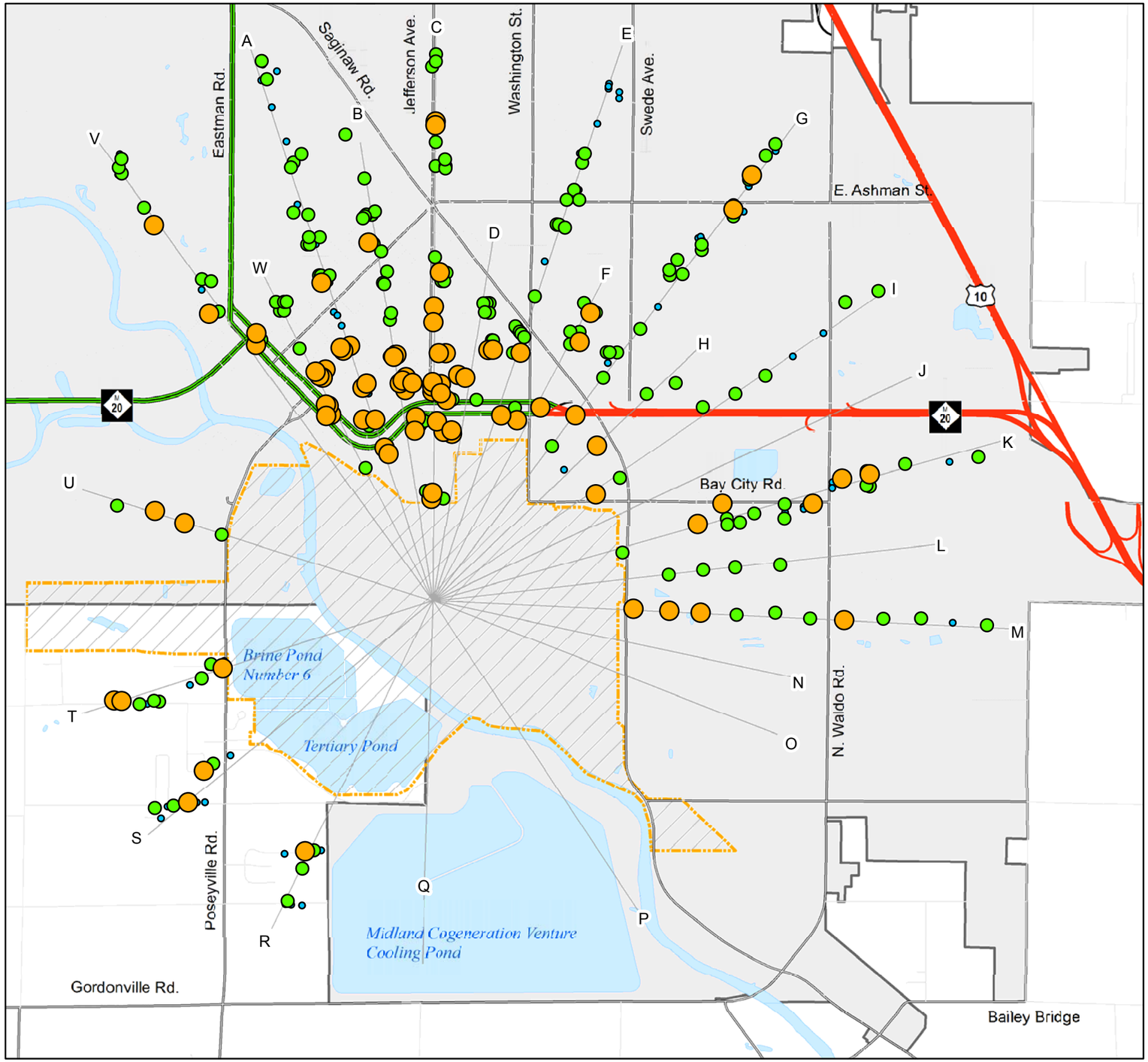
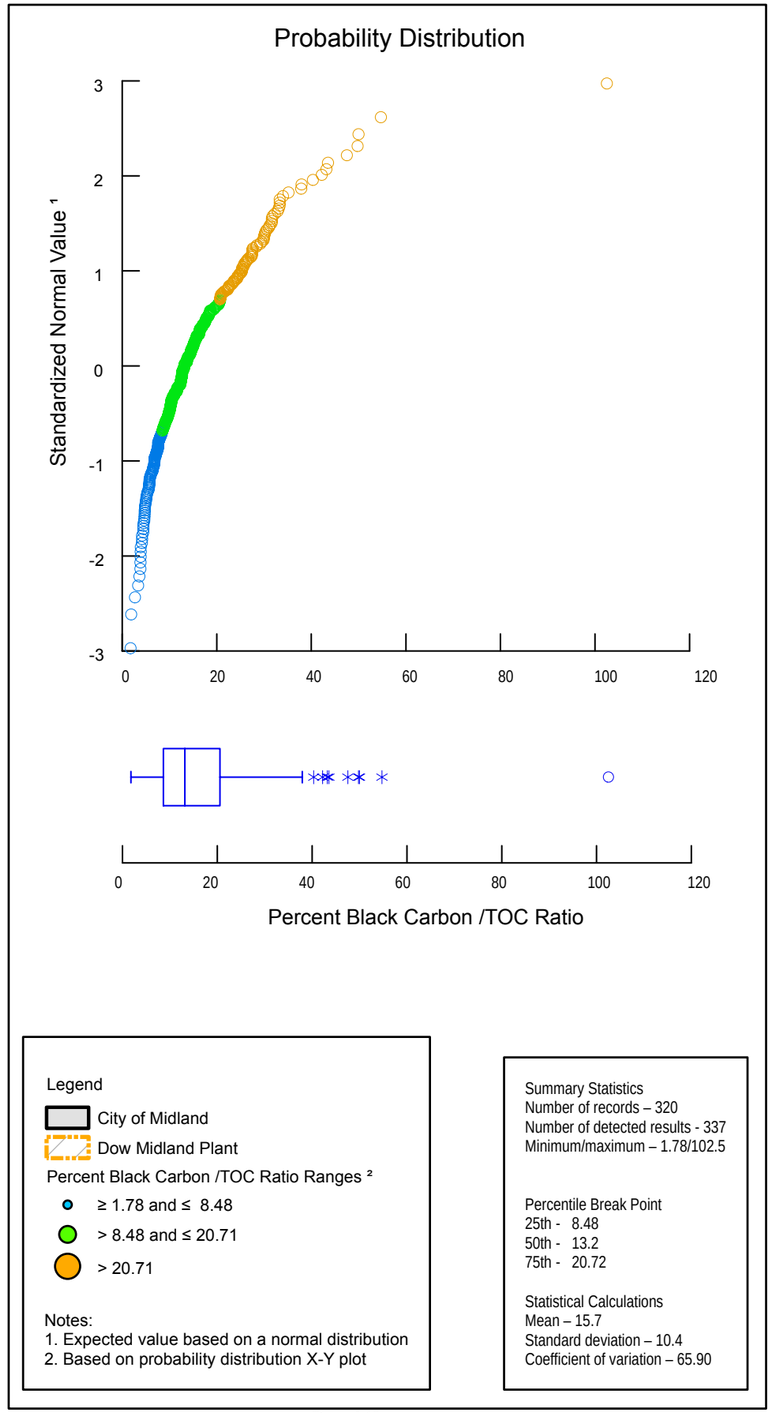


Figure 3-14D
Black Carbon vs. TOC for Surface Area Conditioning Plot
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils





Legend

City of Midland

Dow Midland Plant

Percent Black Carbon /TOC Ratio Ranges ²

- ≥ 1.78 and ≤ 8.48
- > 8.48 and ≤ 20.71
- > 20.71

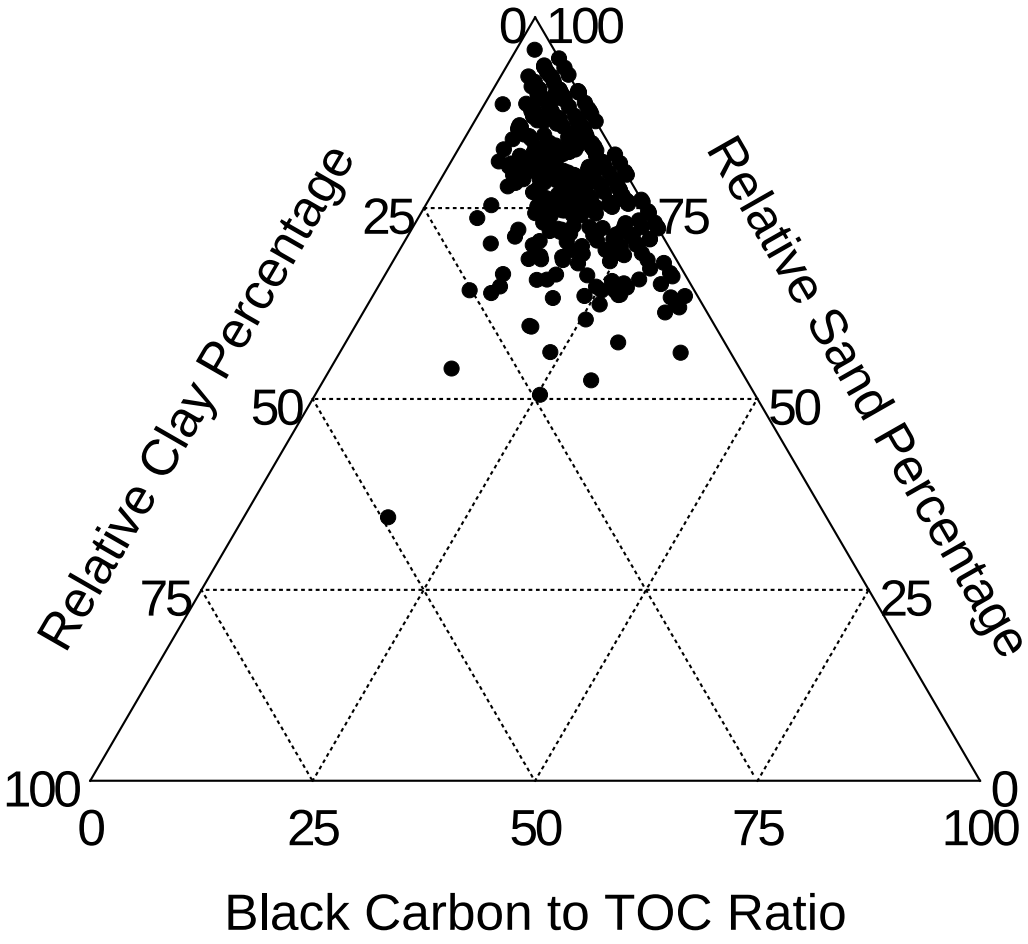
Notes:
1. Expected value based on a normal distribution
2. Based on probability distribution X-Y plot

Summary Statistics
Number of records – 320
Number of detected results - 337
Minimum/maximum – 1.78/102.5

Percentile Break Point
25th - 8.48
50th - 13.2
75th - 20.72

Statistical Calculations
Mean – 15.7
Standard deviation – 10.4
Coefficient of variation – 65.90

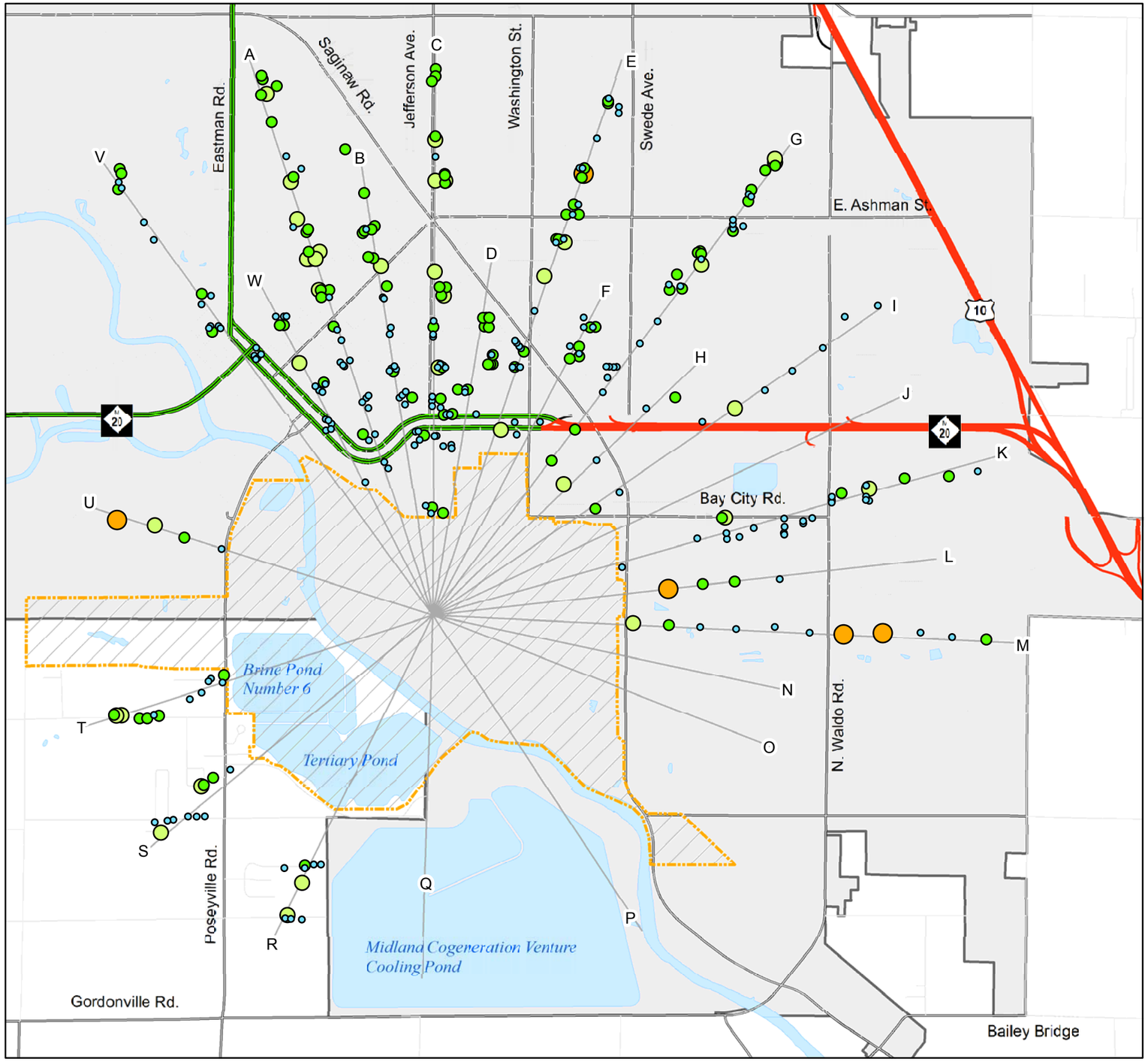
Figure 3-15
Black Carbon/TOC Ratio Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

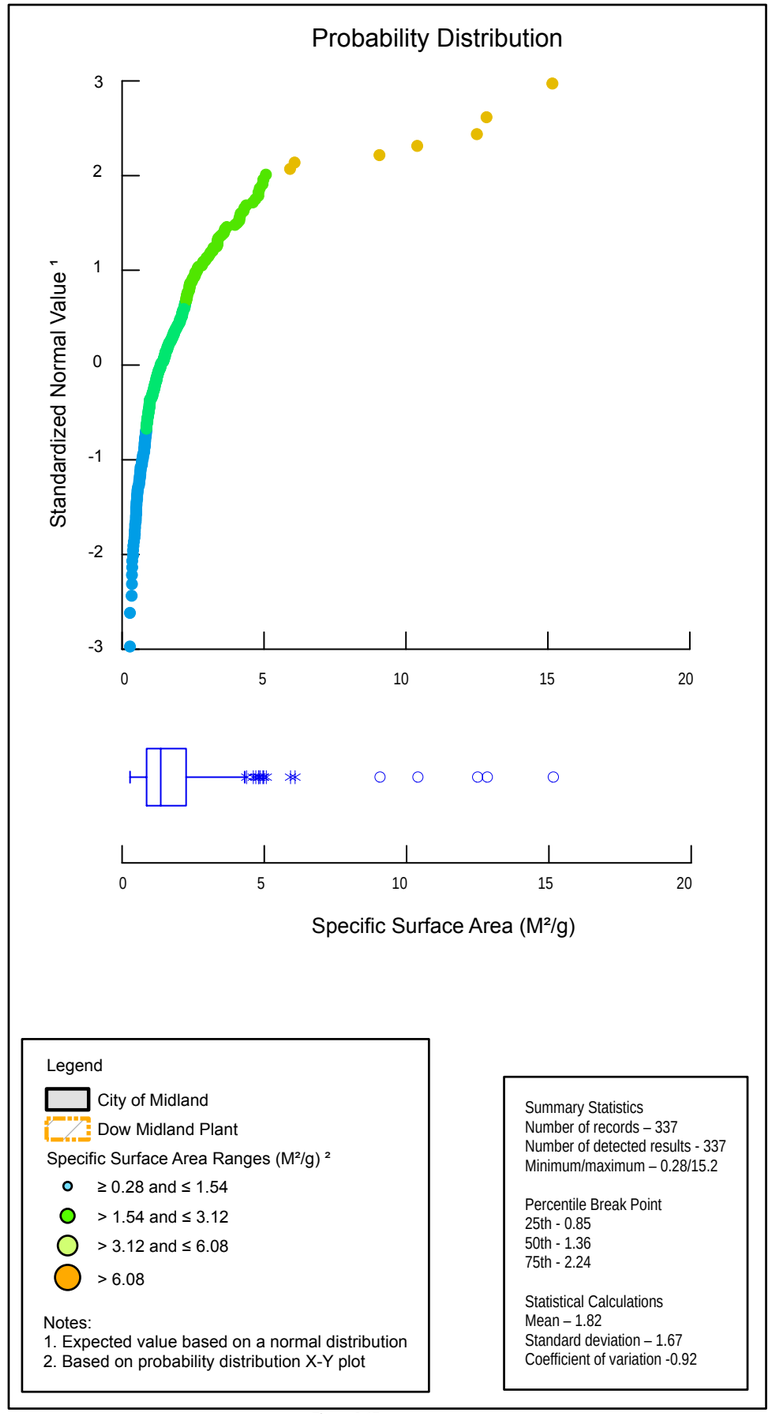


Note: Clay and sand percentages are with respect to each other

Legend
● Soil Results, 337 total
TOC=Total organic carbon

Figure 3-16
Sand, Clay and Black Carbon/TOC Ratio Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils





Legend

- City of Midland
- Dow Midland Plant

Specific Surface Area Ranges (M²/g) ²

- ≥ 0.28 and ≤ 1.54
- > 1.54 and ≤ 3.12
- > 3.12 and ≤ 6.08
- > 6.08

Notes:
1. Expected value based on a normal distribution
2. Based on probability distribution X-Y plot

Summary Statistics
Number of records – 337
Number of detected results - 337
Minimum/maximum – 0.28/15.2

Percentile Break Point
25th - 0.85
50th - 1.36
75th - 2.24

Statistical Calculations
Mean – 1.82
Standard deviation – 1.67
Coefficient of variation -0.92

Figure 3-17
Surface Area Percentage Distribution Across the Midland Area
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SECTION 4

Summary and Conclusions

This report presents the sampling results for physical and chemical parameters measured in soil samples collected in the vicinity of the Dow Midland Plant in Midland, Michigan. The report met the objectives of the study as summarized below:

- The distribution of physical and chemical parameters that are reported to influence bioavailability was characterized for the Study Area. The overall variability of each parameter is comparatively low across the Study Area. Although groups of statistically similar samples can be distinguished based on relative grain size distribution, the samples within each group are not geographically contiguous.
- Additional information was developed to supplement historical information on the nature and extent of dioxins and furans in Midland area soils. The range of concentrations reported was consistent with those previously reported in other studies. Because of the sample blinding requirements of the study, it was not possible to evaluate the spatial extent of dioxin and furans.
- Information was developed on the presence of hazardous substances in soil in the Study Area proximal to the Midland Plant. These included analyses of VOCs, SVOCs, metals, pesticides, and PCBs. Only 17 compounds were identified that exceeded the most stringent MDEQ generic cleanup criteria. It was not possible to assess whether these compounds were related to releases from the Midland Plant due to the blinding requirements of the study.

SECTION 5

References

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Appendix A

Sampling and Analysis Plan Deviation Summary

TABLE A-1
Summary of SAP Deviations
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SAP Deviation and Resolution		
Deviation from Project Plan	**Discussion and Resolution**	**Impact on Results**
Additional chemical sites H-02, M-02, O-01, S-02, and U-01, originally sampled on 11/1 were resampled on 11/2	Because additional chemical stations not requiring MDEQ splits were sampled the first day, not all MDEQ splits could be collected. Due to blinding protocol, stations had to be resampled on the date the remaining MDEQ additional chemical splits were collected.	No impact. In all cases, properly collected samples were submitted to the lab.
No grass seed was used at the sample locations	Sample crews were able to preserve the turf while collecting samples. Lawns were not disturbed enough to require reseeding.	No impact. Lawns were restored to pre-sample conditions.
Sample crews used different tools to collect samples.	Crews used trowels and/or bulb setters to collect samples. Each individual decided which tool was preferred.	No impact. All tools allowed collection of samples from defined intervals, were stainless steel, and were decontaminated following SOPs.
Some stations had more than five parcels with approved access agreements, but less than five parcels were sampled.	At the time parcels were randomly chosen for each station, the sample locations for that station were finalized. In cases where access agreements were received after the date of station finalization, those additional parcels were not considered for sampling.	No impact. In no instance was a station finalized and eliminated from sampling due to an insufficient number of agreements which were later received.
Two samples were submitted to the wrong lab.	Two samples intended for QTI were mistakenly sent to PTL. PTL was able to locate these samples and turned them over to QTI for analysis.	No impact. In all cases, properly collected samples were submitted to the lab. The samples affected did not have minimum holding times.
One sample was mistakenly submitted for analysis.	One soil parameter sample was taken from a location that should not have been sampled for soil parameters. This sample was submitted to the labs for analysis. The labs were contacted and instructed not to report results for this sample and to turn over the sample to FTC&H for disposal.	No impact. The sample and any results of analysis were properly disposed of.
Parcels were added to stations A-10 and C-13.	These stations had two access agreements approved. In order to obtain the minimum three agreements required for sampling the station, the size of the station was enlarged and additional parcels were added.	The impact of this action was the ability to sample more stations than would have otherwise been possible.

TABLE A-1
Summary of SAP Deviations
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SAP Deviation and Resolution		
Deviation from Project Plan	**Discussion and Resolution**	**Impact on Results**
Additional handling of samples was required in order to accommodate the blinding procedures.	Samples jars were labeled using masking tape in the field. To assist with the blinding process, removable wire tag labels were attached around the necks of the sample bottles before the samples were transferred to FTC&H. To prevent the labels from being dislodged during transport, electrical tape was wrapped around the wire at the neck of the bottle.	The use of electrical tape to accommodate the blinding procedures may have attributed to the high toluene concentrations in many of the samples.
All residual soil collected during the sampling event were transferred to FTC&H once sampling was completed.	In some cases, soil was collected, but not sent for analysis. MDEQ splits were collected, but never claimed by MDEQ officials. An excess of soil was mistakenly collected at some locations. In addition, there were a small number of broken sample bottles and their contents.	No impact. In all cases, properly collected samples were submitted to the lab. Excess samples were submitted to FTC&H to retain blinding and ensure they were not analyzed.
Soil samples collected in 32-ounce jars were later divided into three jars.	At the beginning of sampling, the plan was for all soil parameters to be analyzed by a single lab. Later, it was determined that these parameters would be analyzed by three separate labs. All decontamination procedures were utilized in the transfer of soil from large jars to small jars.	No impact. In all cases, properly collected samples were submitted to the lab.
Chain-of-custody handoff irregularity.	Both signed copies of a chain-of-custody went with MDEQ when they picked up a set of splits. In addition, one equipment blank was transferred to FTC&H without being added to the chain-of-custody. A chain-of-custody was generated and submitted to FTC&H on the next sample transfer date.	No impact. In all cases, properly collected samples were submitted to the lab.
Document cleanup issues	During QC of the field documents, some inconsistencies between field books and data sheets were found. All changes to these documents were initialed by the reviewer and dated.	No impact expected. In all cases, properly collected samples were submitted to the lab.
A different land use classification was provided by the field team than that of the GIS analysis for a number of parcels.	GIS personnel and field team members participated in a conference call to discuss land use for these parcels. In all cases, an agreement was reached concerning the correct land use.	No impact. Suitable land use classifications are assigned to all parcels.

TABLE A-1
Summary of SAP Deviations
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

SAP Deviation and Resolution		
Deviation from Project Plan	**Discussion and Resolution**	**Impact on Results**
Differences were found between the number of jars of soil and the number listed in tracking files.	One parameter duplicate was listed in the tracking files, but was never collected. No chain-of-custody was generated for this sample. It has been determined that this duplicate was a typographical error in the tracking file. Five MDEQ splits were collected, but no chain-of-custody was ever generated for these samples. MDEQ officials were present during sample collection and took these samples with them. Consequently, there was no need for a chain-of-custody.	No impact. In all cases, properly collected samples were submitted to the lab.

Appendix B

Quality Control Sample Summary and Equipment and Trip Blank Results

TABLE B-1
Summary of Quality Control Samples and Sample Intervals by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

	0- to 1-inch Sampling Interval*						1- to 6-inch Sampling Interval*			
Station ID	Collocates	Additional Chemical Duplicates	Additional Chemical Splits	Additional Chemical MS/MSD	Soil Parameter Duplicates	Soil Parameter Splits	Collocates	Additional Chemical Duplicates	Additional Chemical Splits	Additional Chemical MS/MSD
A-01	0	1	0	1	0	0	0	1	0	1
A-02	0	0	2	0	0	2	0	0	2	0
A-03	0	0	0	0	0	0	-	-	-	-
A-04	0	0	0	0	0	0	-	-	-	-
A-05	0	0	0	0	0	0	-	-	-	-
A-06	0	0	0	0	0	0	-	-	-	-
A-07	0	0	0	0	0	0	-	-	-	-
A-08	0	0	0	0	1	0	-	-	-	-
A-09	4	0	0	0	0	0	-	-	-	-
A-10	0	0	0	0	0	3	-	-	-	-
A-11	0	0	0	0	0	0	-	-	-	-
A-12	0	0	0	0	0	0	-	-	-	-
A-13	0	0	0	0	0	0	-	-	-	-
B-01	0	0	0	0	1	0	0	0	0	0
B-03	5	0	0	0	1	0	-	-	-	-
B-04	5	0	0	0	1	0	-	-	-	-
B-05	0	0	0	0	1	0	-	-	-	-
B-06	2	0	0	0	0	0	-	-	-	-
B-07	0	0	0	0	1	0	-	-	-	-
B-08	3	0	0	0	0	0	-	-	-	-
B-09	0	0	0	0	1	0	-	-	-	-
B-10	0	0	0	0	0	0	-	-	-	-
B-11	0	0	0	0	0	0	-	-	-	-
C-01	0	0	3	0	0	2	0	0	3	0
C-02	3	0	0	0	0	0	3	0	0	0
C-03	0	0	0	0	1	0	-	-	-	-
C-04	0	0	0	0	1	0	-	-	-	-
C-05	0	0	0	0	0	5	-	-	-	-
C-06	0	0	0	0	0	4	-	-	-	-
C-07	0	0	0	0	1	4	-	-	-	-
C-08	0	0	0	0	0	0	-	-	-	-
C-10	0	0	0	0	1	0	-	-	-	-
C-11	0	0	0	0	1	0	-	-	-	-
C-13	0	0	0	0	0	0	-	-	-	-
D-01	0	1	0	1	0	0	0	1	0	1
D-02	0	0	5	0	0	3	0	0	5	0
D-03	0	0	0	0	0	0	-		-	-
D-04	0	0	0	0	0	0	-		-	-
D-05	0	0	0	0	0	0	-		-	-
E-01	0	0	0	0	0	0	0	0	0	0
E-02	0	0	0	0	1	0	0	0	0	0
E-03	0	0	0	0	0	0	-	-	-	-
E-04	0	0	0	0	0	5	-	-	-	-
E-05	0	0	0	0	0	0	-	-	-	-
E-06	0	0	0	0	0	0	-	-	-	-
E-07	0	0	0	0	0	0	-	-	-	-
E-08	5	0	0	0	0	0	-	-	-	-
E-09	0	0	0	0	1	0	-	-	-	-
E-10	1	0	0	0	0	0	-	-	-	-
E-11	0	0	0	0	1	0	-	-	-	-
F-01	0	0	0	0	0	0	0	0	0	0
F-02	0	0	0	0	0	0	0	0	0	0
F-04	0	0	0	0	0	0	-	-	-	-
F-05	0	0	0	0	0	0	-	-	-	-
G-01	0	1	0	1	0	0	0	1	0	1
G-02	0	1	0	1	0	0	0	1	0	1
G-03	0	0	0	0	1	0	-	-	-	-
G-04	0	0	0	0	0	0	-	-	-	-
G-05	0	0	0	0	1	0	-	-	-	-
G-06	1	0	0	0	1	0	-	-	-	-
G-07	0	0	0	0	0	0	-	-	-	-
G-08	0	0	0	0	1	0	-	-	-	-
G-09	0	0	0	0	0	0	-	-	-	-
G-10	0	0	0	0	1	0	-	-	-	-
G-11	0	0	0	0	0	0	-	-	-	-
G-12	0	0	0	0	1	0	-	-	-	-
H-02	0	0	1	0	0	1	0	0	1	0
H-03	1	0	0	0	0	0	1	0	0	0
H-04	0	0	0	0	0	0	-	-	-	-
H-05	0	0	0	0	0	0	-	-	-	-
I-01	0	0	0	0	0	0	0	0	0	0
I-02	0	0	0	0	0	0	0	0	0	0
I-04	0	0	0	0	1	0	-	-	-	-
I-05	0	0	0	0	0	0	-	-	-	-
I-06	1	0	0	0	0	0	-	-	-	-
I-07	1	0	0	0	0	0	-	-	-	-
I-08	0	0	0	0	0	0	-	-	-	-
I-09	0	0	0	0	0	0	-	-	-	-
I-10	0	0	0	0	0	0	-	-	-	-

TABLE B-1
Summary of Quality Control Samples and Sample Intervals by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

	0- to 1-inch Sampling Interval*						1- to 6-inch Sampling Interval*			
Station ID	**Collocates**	**Additional Chemical Duplicates**	**Additional Chemical Splits**	**Additional Chemical MS/MSD**	**Soil Parameter Duplicates**	**Soil Parameter Splits**	**Collocates**	**Additional Chemical Duplicates**	**Additional Chemical Splits**	**Additional Chemical MS/MSD**
J-01	0	0	0	0	0	0	0	0	0	0
J-02	0	0	0	0	0	0	0	0	0	0
K-01	0	1	0	1	0	0	0	1	0	1
K-03	0	0	0	0	0	0	-	-	-	-
K-04	0	0	0	0	1	0	-	-	-	-
K-05	0	0	0	0	1	5	-	-	-	-
K-06	0	0	0	0	1	0	-	-	-	-
K-07	0	0	0	0	0	0	-	-	-	-
K-08	0	0	0	0	0	0	-	-	-	-
K-09	0	0	0	0	0	0	-	-	-	-
K-10	1	0	0	0	1	0	-	-	-	-
K-11	1	0	0	0	0	0	-	-	-	-
L-01	0	0	0	0	0	0	0	0	0	0
L-02	0	0	0	0	0	0	0	0	0	0
L-03	0	0	0	0	1	0	-	-	-	-
L-04	0	0	0	0	0	0	-	-	-	-
L-05	0	0	0	0	0	0	-	-	-	-
M-01	1	0	0	0	0	0	1	0	0	0
M-02	0	0	1	0	0	1	0	0	1	0
M-03	0	0	0	0	0	0	-	-	-	-
M-04	0	0	0	0	1	0	-	-	-	-
M-05	0	0	0	0	0	0	-	-	-	-
M-06	0	0	0	0	0	0	-	-	-	-
M-07	0	0	0	0	1	0	-	-	-	-
M-08	0	0	0	0	0	0	-	-	-	-
M-09	0	0	0	0	0	0	-	-	-	-
M-10	0	0	0	0	0	0	-	-	-	-
M-11	0	0	0	0	0	0	-	-	-	-
N-01	0	0	0	0	0	0	0	0	0	0
O-01	0	0	0	0	0	0	0	0	0	0
R-02	0	5	0	5	0	0	0	5	0	5
R-03	0	0	0	0	1	0	-	-	-	-
R-04	0	0	0	0	1	4	-	-	-	-
S-01	1	0	0	0	1	0	1	0	0	0
S-02	0	0	3	0	0	2	0	0	3	0
S-03	0	0	0	0	0	0	-	-	-	-
S-04	0	0	0	0	0	0	-	-	-	-
T-01	0	0	0	0	0	0	0	0	0	0
T-02	0	0	0	0	0	0	0	0	0	0
T-03	0	0	0	0	1	0	-	-	-	-
T-04	0	0	0	0	0	0	-	-	-	-
U-01	0	0	1	0	0	1	0	0	1	0
U-02	0	0	0	0	0	0	0	0	0	0
U-03	1	0	0	0	0	0	-	-	-	-
U-04	1	0	0	0	0	0	-	-	-	-
V-02	0	0	0	0	0	0	0	0	0	0
V-04	0	0	0	0	0	0	-	-	-	-
V-05	5	0	0	0	0	0	-	-	-	-
V-06	3	0	0	0	1	0	-	-	-	-
V-08	0	0	0	0	0	0	-	-	-	-
V-09	0	0	0	0	0	0	-	-	-	-
V-10	5	0	0	0	0	0	-	-	-	-
W-01	0	0	0	0	0	0	0	0	0	0
W-03	5	0	0	0	2	0	5	0	0	0
W-04	0	0	0	0	0	0	-	-	-	-
W-05	0	0	0	0	0	0	-	-	-	-
W-06	0	0	0	0	0	0	-	-	-	-
TOTALS	**56**	**10**	**16**	**10**	**36**	**42**	**11**	**10**	**16**	**10**

*Duplicate, split, and MS/MSD samples were collected at every sampling location for dioxins and furans; therefore, they were not summarized in this table.

- = no sample collected from 1 to 6 inches

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-1	EB-10-23-06-1	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	1		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-2	EB-10-23-06-2	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-3	EB-10-23-06-3	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-4	EB-10-23-06-4	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-5	EB-10-23-06-5	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-23-06-6	EB-10-23-06-6	10-23-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Pentachloro-dibenzofuran	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10-30-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10-30-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10-30-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10-30-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-10-30-06-5	EB-10-30-06-5	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-1	EB-11-06-06-1	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-2	EB-11-06-06-2	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-3	EB-11-06-06-3	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-4	EB-11-06-06-4	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-5	EB-11-06-06-5	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-06-06-6	EB-11-06-06-6	11-06-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11-13-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11-13-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11-13-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Heptachloro-dibenzofuran	0		ng/L

TABLE B-2
Dioxin and Furan - Equipment Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-4	EB-11-13-06-4	11-13-2006	Total Tetrachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	2,3,4,7,8-PENTACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	2,3,7,8-TETRACHLORODIBENZOFURAN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5		2005 WHO Mammalian TEQ	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Heptachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Heptachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Hexachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Hexachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Pentachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Pentachloro-dibenzofuran	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Tetrachloro-dibenzodioxin	0		ng/L
MidBlind_EB-11-13-06-5	EB-11-13-06-5	11-13-2006	Total Tetrachloro-dibenzofuran	0		ng/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Hexanone	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acetone	2.94		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chloroform	2.96		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Bromomethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chloromethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dibromomethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Vinyl chloride	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acetonitrile	50		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methylene chloride	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Carbon disulfide	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Bromoform	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Isobutanol	25		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzyl alcohol	4.46		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Phenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pyridine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	bis(2-ethylhexyl) phthalate	5.06		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Di-n-octylphthalate	1.09		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Anthracene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Isosafrole	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acetophenone	0.67		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Total Organic Carbon	1.1		mg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Sulfide	0.5		mg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Diphenylamine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pyrene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	1.09		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Aramite (Total)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Kepone	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachloropropene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Fluoranthene	2.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chrysene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pronamide	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Phorate	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Disulfoton	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Isodrin	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Famphur	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dimethoate	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Phenacetin	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Aniline	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachlorophene	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pentochlorethane	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Isophorone	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Diethyl phthalate	3.01		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Di-n-butyl phthalate	0.627		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Fluorene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dinoseb	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Naphthalene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methapyrilene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Safrole	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2-Methylphenol (o-Cresol)	0.23		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	o-Toluidine	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1		SUMMED PCB	2.25		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Mercury	0.04		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Lead	1.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Nickel	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Silver	0.6		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Thallium	1.4		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Tin	2.3		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Antimony	3.7		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Arsenic	2.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Barium	0.3		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Beryllium	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Cadmium	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Cobalt	0.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Copper	1.2		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Vanadium	2.18		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Zinc	1,380		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Selenium	3.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Styrene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Aldrin	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	BETA BHC	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chlordane	0.25		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dieldrin	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Endrin	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Heptachlor	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Toxaphene	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acrolein	25		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Acrylonitrile	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Vinyl acetate	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Toluene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Chlorobenzene	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	Xylenes, Total	5		µg/L
MidBlind_EB-10-30-06-1	EB-10-30-06-1	10/30/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2		SUMMED PCB	2.25		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Mercury	0.04		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Lead	1.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Nickel	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Silver	0.6		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Thallium	1.54		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Tin	2.3		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Antimony	3.7		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Arsenic	4.25		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Barium	0.3		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Beryllium	0.15		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Cadmium	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Cobalt	0.68		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Copper	1.2		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Vanadium	1.84		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Zinc	67.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Selenium	3.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Styrene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acrolein	25		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acrylonitrile	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Vinyl acetate	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Toluene	0.98		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chlorobenzene	1		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Xylenes, Total	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Hexanone	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acetone	2.93		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chloroform	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Bromomethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chloromethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dibromomethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Vinyl chloride	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acetonitrile	50		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methylene chloride	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Carbon disulfide	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Bromoform	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Isobutanol	25		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Diethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Fluorene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dinoseb	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Naphthalene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methapyrilene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Safrole	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	o-Toluidine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acetophenone	0.366		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Aldrin	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	ALPHA BHC	0.05		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	BETA BHC	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chlordane	0.25		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dieldrin	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Endrin	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Heptachlor	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Toxaphene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Sulfide	0.5		mg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Phenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pyridine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	bis(2-ethylhexyl) phthalate	2.87		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Anthracene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Isosafrole	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Diphenylamine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pyrene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Aramite (Total)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Kepone	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachloropropene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chrysene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pronamide	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Phorate	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Disulfoton	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Isodrin	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Famphur	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Benzo(a)anthracene	2.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Dimethoate	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Phenacetin	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Aniline	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachlorophene	10		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pentochlorethane	5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Isophorone	2.5		µg/L
MidBlind_EB-10-30-06-2	EB-10-30-06-2	10/30/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Aldrin	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	BETA BHC	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chlordane	0.25		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dieldrin	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Endrin	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Heptachlor	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Toxaphene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Sulfide	0.5		mg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chrysene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pronamide	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Phorate	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Disulfoton	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Isodrin	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Famphur	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dimethoate	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Phenacetin	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Aniline	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachlorophene	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pentochlorethane	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachlorocyclopentadiene	2.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Isophorone	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Diethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Fluorene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dinoseb	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Naphthalene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methapyrilene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Safrole	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	o-Toluidine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acetophenone	0.361		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Mercury	0.04		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Lead	1.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Nickel	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Silver	0.6		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Thallium	0.89		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Tin	2.3		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Antimony	3.7		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Arsenic	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Barium	0.3		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Beryllium	0.11		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Cadmium	0.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Cobalt	0.51		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Copper	1.2		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Vanadium	1.37		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Zinc	1.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Selenium	3.1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Styrene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acrolein	25		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acrylonitrile	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Vinyl acetate	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Toluene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chlorobenzene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Xylenes, Total	5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2-Hexanone	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acetone	25		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chloroform	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Bromomethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chloromethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dibromomethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Chloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Vinyl chloride	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acetonitrile	50		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methylene chloride	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Carbon disulfide	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Bromoform	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Isobutanol	25		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Phenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pyridine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	bis(2-ethylhexyl) phthalate	3.24		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Anthracene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Isosafrole	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Diphenylamine	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Pyrene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Aramite (Total)	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Kepone	10		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Hexachloropropene	5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3	10/30/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-10-30-06-3	EB-10-30-06-3		SUMMED PCB	2.25		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4		SUMMED PCB	2.25		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Fluorene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4,6-Trichlorophenol	2.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dinoseb	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Naphthalene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methapyrilene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Safrole	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	o-Toluidine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acetophenone	0.416		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Aldrin	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	BETA BHC	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	DELTA BHC	0.012		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chlordane	0.25		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dieldrin	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Endrin	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Heptachlor	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Toxaphene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Sulfide	0.5		mg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Phenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pyridine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	bis(2-ethylhexyl) phthalate	2.65		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Anthracene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Isosafrole	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Diphenylamine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pyrene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Aramite (Total)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Kepone	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachloropropene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chrysene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pronamide	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Phorate	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Disulfoton	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Isodrin	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Famphur	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dimethoate	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Phenacetin	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Aniline	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachlorophene	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pentochlorethane	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Isophorone	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Diethyl phthalate	2.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Mercury	0.04		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Lead	1.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Nickel	0.51		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Silver	0.6		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Thallium	0.89		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Tin	2.3		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Antimony	3.7		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Arsenic	3.23		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Barium	0.3		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Beryllium	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Cadmium	0.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Cobalt	0.5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Copper	1.2		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Vanadium	0.7		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Zinc	1.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Selenium	3.1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Styrene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acrolein	25		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acrylonitrile	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Vinyl acetate	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Toluene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chlorobenzene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Xylenes, Total	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	2-Hexanone	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acetone	2.72		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chloroform	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Benzene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Bromomethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chloromethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dibromomethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Chloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Vinyl chloride	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Acetonitrile	50		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methylene chloride	5		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Carbon disulfide	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Bromoform	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Isobutanol	25		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-10-30-06-4	EB-10-30-06-4	10/30/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Mercury	0.09048		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Lead	1.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Nickel	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Silver	0.6		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Thallium	1.4		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Tin	2.3		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Antimony	3.7		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Arsenic	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Barium	0.3		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Beryllium	0.12		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Cadmium	0.34		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Cobalt	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Copper	1.2		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Vanadium	0.7		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Zinc	5.53		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Selenium	3.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Styrene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acrolein	25		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acrylonitrile	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Vinyl acetate	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Toluene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chlorobenzene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Xylenes, Total	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Hexanone	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acetone	25		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chloroform	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Bromomethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chloromethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dibromomethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Vinyl chloride	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acetonitrile	50		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methylene chloride	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Carbon disulfide	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Bromoform	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Isobutanol	25		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Phenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pyridine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	bis(2-ethylhexyl) phthalate	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Anthracene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Isosafrole	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acetophenone	0.216		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Aldrin	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	BETA BHC	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chlordane	0.25		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dieldrin	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Endrin	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Endrin aldehyde	0.1		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
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Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Heptachlor	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Toxaphene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Cyanide, Total	0.001		mg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Sulfide	0.5		mg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1		SUMMED PCB	2.25		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Diphenylamine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pyrene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Aramite (Total)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Kepone	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachloropropene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chrysene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pronamide	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Phorate	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Disulfoton	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Isodrin	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Famphur	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dimethoate	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Phenacetin	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Aniline	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachlorophene	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pentochlorethane	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Isophorone	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Diethyl phthalate	0.157		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Fluorene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Dinoseb	10		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Naphthalene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Naphthylamine	10		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Methapyrilene	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	Safrole	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	o-Toluidine	5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-1	EB-11-13-06-1	11/13/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acetone	25		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chloroform	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Bromomethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chloromethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dibromomethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Vinyl chloride	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acetonitrile	50		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methylene chloride	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Carbon disulfide	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Bromoform	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Isobutanol	25		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Phenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pyridine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	bis(2-ethylhexyl) phthalate	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Anthracene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Isosafrole	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Diphenylamine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pyrene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Aramite (Total)	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Kepone	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachloropropene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chrysene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pronamide	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Phorate	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Disulfoton	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Isodrin	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Famphur	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2		SUMMED PCB	2.25		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Sulfide	0.5		mg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dimethoate	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Phenacetin	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Aniline	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachlorophene	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pentochlorethane	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Isophorone	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Diethyl phthalate	0.153		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Fluorene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dinoseb	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Naphthalene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methapyrilene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Safrole	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	o-Toluidine	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acetophenone	0.274		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Aldrin	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	BETA BHC	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chlordane	0.25		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dieldrin	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Endrin	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methoxychlor	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Heptachlor	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Toxaphene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Mercury	0.04		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Lead	1.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Nickel	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Silver	0.6		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Thallium	0.89		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Tin	2.3		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Antimony	3.7		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Arsenic	2.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Barium	0.3		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Beryllium	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Cadmium	0.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Cobalt	0.5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Copper	1.2		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Vanadium	1.42		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Zinc	5.08		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Selenium	3.1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Styrene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acrolein	25		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Acrylonitrile	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Vinyl acetate	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Toluene	1.3		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Chlorobenzene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Xylenes, Total	5		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-11-13-06-2	EB-11-13-06-2	11/13/2006	2-Hexanone	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4,4'-DDD	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4,4'-DDE	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Endrin aldehyde	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Heptachlor	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Toxaphene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Endosulfan I	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Total Organic Carbon	1		mg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Cyanide, Total	0.005		mg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Sulfide	0.5		mg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Mercury	0.04		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Lead	1.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Nickel	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Silver	0.6		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Thallium	0.89		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Tin	2.3		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Antimony	3.7		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Arsenic	2.88		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Barium	0.3		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Beryllium	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Cadmium	0.1		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	CHROMIUM, TOTAL	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Cobalt	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Copper	1.2		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Vanadium	1.43		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Zinc	313		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Selenium	3.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Ethyl Benzene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Styrene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	cis-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	trans-1,3-Dichloropropene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2-Dibromoethane (EDB)	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acrolein	25		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Propionitrile, Ethyl Cyanide	50		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acrylonitrile	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Vinyl acetate	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Toluene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chlorobenzene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	trans-1,4-Dichloro-2-butene	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dibromochloromethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methylacrylonitrile	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Tetrachloroethene (PCE)	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Xylenes, Total	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	trans-1,2-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Carbon tetrachloride	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Hexanone	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1,1,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acetone	25		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chloroform	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1,1-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Bromomethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chloromethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methyl Iodide (Iodomethane)	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dibromomethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Vinyl chloride	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acetonitrile	50		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methylene chloride	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Carbon disulfide	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Bromoform	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Bromodichloromethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1-Dichloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1-Dichloroethene	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Trichlorofluoromethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dichlorodifluoromethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Isobutanol	25		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2-Dichloropropane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	METHYL ETHYL KETONE (2-BUTANONE)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1,2-Trichloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Trichloroethene (TCE)	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,1,2,2-Tetrachloroethane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2-Dibromo-3-chloropropane	2		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2,3-Trichloropropane	1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Ethyl methacrylate	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Nitrophenol	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzyl alcohol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosopiperidine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Bromophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4-Dimethylphenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosomethylethylamine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,4-Dichlorobenzene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Chloroaniline	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	p-Phenylenediamine	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,2'-Oxybis(1-Chloropropane)	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Phenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pyridine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Bis(2-Chloroethyl) ether	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Bis(2-Chloroethoxy) methane	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	bis(2-ethylhexyl) phthalate	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Di-n-octylphthalate	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	3,3'-Dimethylbenzidine	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Anthracene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Isosafrole	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Diphenylamine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,4-Dioxane	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	O,O,O-TRIETHYL PHOSPHOROTHIOATE	10		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pyrene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,4-Naphthoquinone	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dimethyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	3 & 4-METHYLPHENOL (M,P-CRESOL)	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dibenzofuran	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1-Naphthylamine	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Aramite (Total)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Kepone	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3		SUMMED PCB	2.25		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachloropropene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzo(g,h,i)perylene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	INDENO(1,2,3-C,D)PYRENE	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzo(b)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzo(k)fluoranthene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acenaphthylene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chrysene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pronamide	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PARATHION, METHYL	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Phorate	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Disulfoton	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Isodrin	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzo(a)pyrene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4-Dinitrophenol	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chlorobenzilate	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Famphur	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dibenz(a,h)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Acetylaminofluorene	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4,6-Dinitro-2-methylphenol	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,3-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosodiethylamine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PARATHION, ETHYL (PARATHION)	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	3-Methylcholanthrene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzo(a)anthracene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Nitroquinoline-1-oxide	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	7,12-Dimethylbenz(a)anthracene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,3,4,6-Tetrachlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Chloro-3-methylphenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosomorpholine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	p-Dimethylaminoazobenzene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dimethoate	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,6-Dinitrotoluene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pentachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Phenacetin	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Ethyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Aniline	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosodimethylamine	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosodi-n-propylamine	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methyl methanesulfonate	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachloroethane	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachlorophene	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Chlorophenyl phenyl ether	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pentochlorethane	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachlorocyclopentadiene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Isophorone	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pentachloronitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acenaphthene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Diethyl phthalate	0.163		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Di-n-butyl phthalate	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Phenanthrene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Benzyl Butyl Phthalate	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosodiphenylamine	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Fluorene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,6-Dichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Hexachlorobutadiene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Pentachlorophenol	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4,6-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Nitrophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dinoseb	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Naphthalene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Methylnaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Chloronaphthalene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Naphthylamine	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methapyrilene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	3,3'-Dichlorobenzidine	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4-Aminobiphenyl	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	N-Nitroso-di-n-butylamine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	n-Nitrosopyrrolidine	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Safrole	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Methylphenol (o-Cresol)	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2-Dichlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	o-Toluidine	5		µg/L

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2-Chlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,2,4,5-Tetrachlorobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4,5-Trichlorophenol	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Acetophenone	0.449		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Nitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	3-Nitroaniline	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Sym-Trinitrobenzene	5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	5-Nitro-o-toluidine	10		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	1,3-Dinitrobenzene	2.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1260 (AROCLOR 1260)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1254 (AROCLOR 1254)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1268 (AROCLOR 1268)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1221 (AROCLOR 1221)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1232 (AROCLOR 1232)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1248 (AROCLOR 1248)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1016 (AROCLOR 1016)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1262 (AROCLOR 1262)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	PCB-1242 (AROCLOR 1242)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	SILVEX (2,4,5-TP)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	2,4-D (DICHLOROPHENOXYACETIC ACID)	0.5		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Heptachlor epoxide	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Endosulfan sulfate	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Aldrin	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	ALPHA BHC	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	BETA BHC	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	DELTA BHC	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Endosulfan II	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	4,4'-DDT	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Chlordane	0.25		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	GAMMA BHC (LINDANE)	0.05		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Dieldrin	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Endrin	0.1		µg/L
MidBlind_EB-11-13-06-3	EB-11-13-06-3	11/13/2006	Methoxychlor	0.5		µg/L
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Bromoform	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Bromodichloromethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1-Dichloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1-Dichloroethene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Trichlorofluoromethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Dichlorodifluoromethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Isobutanol	58,100		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,2-Dichloropropane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	METHYL ETHYL KETONE (2-BUTANONE)	2,910		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1,2-Trichloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Trichloroethene (TCE)	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1,2,2-Tetrachloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Methyl methacrylate	1,160		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,2-Dibromo-3-chloropropane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,2,3-Trichloropropane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Ethyl methacrylate	1,160		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Ethyl Benzene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Styrene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	cis-1,3-Dichloropropene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	trans-1,3-Dichloropropene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,2-Dibromoethane (EDB)	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Acrolein	5,810		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	1,160		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,2-Dichloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Propionitrile, Ethyl Cyanide	11,600		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Acrylonitrile	5,810		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Vinyl acetate	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	1,160		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Toluene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Chlorobenzene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	trans-1,4-Dichloro-2-butene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Dibromochloromethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Methylacrylonitrile	2,910		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5,810		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Tetrachloroethene (PCE)	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Xylenes, Total	1,740		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	trans-1,2-Dichloroethene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Carbon tetrachloride	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	2-Hexanone	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1,1,2-Tetrachloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Acetone	1,460		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Chloroform	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Benzene	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	1,1,1-Trichloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Bromomethane	1,130		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Chloromethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Methyl Iodide (Iodomethane)	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Dibromomethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Chloroethane	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Vinyl chloride	581		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Acetonitrile	11,600		µg/kg
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Methylene chloride	2,910		µg/kg

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_TB-10-30-06-1	TB-10-30-06-1	11/3/2006	Carbon disulfide	581		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Ethyl Benzene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Styrene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	cis-1,3-Dichloropropene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	trans-1,3-Dichloropropene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,2-Dibromoethane (EDB)	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Acrolein	5,210		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	1,040		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,2-Dichloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Propionitrile, Ethyl Cyanide	10,400		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Acrylonitrile	5,210		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Vinyl acetate	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	1,040		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Toluene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Chlorobenzene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	trans-1,4-Dichloro-2-butene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Dibromochloromethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Methylacrylonitrile	2,600		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	5,210		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Tetrachloroethene (PCE)	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Xylenes, Total	1,560		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	trans-1,2-Dichloroethene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Carbon tetrachloride	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	2-Hexanone	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1,1,2-Tetrachloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Acetone	1,360		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Chloroform	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Benzene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1,1-Trichloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Bromomethane	1,260		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Chloromethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Methyl Iodide (Iodomethane)	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Dibromomethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Chloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Vinyl chloride	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Acetonitrile	10,400		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Methylene chloride	2,600		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Carbon disulfide	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Bromoform	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Bromodichloromethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1-Dichloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1-Dichloroethene	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Trichlorofluoromethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Dichlorodifluoromethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Isobutanol	52,100		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,2-Dichloropropane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	METHYL ETHYL KETONE (2-BUTANONE)	2,600		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1,2-Trichloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Trichloroethene (TCE)	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,1,2,2-Tetrachloroethane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Methyl methacrylate	1,040		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,2-Dibromo-3-chloropropane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	1,2,3-Trichloropropane	521		µg/kg
MidBlind_TB-10-30-06-2	TB-10-30-06-2	11/3/2006	Ethyl methacrylate	1,040		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Ethyl Benzene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Styrene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	cis-1,3-Dichloropropene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	trans-1,3-Dichloropropene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,2-Dibromoethane (EDB)	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Acrolein	2,620		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	524		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,2-Dichloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Propionitrile, Ethyl Cyanide	5,240		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Acrylonitrile	2,620		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Vinyl acetate	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	524		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Toluene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Chlorobenzene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	trans-1,4-Dichloro-2-butene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Dibromochloromethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Methylacrylonitrile	1,310		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	2,620		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Tetrachloroethene (PCE)	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Xylenes, Total	785		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	trans-1,2-Dichloroethene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Carbon tetrachloride	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	2-Hexanone	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1,1,2-Tetrachloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Acetone	3,050		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Chloroform	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Benzene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1,1-Trichloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Bromomethane	524		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Chloromethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Methyl Iodide (Iodomethane)	906		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Dibromomethane	262		µg/kg

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Chloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Vinyl chloride	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Acetonitrile	5,240		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Methylene chloride	1,310		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Carbon disulfide	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Bromoform	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Bromodichloromethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1-Dichloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1-Dichloroethene	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Trichlorofluoromethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Dichlorodifluoromethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Isobutanol	26,200		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,2-Dichloropropane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	METHYL ETHYL KETONE (2-BUTANONE)	1,310		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1,2-Trichloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Trichloroethene (TCE)	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,1,2,2-Tetrachloroethane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Methyl methacrylate	524		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,2-Dibromo-3-chloropropane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	1,2,3-Trichloropropane	262		µg/kg
MidBlind_TB-10-30-06-3	TB-10-30-06-3	11/3/2006	Ethyl methacrylate	524		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Ethyl Benzene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Styrene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	cis-1,3-Dichloropropene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	trans-1,3-Dichloropropene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,2-Dibromoethane (EDB)	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Acrolein	1,880		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	376		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,2-Dichloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Propionitrile, Ethyl Cyanide	3,760		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Acrylonitrile	1,880		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Vinyl acetate	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	376		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Toluene	960		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Chlorobenzene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	trans-1,4-Dichloro-2-butene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Dibromochloromethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Methylacrylonitrile	940		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	1,880		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Tetrachloroethene (PCE)	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Xylenes, Total	564		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	trans-1,2-Dichloroethene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Carbon tetrachloride	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	2-Hexanone	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1,1,2-Tetrachloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Acetone	4,320		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Chloroform	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Benzene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1,1-Trichloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Bromomethane	376		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Chloromethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Methyl Iodide (Iodomethane)	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Dibromomethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Chloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Vinyl chloride	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Acetonitrile	3,760		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Methylene chloride	940		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Carbon disulfide	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Bromoform	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Bromodichloromethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1-Dichloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1-Dichloroethene	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Trichlorofluoromethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Dichlorodifluoromethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Isobutanol	18,800		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,2-Dichloropropane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	METHYL ETHYL KETONE (2-BUTANONE)	940		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1,2-Trichloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Trichloroethene (TCE)	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,1,2,2-Tetrachloroethane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Methyl methacrylate	940		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,2-Dibromo-3-chloropropane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	1,2,3-Trichloropropane	188		µg/kg
MidBlind_TB-10-30-06-4	TB-10-30-06-4	11/3/2006	Ethyl methacrylate	376		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Ethyl Benzene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Styrene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	cis-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	trans-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,2-Dibromoethane (EDB)	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Acrolein	500		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	100		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,2-Dichloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Propionitrile, Ethyl Cyanide	1,000		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Acrylonitrile	500		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Vinyl acetate	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	100		µg/kg

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Toluene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Chlorobenzene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	trans-1,4-Dichloro-2-butene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Dibromochloromethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Methylacrylonitrile	250		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	500		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Tetrachloroethene (PCE)	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Xylenes, Total	150		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	trans-1,2-Dichloroethene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Carbon tetrachloride	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	2-Hexanone	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1,1,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Acetone	689		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Chloroform	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Benzene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1,1-Trichloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Bromomethane	100		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Chloromethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Methyl Iodide (Iodomethane)	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Dibromomethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Chloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Vinyl chloride	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Acetonitrile	1,000		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Methylene chloride	250		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Carbon disulfide	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Bromoform	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Bromodichloromethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1-Dichloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1-Dichloroethene	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Trichlorofluoromethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Dichlorodifluoromethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Isobutanol	5,000		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,2-Dichloropropane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	METHYL ETHYL KETONE (2-BUTANONE)	250		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1,2-Trichloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Trichloroethene (TCE)	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,1,2,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Methyl methacrylate	100		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,2-Dibromo-3-chloropropane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	1,2,3-Trichloropropane	50		µg/kg
MidBlind_TB-10-30-06-5	TB-10-30-06-5	11/4/2006	Ethyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Ethyl Benzene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Styrene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	cis-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	trans-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,2-Dibromoethane (EDB)	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Acrolein	500		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	100		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,2-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Propionitrile, Ethyl Cyanide	1,000		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Acrylonitrile	500		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Vinyl acetate	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	100		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Toluene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Chlorobenzene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	trans-1,4-Dichloro-2-butene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Dibromochloromethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Methylacrylonitrile	250		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	500		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Tetrachloroethene (PCE)	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Xylenes, Total	150		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	trans-1,2-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Carbon tetrachloride	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	2-Hexanone	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1,1,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Acetone	1,000		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Chloroform	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Benzene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1,1-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Bromomethane	100		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Chloromethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Methyl Iodide (Iodomethane)	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Dibromomethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Chloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Vinyl chloride	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Acetonitrile	1,000		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Methylene chloride	174		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Carbon disulfide	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Bromoform	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Bromodichloromethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Trichlorofluoromethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Dichlorodifluoromethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Isobutanol	5,000		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,2-Dichloropropane	50		µg/kg

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	METHYL ETHYL KETONE (2-BUTANONE)	250		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1,2-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Trichloroethene (TCE)	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,1,2,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Methyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,2-Dibromo-3-chloropropane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	1,2,3-Trichloropropane	50		µg/kg
MidBlind_TB-11-13-06-1	TB-11-13-06-1	11/17/2006	Ethyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Ethyl Benzene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Styrene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	cis-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	trans-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,2-Dibromoethane (EDB)	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Acrolein	500		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	100		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,2-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Propionitrile, Ethyl Cyanide	1,000		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Acrylonitrile	500		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Vinyl acetate	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	100		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Toluene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Chlorobenzene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	trans-1,4-Dichloro-2-butene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Dibromochloromethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Methylacrylonitrile	250		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	500		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Tetrachloroethene (PCE)	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Xylenes, Total	150		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	trans-1,2-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Carbon tetrachloride	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	2-Hexanone	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1,1,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Acetone	328		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Chloroform	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Benzene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1,1-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Bromomethane	100		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Chloromethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Methyl Iodide (Iodomethane)	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Dibromomethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Chloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Vinyl chloride	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Acetonitrile	1,000		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Methylene chloride	90.9		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Carbon disulfide	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Bromoform	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Bromodichloromethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Trichlorofluoromethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Dichlorodifluoromethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Isobutanol	5,000		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,2-Dichloropropane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	METHYL ETHYL KETONE (2-BUTANONE)	250		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1,2-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Trichloroethene (TCE)	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,1,2,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Methyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,2-Dibromo-3-chloropropane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	1,2,3-Trichloropropane	50		µg/kg
MidBlind_TB-11-13-06-2	TB-11-13-06-2	11/17/2006	Ethyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Dibromomethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Chloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Vinyl chloride	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Acetonitrile	1,000		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Methylene chloride	88.4		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Carbon disulfide	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Bromoform	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Bromodichloromethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Trichlorofluoromethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Dichlorodifluoromethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Isobutanol	5,000		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,2-Dichloropropane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	METHYL ETHYL KETONE (2-BUTANONE)	250		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1,2-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Trichloroethene (TCE)	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1,2,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Methyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,2-Dibromo-3-chloropropane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,2,3-Trichloropropane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Ethyl methacrylate	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Ethyl Benzene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Styrene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	cis-1,3-Dichloropropene	50		µg/kg

TABLE B-3
Additional Chemicals - Equipment Blank and Trip Blank Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Location ID	Field Sample ID	Date Sampled	Parameter Name	Report Result	Validation Qualifier	Report Units
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	trans-1,3-Dichloropropene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,2-Dibromoethane (EDB)	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Acrolein	500		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,2-Dichloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Propionitrile, Ethyl Cyanide	1,000		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Acrylonitrile	500		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Vinyl acetate	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Toluene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Chlorobenzene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	trans-1,4-Dichloro-2-butene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Dibromochloromethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Methylacrylonitrile	250		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	500		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Tetrachloroethene (PCE)	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Xylenes, Total	150		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	trans-1,2-Dichloroethene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Carbon tetrachloride	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	2-Hexanone	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1,1,2-Tetrachloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Acetone	1,000		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Chloroform	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Benzene	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	1,1,1-Trichloroethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Bromomethane	100		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Chloromethane	50		µg/kg
MidBlind_TB-11-13-06-3	TB-11-13-06-3	11/17/2006	Methyl Iodide (Iodomethane)	50		µg/kg

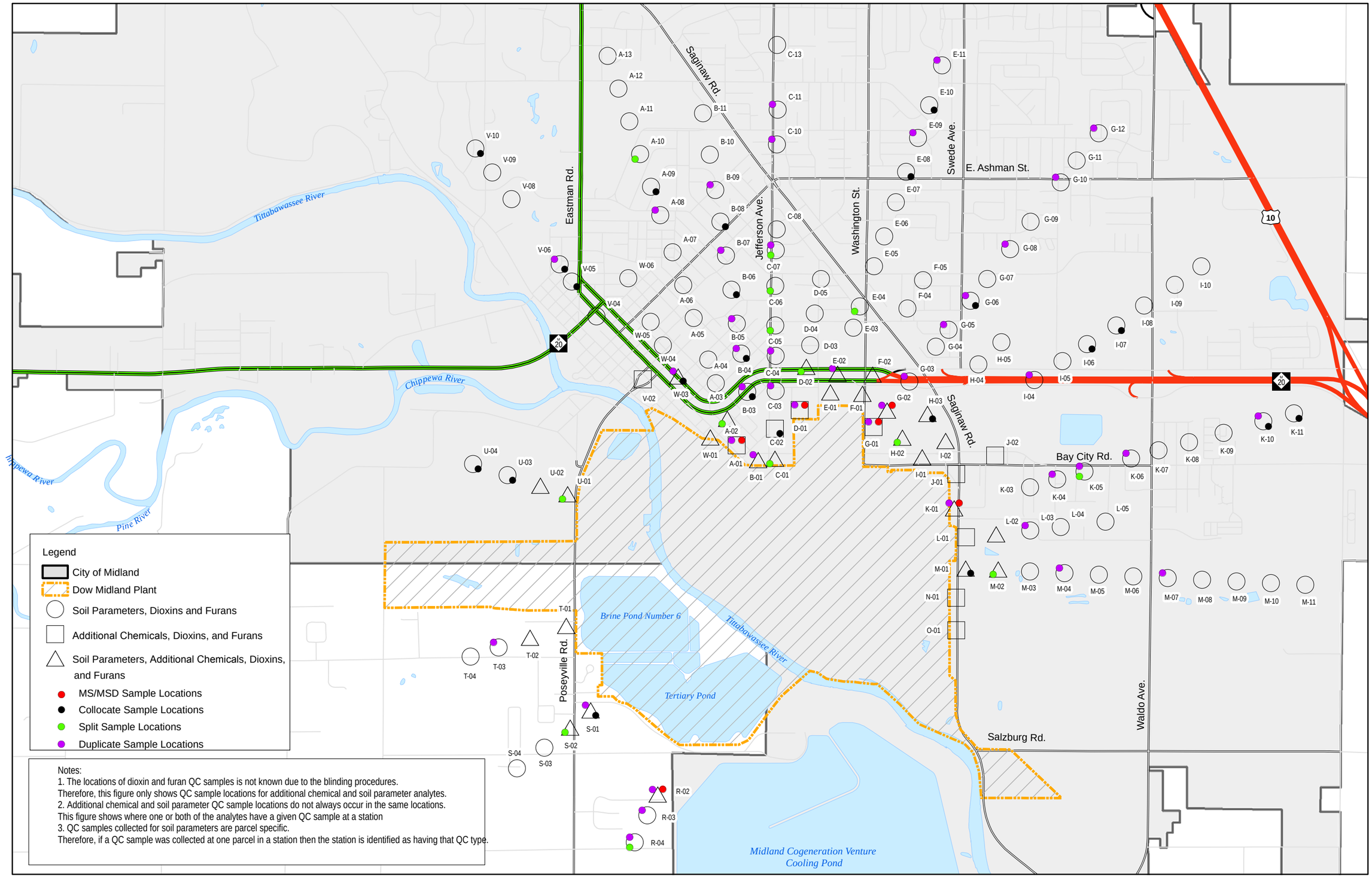

Figure B-1
Summary of Quality Control Samples by Station
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Appendix C

Dioxin and Furan Summary Statistics and Analytical Results

TABLE C-1
Dioxin and Furan Summary Statistics
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL2	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
DIOXINS and FURANS																
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-p-DIOXIN	ng/kg	199	199	1	--	--	17	11,000	1,271	900	1,457	1.15	1,442	--	--	--
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	5.4	5,000	736	410	900	1.22	841	--	--	--
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	198	199	0.99	0.82	0.82	0.43	350	32.0	17	49.4	1.55	37.7	--	--	--
1,2,3,4,7,8-HEXACHLORODIBENZO-p-DIOXIN	ng/kg	199	199	1	--	--	0.78	210	24.2	15	25.9	1.07	27.3	--	--	--
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	199	199	1	--	--	1.5	480	70.3	45	77.1	1.10	79.3	--	--	--
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	199	199	1	--	--	1.2	370	45.1	30	48.8	1.08	50.8	--	--	--
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	0.51	250	19.9	11	27.1	1.36	23.1	--	--	--
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	0.72	600	59.4	34	86.5	1.46	69.6	--	--	--
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	0.42	260	27.6	15	37.6	1.36	32.1	--	--	--
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	96	199	0.48	0.26	10	0.69	26	3.26	1.8	3.89	1.19	3.71	--	--	--
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-p-DIOXIN	ng/kg	199	199	1	--	--	100	121,000	13,061	8,600	16,071	1.23	14,944	--	--	--
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	7.1	9,400	1,246	800	1,495	1.20	1,422	--	--	--
1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN	ng/kg	199	199	1	--	--	0.76	230	30.5	21	31.4	1.03	34.1	--	--	--
1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	0.23	270	23.7	13	35.5	1.50	27.9	--	--	--
2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	198	199	0.99	0.42	0.42	0.54	250	25.6	15	34.1	1.33	29.6	--	--	--
2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN	ng/kg	199	199	1	--	--	0.74	400	60.4	36	65.4	1.08	68.1	--	--	--
2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	199	199	1	--	--	0.26	460	33.6	17	57.7	1.72	40.4	--	--	--
2005 WHO Mammalian TEQ	ng/kg	199	199	1	--	--	2.4	950	152	100	151	0.99	169	90	110	--
Total Heptachloro-dibenzodioxin	ng/kg	199	199	1	--	--	33	21,000	2,350	1,600	2,729	1.16	2,669	--	--	--
Total Heptachloro-dibenzofuran	ng/kg	199	199	1	--	--	9.3	11,000	1,592	940	1,922	1.21	1,817	--	--	--
Total Hexachloro-dibenzodioxin	ng/kg	199	199	1	--	--	11	4,400	584	380	627	1.07	658	--	--	--
Total Hexachloro-dibenzofuran	ng/kg	199	199	1	--	--	6.3	8,400	654	360	913	1.40	761	--	--	--
Total Pentachloro-dibenzodioxin	ng/kg	199	199	1	--	--	5.5	1,300	243	160	244	1.00	272	--	--	--
Total Pentachloro-dibenzofuran	ng/kg	199	199	1	--	--	3.1	23,000	480	230	1,652	3.44	673	--	--	--
Total Tetrachloro-dibenzodioxin	ng/kg	199	199	1	--	--	5	1,900	349	230	350	1.00	390	--	--	--
Total Tetrachloro-dibenzofuran	ng/kg	199	199	1	--	--	12	8,300	666	430	810	1.22	761	--	--	--

[a] The MDL was used to calcluate the mean and median where concentrations were nondetected.
[b] SL = the selected MDEQ Screening Level
-- = not applicable

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

				Sample ID	1139-1-D	1139-1	1139-2-D	1139-2	1144-1	1251-1	1251-2	130-1	138-1-C	138-1	1438-1
				Location ID	MidBlind_1139-1-D	MidBlind_1139-1	MidBlind_1139-2-D	MidBlind_1139-2	MidBlind_1144-1	MidBlind_1251-1	MidBlind_1251-2	MidBlind_130-1	MidBlind_138-1-C	MidBlind_138-1	MidBlind_1438-1
				Sample Date	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/23/2006	10/23/2006	11/13/2006
				Sample Depth (in)	0-1	0-1	1-6	1-6	0-1	0-1	1-6	0-1	0-1	0-1	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**												
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5900** J	**8600** J	**5400** J	**7500** J	**12000**	**19000**	**18000**	**3500**	**14000** J	**31000** J	**7100**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**760** J	**1200** J	**650**	**910**	**880**	**2100**	**1900**	**290**	**1100** J	**3300** J	**490**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**660** J	**950** J	**610**	**810**	**1100**	**1800**	**1800**	**270**	**1300** J	**3200** J	**710**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**380**	**530**	**350**	**480**	**390**	**940**	**890**	**180**	**620** J	**1900** J	**310**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**13** J	**20** J	**13**	**17**	**13**	**42**	**48**	**6.4**	**26**	**79**	**11**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12**	**16**	**11**	**14**	**14**	**34**	**34**	**7.7**	**30**	**83**	**13**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**20**	**25**	**19**	**24**	**17**	**89**	**84**	**16**	**53**	**160**	**16**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**38**	**48**	**33**	**46**	**41**	**110**	**110**	**16**	**78**	**210**	**32**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**10**	**13**	**10**	**12**	**11**	**41**	**38**	**7**	**25** D	**78** D	**8.5**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**23**	**29**	**20**	**26**	**26**	**61**	**67**	**11**	**53**	**140**	**25**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.3 U	1.4 U	1.1 U	1.1 U	1.3 U	2.2 U	**4.2**	0.63 U	2.9 U	**9.5**	1.1 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**19**	**24**	**16**	**22**	**18**	**50**	**48**	**10**	**85**	**180**	**11**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**5.6**	**7**	**5**	**6.3**	**4.5**	**40**	**37**	**9.7**	**26**	**84**	**6.9**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**9.5**	**12**	**9**	**11**	**11**	**27**	**28**	**6**	**18** J	**49** J	**6.8**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**9.6**	**12**	**8.9**	**11**	**7.8**	**39**	**39**	**13**	**27**	**86**	**7.1**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**51**	**63**	**45**	**59**	**34**	**120**	**120**	**17**	**140**	**400**	**13**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**6.5**	**7.8**	**6**	**7.8**	**5.3**	**56**	**51**	**24**	**37**	**120**	**8.7**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**97**	**120**	**87**	**110**	**86**	**260**	**260**	**46**	**280**	**760**	**50**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1200**	**1700**	**1100**	**1400**	**2000**	**3300**	**3200**	**500**	**2400**	**6000**	**1300**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**880** J	**1300** J	**770**	**1100**	**920**	**2200**	**2200**	**380**	**1300**	**4100**	**620**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**320**	**400**	**280**	**380**	**370**	**830**	**860**	**140**	**640**	**1800**	**270**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**280**	**370**	**250**	**330** J	**250**	**840** J	**780** J	**130**	**500** J	**1600** J	**200**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**190**	**200**	**150**	**200**	**160**	**420**	**410**	**72**	**420**	**1100**	**90**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**180** J	**200** J	**160** J	**210** J	**140**	**490** J	**540** J	**110**	**330** J	**1100** J	**120** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**320**	**360**	**260**	**340**	**280**	**680**	**690**	**100**	**690**	**1900**	**110**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**450** J	**560**	**410**	**540**	**470**	**1200** J	**1200** J	**190**	**1100** J	**3100** J	**200** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	1438-2	1469-1	1517-1-C	1517-1	1517-2-C	1517-2	154-1	1582-1	1582-2	159-1	161-1
			Location ID	MidBlind_1438-2	MidBlind_1469-1	MidBlind_1517-1-C	MidBlind_1517-1	MidBlind_1517-2-C	MidBlind_1517-2	MidBlind_154-1	MidBlind_1582-1	MidBlind_1582-2	MidBlind_159-1	MidBlind_161-1
			Sample Date	11/13/2006	10/23/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/6/2006	10/30/2006	10/30/2006	11/6/2006	11/6/2006
			Sample Depth (in)	1-6	0-1	0-1	0-1	1-6	1-6	0-1	0-1	1-6	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**6000**	**8400** J	**11000** J	**29000** J	**15000** J	**28000** J	**3700**	**8400** J	**7900** J	**2300**	**8900**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**440**	**990** J	**1400** J	**2800** J	**2000** J	**3300** J	**410**	**890**	**830**	**260**	**890**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**630**	**940** J	**980** J	**2300** J	**1600** J	**2500** J	**330**	**760**	**730**	**230**	**920**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**260**	**860** J	**990** J	**1600** J	**1300** J	**1900** J	**180** J	**510**	**470**	**190** J	**540** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**10**	**64**	**26** J	**45** J	**53**	**68**	**7.3**	**20**	**20**	**6.3**	**21**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12**	**40**	**21** J	**37** J	**34**	**42**	**6.1**	**13**	**12**	**5.2**	**20**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**14**	**250**	**54** J	**83** J	**95**	**110**	**13**	**44**	**43**	**13**	**43**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**28**	**180**	**62** J	**120** J	**96**	**140**	**18**	**44**	**37**	**14**	**60**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**7.2**	**260** J	**24** J	**40** J	**37**	**48**	**6**	**17**	**15**	**6.4**	**20**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**22**	**93**	**39** J	**65** J	**55**	**76**	**11**	**24**	**22**	**10**	**39**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	0.94 U	**8.3**	1.8 UJ	**4.9** J	**6.1**	**4.9**	0.64 U	1.6 U	2 U	**1.2** J	1.6 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**9.6**	**89**	**29** J	**65** J	**42** J	**71** J	**9.1**	**25**	**25**	**7**	**30**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**6.1**	**48**	**26**	**31**	**27**	**34**	**5.2**	**19**	**19**	**6.3**	**18**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**6.1**	**250** J	**19** J	**33** J	**32**	**39**	**4.9**	**9.3**	**9.1**	**4.4**	**15**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**6.2**	**250**	**27**	**38**	**35**	**43**	**5.6**	**16**	**15**	**5.7**	**19**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**13**	**65**	**49** J	**160** J	**91** J	**190** J	**18**	**37**	**36**	**9.1**	**58**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**8**	**50**	**37**	**46**	**42**	**51**	**7.3**	**26**	**24**	**7.9**	**24**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**45**	**360**	**140**	**320**	**220**	**380**	**42**	**100**	**97**	**29**	**130**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1100**	**1800**	**1700**	**4100**	**2800**	**4500**	**580**	**1400**	**1400**	**430**	**1700**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**550**	**1800**	**2000**	**3400**	**2600**	**4000**	**460** J	**1100**	**1000**	**380** J	**1200**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**230**	**2000**	**550**	**960**	**820**	**1100**	**140**	**320**	**290**	**130**	**470**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**170**	**8400** J	**600** J	**1100** J	**880**	**1300**	**140**	**380**	**360**	**130**	**490**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**80**	**1300**	**270**	**460**	**340**	**520**	**75**	**150**	**140**	**60**	**260**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**100** J	**23000** J	**350** J	**650** J	**450** J	**750** J	**87** J	**200** J	**180**	**86** J	**310** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**100**	**650**	**410**	**850**	**600**	**1000**	**98**	**240**	**240**	**79**	**410**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**180** J	**8300** J	**640** J	**1300** J	**950** J	**1400** J	**190** J	**370** J	**380** J	**170** J	**670** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	1702-1-C	1702-1	1883-1	1932-1	1951-1	1963-1	199-1	1992-1-C	1992-1	2120-1	2147-1
			Location ID	MidBlind_1702-1-C	MidBlind_1702-1	MidBlind_1883-1	MidBlind_1932-1	MidBlind_1951-1	MidBlind_1963-1	MidBlind_199-1	MidBlind_1992-1-C	MidBlind_1992-1	MidBlind_2120-1	MidBlind_2147-1
			Sample Date	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006	10/30/2006	10/23/2006	10/23/2006	11/6/2006	10/30/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**18000**	**7900**	**4800**	**11000**	**6000**	**2600**	**8400** J	**4000** J	**5200** J	**4600**	**800** J
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**1200**	**600**	**560**	**1200**	**530**	**200**	**730**	**260** J	**380** J	**360**	**68**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2000**	**780**	**500**	**1100**	**680**	**330**	**870**	**430** J	**590** J	**540**	**87**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**610** J	**400** J	**240** J	**670**	**320**	**150** J	**510**	**130** J	**190** J	**160** J	**41** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**38**	**20**	**12**	**23**	**16**	**7.1**	**19**	**6.8**	**11**	**9.6**	**2** J
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**43**	**18**	**9.8**	**25**	**15**	**11**	**23**	**8.7**	**12**	**13**	**2.3** J
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**100**	**68**	**26**	**36**	**40**	**12**	**33**	**9.2**	**19**	**15**	**3.7**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**110**	**45**	**29**	**62**	**47**	**24**	**62**	**21**	**32**	**30**	**5.8**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**35**	**23**	**10**	**19**	**18**	**6.6**	**16**	**5.6**	**9.3**	**7.4**	**2.5**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**76**	**32**	**21**	**45**	**35**	**19**	**40**	**17**	**24**	**21**	**4.7**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**4.7**	1.6 U	**1.4** J	**4.4**	1.3 U	**1** J	**3.5**	1.3 U	1.9 U	**1.3** J	**1.2** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**48**	**20**	**13**	**35**	**21**	**12**	**30**	**9.2**	**16**	**17**	**2.6**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**95**	**69**	**9.3**	**10**	**26**	**3.5**	**17**	**4.2**	**9.9**	**5.9**	**1.9** J
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**22**	**14**	**6**	**14**	**13**	**5.8**	**12**	**4.2** J	**6.9** J	**6.1**	**2.3** J
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**68**	**46**	**7.9**	**13**	**24**	**4.3**	**14**	**5**	**11**	**6.9**	**2.6**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**140**	**110**	**26**	**51**	**43**	**23**	**64**	**17**	**33**	**45**	**3.6**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**130**	**88**	**8.7**	**11**	**40**	**4.3**	**20**	**6.1**	**15**	**7.2**	**2.7**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**300**	**190**	**62**	**130**	**100**	**50**	**140**	**42**	**74**	**83**	**11**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**3700**	**1400**	**910**	**2100**	**1200**	**590**	**1600**	**770**	**1000**	**970**	**170**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**1400**	**840**	**550**	**1400**	**690**	**300**	**1100**	**280**	**440**	**380**	**84** J
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**950**	**380**	**240**	**530**	**390**	**220**	**520**	**170**	**260**	**260**	**59**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**730**	**460**	**210**	**440**	**380** J	**140**	**420**	**110**	**180**	**160**	**55** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**410**	**160**	**100**	**250**	**190**	**99**	**260**	**66**	**120**	**140**	**22**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**680** J	**440** J	**120** J	**220** J	**380** J	**93** J	**280** J	**71**	**130** J	**120** J	**48** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**820**	**340**	**170**	**300**	**360**	**140**	**420**	**94**	**170**	**240**	**26**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**1600** J	**710** J	**240** J	**630** J	**890** J	**260** J	**770** J	**170**	**310** J	**380** J	**64** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

				Sample ID	2147-2	2218-1-C	2218-1	2330-1	2451-1	2485-1	2507-1-C	2507-1	2594-1	2600-1	2623-1
				Location ID	MidBlind_2147-2	MidBlind_2218-1-C	MidBlind_2218-1	MidBlind_2330-1	MidBlind_2451-1	MidBlind_2485-1	MidBlind_2507-1-C	MidBlind_2507-1	MidBlind_2594-1	MidBlind_2600-1	MidBlind_2623-1
				Sample Date	10/30/2006	11/6/2006	11/6/2006	11/13/2006	10/30/2006	11/13/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006
				Sample Depth (in)	1-6	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**												
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**470** J	**15000**	**18000**	**32000**	**19000**	**8600**	**4400**	**2600**	**2500**	**16000**	**1900**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**32**	**1300**	**1900**	**2200**	**1600**	**970**	**240**	**180**	**230**	**1400**	**300**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**53**	**1500**	**1800**	**2500**	**1700**	**930**	**370**	**280**	**300**	**1700**	**210**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**23** J	**850**	**1000**	**710**	**880**	**430**	**97** J	**93** J	**150** J	**480** J	**180** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**1.1** J	**24**	**31**	**31**	**35**	**16**	**5.7**	**4.8**	**8.1**	**31**	**8.5**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1.7** J	**32**	**39**	**28**	**25**	**22**	**7.2**	**6.3**	**9.1**	**28**	**5.8**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.5** J	**37**	**41**	**37**	**55**	**23**	**9.1**	**8.5**	**14**	**43**	**21**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3.9**	**74**	**88**	**95**	**68**	**53**	**17**	**16**	**20**	**86**	**16**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.5** J	**22**	**25**	**19**	**29**	**14**	**4.9**	**4.8**	**7.8**	**19**	**10**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2.8**	**57**	**69**	**61**	**48**	**38**	**13**	**11**	**16**	**63**	**9.3**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**0.69** J	2.5 U	2 U	1.9 U	2 U	**1.8**	**2.2** J	**2.1**	**1.3** J	2.3 U	**1.8** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2.4** J	**40**	**43**	**40**	**33**	**31**	**9.7**	**8.8**	**13**	**41**	**7.1**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**1.3** J	**11**	**12**	**9.6**	**16**	**6.2**	**3.7**	**3.4**	**5.7**	**13**	**7.8**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.7** J	**16**	**18**	**17**	**23**	**13**	**3.7**	**3.7**	**6.2**	**18**	**6.5**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**2.2** J	**13**	**15**	**14**	**23**	**10**	**4.3**	**3.6**	**6.8**	**19**	**8**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3.3**	**57**	**81**	**80**	**38**	**77**	**19**	**33**	**23**	**220**	**15**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**2.1**	**12**	**14**	**13**	**21**	**7.6**	**4.6**	**3.3**	**6.7**	**17**	**10**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**8.9**	**150**	**190**	**200**	**140**	**140**	**42**	**53**	**52**	**330**	**37**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**100**	**2800**	**3400**	**4700**	**3100**	**1700**	**690**	**520**	**540**	**3100**	**380**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**44** J	**1700**	**2100**	**1800**	**1900**	**990**	**220**	**200**	**310** J	**1200**	**410**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**41**	**640**	**810**	**760**	**580**	**510**	**150**	**140**	**180**	**700**	**140**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**28** J	**520**	**570**	**460**	**750** J	**310**	**100**	**96**	**160**	**460**	**220**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**21**	**250**	**340**	**250**	**230**	**250**	**80**	**76**	**110**	**310**	**73**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**29**	**230** J	**270** J	**250**	**520** J	**190**	**73** J	**68**	**150** J	**300** J	**220** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**28**	**320**	**480**	**390**	**220**	**440**	**130**	**140**	**160**	**690**	**100**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**63**	**670** J	**890** J	**700**	**500** J	**540**	**280** J	**200**	**290** J	**780** J	**260** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	265-1	2689-1-D	2689-1-M	2721-1	2753-1	2753-2	2808-1	2808-2	2823-1	2823-2	3018-1-C
			Location ID	MidBlind_265-1	MidBlind_2689-1-D	MidBlind_2689-1-M	MidBlind_2721-1	MidBlind_2753-1	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1	MidBlind_2823-2	MidBlind_3018-1-C
			Sample Date	11/13/2006	11/6/2006	11/6/2006	11/6/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/6/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	0-1	1-6	0-1	1-6	0-1	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**33000**	**3500**	**4100** J	**2100**	**11000**	**9900** J	**11000**	**14000**	**4800**	**4700**	**4000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**4400**	**370**	**440**	**150**	**880**	**880**	**640**	**800**	**460**	**530**	**300**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3000**	**340**	**420**	**240**	**870**	**810**	**920**	**1100**	**490**	**500**	**450**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**3200**	**290** J	**210** J	**89** J	**490**	**490**	**320**	**390**	**310**	**330**	**140** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**62**	**15**	**8.9**	**5.2**	**16**	**16**	**14**	**17**	**12**	**13**	**8.2**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**53**	**5.7**	**8.1**	**5.8**	**13**	**12**	**13**	**16**	**11**	**12**	**11**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**86**	**38**	**20**	**8.9**	**32**	**31**	**33**	**38**	**26**	**26**	**14**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**150**	**17**	**20**	**16**	**38**	**34**	**37**	**44**	**31**	**31**	**27**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**49**	**15**	**8.9**	**5**	**16**	**14**	**14**	**16** D	**12**	**12**	**6.7**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**100**	**10**	**13**	**13**	**25**	**22**	**26**	**31**	**21**	**21**	**20**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**6.5**	1.1 U	0.72 U	**2.4** J	**2.6**	1.2 U	0.84 U	**1.9** J	0.94 U	0.87 U	1.4 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**60**	**6.4**	**8.1**	**8.9**	**13**	**12**	**13**	**17**	**16**	**15**	**13**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**18**	**12**	**14**	**3.3**	**20**	**16**	**21**	**23**	**12**	**13**	**7.3**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**48**	**5.7**	**5.8**	**4.5**	**11**	**11**	**12**	**12**	**11**	**11**	**5.3**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**30**	**11**	**12**	**3.9**	**21**	**17**	**21**	**23**	**14**	**14**	**7.3**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**100**	**15**	**19** J	**20**	**20**	**20**	**28**	**37**	**32**	**30**	**32**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**18**	**18**	**19** J	**2.9**	**35**	**24**	**34**	**36**	**18**	**18**	**8.2**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**300**	**44**	**48**	**40**	**74**	**69**	**80**	**100**	**75**	**73**	**64**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**5400**	**610**	**760**	**430**	**1600**	**1500**	**1900**	**2200**	**890**	**900**	**830**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**6400**	**680**	**520** J	**190**	**1000**	**1100**	**700**	**870**	**640**	**700**	**310**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**1400**	**140**	**170**	**140**	**350**	**320**	**370**	**440**	**240**	**250**	**230**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**1700**	**260**	**200**	**100**	**400**	**380**	**350**	**400** J	**280**	**280**	**150**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**500**	**56**	**72**	**74**	**110**	**100**	**110**	**120**	**120**	**120**	**110**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**660** J	**140** J	**140** J	**82** J	**280** J	**250** J	**270** J	**290** J	**180** J	**170** J	**100**
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**720**	**85**	**120**	**120**	**120**	**130**	**130**	**160**	**200**	**200**	**190**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**1100** J	**200** J	**250** J	**200** J	**330** J	**300** J	**320** J	**370** J	**340** J	**280** J	**290**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	3018-1	3313-1-C	3313-1	3374-1	3374-2	3473-1-M	3549-1	3607-1	3653-1-C	3653-1	3672-1
			Location ID	MidBlind_3018-1	MidBlind_3313-1-C	MidBlind_3313-1	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3473-1-M	MidBlind_3549-1	MidBlind_3607-1	MidBlind_3653-1-C	MidBlind_3653-1	MidBlind_3672-1
			Sample Date	11/6/2006	10/23/2006	10/23/2006	10/30/2006	10/30/2006	11/13/2006	11/6/2006	10/23/2006	10/23/2006	10/23/2006	11/13/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	1-6	0-1	0-1	0-1	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**8400**	**5500** J	**8600** J	**26000**	**15000**	**9600**	**41000**	**6700** J	**1200** J	**930** J	**13000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**690**	**1000** J	**1800** J	**1300**	**1000**	**710** J	**5400**	**720** J	**72** J	**66** J	**1300**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**910**	**550** J	**790** J	**2600**	**1500**	**880**	**4300**	**770** J	**140** J	**110** J	**1300**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**270** J	**1900** J	**3600** J	**550**	**430**	**260**	**3400**	**300** J	**34** J	**33** J	**820**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**16**	**40**	**66**	**31**	**26**	**14**	**120**	**13**	**2.4** J	**2.1** J	**29**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24**	**11**	**15**	**33**	**24**	**14**	**120**	**13**	**2.6**	**2.3** J	**24**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**27**	**86**	**140**	**50**	**35**	**23**	**180**	**17**	**3.9**	**3.8**	**61**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**53**	**59**	**81**	**91**	**66**	**41**	**280**	**36**	**7.2**	**6.4**	**73**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**12**	**31** D	**53**	**28**	**20**	**13**	**77**	**10**	**2.2** J	**2.1** J	**26**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**40**	**32**	**42**	**62**	**42**	**30**	**190**	**28**	**5.6**	**4.7**	**43**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.2 U	4.2 U	4.4 U	2.1 U	4.8 U	1.7 U	**13**	2 U	**1** J	**1.1** J	1.7 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24**	**20**	**30**	**29**	**22**	**21**	**150**	**19**	**3.7**	**3.2**	**33**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**13**	**15**	**21**	**18**	**11**	**11**	**46**	**4.4**	**2.3** J	**1.9** J	**27**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**9.1**	**19** J	**35** J	**19**	**14**	**11**	**71**	**7.9** J	**1.6** J	**1.6** J	**20**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**12**	**29**	**45**	**21**	**13**	**13**	**62**	**6.5**	**2.5** J	**2.2** J	**27**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**57**	**12**	**15**	**35**	**30**	**47**	**310**	**36**	**8.2**	**8.4**	**66**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**13**	**20**	**24**	**23**	**14**	**17**	**45**	**4.8**	**3.8**	**2.9**	**37**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**120**	**94**	**150**	**140**	**100**	**100**	**670**	**82**	**18**	**17**	**160**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1700**	**1000**	**1400**	**5000**	**2800**	**1700**	**7800**	**1400**	**260**	**200**	**2300**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**610**	**3200**	**5900**	**1400**	**1100**	**640**	**7100**	**690**	**78**	**72**	**1700**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**460**	**500**	**710**	**710**	**510**	**370**	**2400**	**300**	**66**	**58**	**580**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**270**	**1000** J	**1800** J	**700**	**500**	**290**	**2200** J	**220**	**39**	**36**	**650** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**210**	**210**	**320**	**200**	**160**	**150**	**1200**	**110**	**31**	**29**	**260**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**200** J	**320** J	**500** J	**420**	**300**	**250**	**1200** J	**100**	**32**	**29**	**310** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**350**	**110**	**140**	**240**	**200**	**230**	**1700**	**130**	**40**	**44**	**400**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**540** J	**300** J	**430** J	**360**	**290**	**400**	**2500** J	**240**	**81**	**77**	**630** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	3672-2	4072-1	4107-1	4312-1	4421-1	4460-1	4460-2	4505-1	4507-1	4507-2	4528-1
			Location ID	MidBlind_3672-2	MidBlind_4072-1	MidBlind_4107-1	MidBlind_4312-1	MidBlind_4421-1	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4505-1	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1
			Sample Date	11/13/2006	10/23/2006	11/6/2006	11/6/2006	11/13/2006	10/30/2006	10/30/2006	11/6/2006	11/13/2006	11/13/2006	11/13/2006
			Sample Depth (in)	1-6	0-1	0-1	0-1	0-1	0-1	1-6	0-1	0-1	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**15000**	**21000** J	**3400**	**4800**	**1500**	**22000**	**27000**	**3400**	**12000**	**13000**	**1600**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**1400**	**2500** J	**790**	**390**	**99**	**1500**	**2100**	**170**	**580**	**690**	**250**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1400**	**2100** J	**340**	**460**	**160**	**2200**	**2700**	**210**	**830**	**900**	**170**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**860**	**1600** J	**590** J	**230** J	**54**	**1100**	**1500**	**88** J	**200**	**240**	**170**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**30**	**55**	**25**	**7.1**	**2.6**	**49**	**67**	**4.1**	**11**	**11**	**5**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**26**	**53**	**5.2**	**7.2**	**4.1**	**45**	**66**	**4.9**	**11**	**11**	**4.4**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**66**	**100**	**160**	**9.3**	**5**	**230**	**290**	**6.5**	**34**	**37**	**13**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**80**	**130**	**18**	**19**	**9.8**	**130**	**170**	**11**	**29**	**33**	**13**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**29**	**44**	**37**	**5.9**	**3.1**	**75**	**95**	**4.2**	**11**	**13**	**5.8**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**48**	**86**	**10**	**16**	**7.8**	**71**	**98**	**9**	**24**	**24**	**8.8**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.9 U	**5.5**	**5.1**	**2.5** J	**1.6**	**4.4**	10 U	**1.8** J	1.4 U	1.7 U	1.3 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**37**	**77**	**6.2**	**6.2**	**4.9**	**40**	**54**	**5.1**	**9.9**	**11**	**5.9**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**30**	**41**	**200**	**2.6**	**2.8**	**230**	**270**	**2.4** J	**37**	**36**	**7.7**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**21**	**30** J	**15**	**4.4**	**2.8**	**38**	**45**	**3.1**	**8.1**	**7.7**	**5.2**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**29**	**49**	**160**	**3.2**	**3.6**	**170**	**200**	**2.9**	**30**	**29**	**7.3**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**78**	**170**	**7.3**	**5.5**	**8.6**	**69**	**95**	**9.1**	**8.4**	**12**	**11**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**43**	**58**	**410**	**3.1**	**5**	**380**	**460**	**2.8**	**75**	**75**	**14**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**180**	**350**	**150**	**28**	**21**	**300**	**390**	**24**	**62**	**68**	**29**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**2500**	**3700**	**570**	**830**	**290**	**4200**	**5400**	**430**	**1600**	**1700**	**310**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**1800**	**3100**	**1200**	**480**	**110**	**2400**	**3200**	**170**	**540**	**610**	**340**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**630**	**1300**	**130**	**160**	**94**	**1000**	**1400**	**110**	**270**	**270**	**99**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**690** J	**1100**	**530**	**160**	**57**	**1300**	**1800** J	**85**	**220**	**230**	**130**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**300**	**630**	**57**	**46**	**43**	**370**	**520**	**48**	**71**	**82**	**46**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**350** J	**710** J	**790** J	**69** J	**50**	**1200** J	**1500** J	**67** J	**210**	**210**	**78** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**450**	**1100**	**69**	**41**	**65**	**510**	**790**	**72**	**72**	**93**	**67**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**700** J	**1800** J	**1000** J	**97** J	**140**	**1500** J	**2200** J	**160**	**320**	**330**	**120** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	4528-2	4534-1	4755-1	4853-1	4927-1	494-1-M	4975-1	4990-1	4995-1	4995-2	5035-1-C
			Location ID	MidBlind_4528-2	MidBlind_4534-1	MidBlind_4755-1	MidBlind_4853-1	MidBlind_4927-1	MidBlind_494-1-M	MidBlind_4975-1	MidBlind_4990-1	MidBlind_4995-1	MidBlind_4995-2	MidBlind_5035-1-C
			Sample Date	11/13/2006	10/30/2006	11/6/2006	10/23/2006	11/6/2006	11/13/2006	11/6/2006	11/6/2006	10/30/2006	10/30/2006	11/6/2006
			Sample Depth (in)	1-6	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**730**	**15000**	**9600**	**1600** J	**16000**	**4900**	**12000**	**8200**	**12000**	**21000**	**23000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**93**	**1700**	**1100**	**170** J	**2200**	**230**	**860**	**640**	**2000**	**3800**	**240**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**80**	**1600**	**940**	**170** J	**2000**	**440**	**1100**	**960**	**1200**	**2200**	**2800**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**90**	**1300**	**580** J	**120** J	**1300**	**120**	**450** J	**330** J	**1100**	**1900**	**110** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**3.1**	**38**	**26**	**4.6**	**94**	**6.8**	**20**	**15**	**32**	**62**	**5.9**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2.6**	**44**	**22**	**4.5**	**70**	**9**	**19**	**17**	**22**	**40**	**18**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**8.4**	**75**	**54**	**9.5**	**140**	**9.5**	**36**	**18**	**49**	**84**	**9.3**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**6.7**	**120**	**54**	**12**	**210**	**19**	**52**	**37**	**71**	**130**	**39**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**3.5**	**37** D	**21**	**5**	**61**	**5.1**	**18**	**11**	**23**	**41**	**4.7**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**4.5**	**79**	**39**	**7.8**	**130**	**16**	**35**	**34**	**41**	**72**	**35**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.8** J	**6.2**	1.9 U	**2.4** J	**16**	**2.2**	1.7 U	**2.1** J	4.6 U	5.1 U	**2** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3**	**74**	**25**	**12**	**83**	**11**	**22**	**22**	**28**	**55**	**7.3**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**5.4**	**33**	**20**	**4.4**	**20**	**4.1**	**16**	**3.8**	**14**	**19**	**4**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.7**	**28**	**14**	**3.6** J	**47**	**4.8**	**13**	**7.3**	**16**	**27**	**3**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**4.5**	**41**	**22**	**4.6**	**34**	**5**	**16**	**5.8**	**19**	**30**	**3.9**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5.5**	**120**	**66**	**22**	**130**	**14**	**53**	**17**	**55**	**98**	**9.1**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**7.4**	**53**	**22**	**6**	**18**	**6.6**	**20**	**3.6**	**15**	**22**	**4.3**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**16**	**290**	**140**	**44**	**330**	**40**	**120**	**69**	**140**	**250**	**66**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**150**	**2900**	**1600**	**320**	**3700**	**850**	**1900**	**1800**	**2200**	**4000**	**5000**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**170**	**2400**	**1300**	**240**	**3000**	**260**	**990**	**720**	**2400**	**4500**	**250**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**56**	**1200**	**470**	**110**	**1800**	**200**	**420**	**340**	**530**	**970**	**340**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**72**	**900** J	**490** J	**100**	**1500** J	**100**	**420** J	**240**	**670**	**1200**	**95**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**25**	**720**	**240**	**70**	**630**	**77**	**190**	**110**	**220**	**420**	**55**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**48** J	**650** J	**320** J	**70** J	**1100** J	**73**	**250** J	**100** J	**290**	**470** J	**51** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**39**	**950**	**380**	**110**	**760**	**110**	**290**	**87**	**260**	**470**	**72**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**70** J	**1700** J	**590** J	**180** J	**1100** J	**200**	**570** J	**210** J	**380**	**650** J	**150** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	5035-1	5074-1-D	5074-1-M	5112-1	5116-1	5135-1-D	5135-1-M	5299-1-C	5299-1	5308-1	5338-1
			Location ID	MidBlind_5035-1	MidBlind_5074-1-D	MidBlind_5074-1-M	MidBlind_5112-1	MidBlind_5116-1	MidBlind_5135-1-D	MidBlind_5135-1-M	MidBlind_5299-1-C	MidBlind_5299-1	MidBlind_5308-1	MidBlind_5338-1
			Sample Date	11/6/2006	11/6/2006	11/6/2006	10/23/2006	11/13/2006	10/23/2006	10/23/2006	10/23/2006	10/23/2006	11/6/2006	10/30/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**8800**	**14000**	**14000**	**860** J	**6900**	**7200** J	**6800** J	**5400** J	**12000** J	**24000**	**15000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**130**	**1600**	**1400** J	**49** J	**520**	**710** J	**700** J	**420** J	**860** J	**1900**	**790**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**880**	**1500**	**1500**	**85** J	**780**	**610** J	**610** J	**690** J	**1400** J	**1800**	**1500**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**60** J	**920**	**910**	**32** J	**220**	**470** J	**490** J	**170** J	**280** J	**1100**	**280**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**3.1**	**36**	**38**	**2** J	**13**	**14**	**14**	**12**	**22**	**41**	**19**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5.6**	**38**	**36**	**2.6**	**15**	**14**	**14**	**17**	**28**	**42**	**21**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**5**	**74**	**72**	**3.5**	**21**	**24**	**24**	**19**	**28**	**73**	**45**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**14**	**93**	**91**	**5.8**	**44**	**36**	**35**	**36**	**66**	**100**	**69**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.5**	**33**	**34**	**1.9** J	**11**	**12** D	**12**	**10**	**15**	**30**	**17**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12**	**62**	**57**	**4**	**28**	**26**	**24**	**26**	**47**	**70**	**43**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.1** J	2.2 U	**6.1**	**1.5** J	1.2 U	**1.8** J	**2.5**	1.8 U	**2.3**	2.5 U	3.2 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3.4**	**48**	**49**	**3.4**	**20**	**21**	**21**	**22**	**39**	**82**	**21**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**2.6**	**36**	**32**	**1.3** J	**9.4**	**10**	**9.8**	**7.7**	**11**	**31**	**33**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.6** J	**27**	**27**	**1.8** J	**9.4**	**11** J	**11** J	**9.2** J	**12** J	**26**	**11**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**2.2** J	**34**	**32**	**1.8**	**11**	**13**	**13**	**11**	**15**	**31**	**24**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5**	**110**	**110**	**5**	**56**	**40**	**40**	**55**	**110**	**170**	**47**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**3**	**52**	**41**	**1.5**	**13**	**14**	**14**	**13**	**14**	**36**	**44**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**26**	**240**	**230**	**13**	**110**	**93**	**93**	**100**	**190**	**330**	**120**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1600**	**2600**	**2600**	**240**	**1400**	**1200**	**1100**	**1300**	**2700**	**3200**	**3000**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**140**	**2000**	**1900**	**65**	**520**	**900**	**940**	**450**	**800**	**2300**	**740**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**120**	**820**	**800**	**61**	**370**	**350**	**340**	**330**	**590**	**870**	**540**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**53**	**870** J	**850** J	**40**	**210**	**310** J	**320** J	**210**	**330**	**1000** J	**330**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**28**	**460**	**450**	**26**	**160**	**160**	**170**	**180**	**290**	**510**	**150**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**29** J	**700** J	**700** J	**40**	**170** J	**190** J	**200** J	**180**	**240**	**640** J	**230** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**34**	**730**	**720**	**38**	**300**	**200**	**210**	**310**	**520**	**800**	**210**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**64** J	**1500** J	**1400** J	**79**	**540**	**420** J	**440** J	**610**	**810**	**1100** J	**330**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	5338-2	5453-1	5583-1	5583-2	5620-1-C	5620-1	5620-2-C	5620-2	5664-1	5672-1-C	5672-1
			Location ID	MidBlind_5338-2	MidBlind_5453-1	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1-C	MidBlind_5620-1	MidBlind_5620-2-C	MidBlind_5620-2	MidBlind_5664-1	MidBlind_5672-1-C	MidBlind_5672-1
			Sample Date	10/30/2006	11/6/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/23/2006	11/6/2006	11/6/2006
			Sample Depth (in)	1-6	0-1	0-1	1-6	0-1	0-1	1-6	1-6	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**15000**	**2100**	**11000**	**9100**	**16000**	**18000**	**14000**	**17000**	**3800** J	**1600**	**4600**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**830**	**280**	**1400**	**840**	**1400**	**1600**	**1600**	**1800**	**380** J	**150**	**410**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1500**	**250**	**1100**	**900**	**1600**	**1800**	**1600**	**1800**	**330** J	**170**	**490**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**290**	**220** J	**880**	**790**	**890**	**1100**	**1000**	**1300**	**140** J	**94** J	**300** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**18**	**8.6**	**50**	**52**	**39**	**46**	**43**	**52**	**6.4**	**3.1**	**9**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**20**	**6.4**	**14**	**13**	**39**	**44**	**37**	**45**	**6.7**	**3.6**	**11**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**50**	**19**	**74**	**75**	**120**	**110**	**130**	**140**	**9.8**	**4.8**	**16**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**55**	**18**	**79**	**87**	**110**	**120**	**110**	**150**	**21**	**8.8**	**27**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**18**	**8.5**	**30**	**29**	**47**	**52**	**49**	**62**	**5.3**	**2.5** J	**8.3**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**38**	**11**	**33**	**29**	**66**	**80**	**68**	**89**	**13**	**6.9**	**18**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	3.3 U	0.65 U	1.7 U	1.7 U	**4.4**	**4.7**	**5**	**5.7**	0.72 U	**1.2** J	1.8 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**22**	**8.8**	**17**	**15**	**48**	**52**	**53**	**59**	**17**	**4.4**	**13**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**40**	**8.4**	**20**	**17**	**83** J	**58** J	**86**	**64**	**3.3**	**1.7** J	**6.8**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**9.6**	**6.5**	**18**	**17**	**33**	**39**	**37**	**45**	**5.1** J	**2** J	**6.9**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**30**	**8.4**	**22**	**21**	**76**	**58**	**80**	**69**	**4.7**	**2** J	**6.7**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**53**	**17**	**26**	**23**	**110**	**110**	**110**	**120**	**52**	**8**	**24**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**51**	**11**	**25**	**21**	**150** J	**98** J	**160** J	**110** J	**4.1**	**2.1**	**7.4**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**130**	**42**	**100**	**93**	**270**	**270**	**280**	**300**	**83**	**19**	**59**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**2800**	**420**	**1900**	**1600**	**3100**	**3400**	**2900**	**3300**	**630**	**310**	**890**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**780**	**440** J	**1800**	**1500**	**1900**	**2300**	**2200**	**2700**	**380**	**190**	**580**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**450**	**140**	**480**	**470**	**950**	**1100**	**970**	**1200**	**170**	**79**	**240**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**340**	**170**	**600** J	**580** J	**940**	**1100**	**1100**	**1400**	**120**	**59**	**210**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**150**	**72**	**140**	**130**	**460**	**490**	**510**	**590**	**92**	**38**	**140**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**250**	**94**	**230** J	**220** J	**860** J	**940** J	**950** J	**1100** J	**72** J	**31** J	**120** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**230**	**110**	**150**	**140**	**800**	**890**	**910**	**1000**	**170**	**48**	**240**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**360**	**160** J	**290** J	**250** J	**2000** J	**2000** J	**2200** J	**2200** J	**240**	**96** J	**450** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 1 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	5685-1	5685-2	5690-1	5716-1	574-1	574-2	5890-1	5895-1-C	5895-1
			Location ID	MidBlind_5685-1	MidBlind_5685-2	MidBlind_5690-1	MidBlind_5716-1	MidBlind_574-1	MidBlind_574-2	MidBlind_5890-1	MidBlind_5895-1-C	MidBlind_5895-1
			Sample Date	11/13/2006	11/13/2006	10/23/2006	11/6/2006	11/13/2006	11/13/2006	11/13/2006	11/6/2006	11/6/2006
			Sample Depth (in)	0-1	1-6	0-1	0-1	0-1	1-6	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**									
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24000**	**18000**	**13000** J	**560**	**53000**	**45000**	**11000**	**26000**	**25000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**2300**	**1800**	**1700** J	**57**	**7400**	**6400**	**1100**	**2500**	**2700**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2100**	**1700**	**1200** J	**63**	**5300**	**4400**	**1100**	**2700**	**2600**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**1200**	**990**	**1200** J	**40** J	**2400**	**2100**	**530**	**1700**	**1800**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**35**	**31**	**27**	**4.1**	**94**	**85**	**22**	**64**	**67**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**29**	**25**	**23**	**1.6** J	**65**	**53**	**21**	**59**	**61**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**48** J	**45**	**41**	**58**	**120**	**110**	**31**	**130**	**160**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**92**	**72**	**69**	**4.7**	**230**	**190**	**57**	**180**	**180**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**31**	**27** J	**21** D	**14**	**75**	**64**	**18**	**63**	**64**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**54**	**44**	**45**	**3.1**	**120**	**95**	**38**	**100**	**100**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.7 U	1.4 U	3.1 U	**1.5** J	3.3 U	3.6 U	1.9 U	**7.9**	**9.5**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**41**	**36**	**25**	**2** J	**78**	**62**	**30**	**66**	**66**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**11**	**11**	**13**	**77**	**24**	**21**	**11**	**61**	**82**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**24**	**21**	**20** J	**5.1**	**57**	**48**	**18**	**45**	**45**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**17**	**16**	**20**	**51**	**40**	**36**	**15**	**58**	**68**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**34**	**29**	**46**	**3.9**	**270**	**240**	**64**	**140**	**160**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**15**	**15**	**15**	**97**	**34**	**29**	**16**	**86**	**100**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**150**	**130**	**130**	**43**	**520**	**450**	**140**	**350**	**370**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**4000**	**3200**	**2300**	**110**	**9400**	**7900**	**2000**	**5000**	**4700**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**2500**	**2100**	**2300**	**85**	**6700**	**5800**	**1200**	**3700**	**3900**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**690**	**570**	**630**	**40**	**1600**	**1400**	**510**	**1400**	**1400**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**930** J	**770** J	**650** J	**130**	**2300**	**2000** J	**410**	**1700**	**1700**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**220**	**190**	**220**	**20**	**570**	**480**	**230**	**560**	**600**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**450** J	**410** J	**310** J	**260** J	**950**	**870** J	**300** J	**1200** J	**990** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**210**	**180**	**300**	**28**	**940**	**790**	**380**	**920**	**1000**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**530** J	**460** J	**520** J	**300** J	**1200**	**970** J	**700**	**1800** J	**1800** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	593-1	6038-1	6082-1	6328-1	6450-1	6547-1-D	6547-1	6630-1	6676-1	6676-2-D	6676-2
			Location ID	MidBlind_593-1	MidBlind_6038-1	MidBlind_6082-1	MidBlind_6328-1	MidBlind_6450-1	MidBlind_6547-1-D	MidBlind_6547-1	MidBlind_6630-1	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2
			Sample Date	11/6/2006	11/6/2006	11/13/2006	10/23/2006	11/6/2006	11/6/2006	11/6/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	1-6	1-6
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**11000**	**6300**	**1500**	**3600** J	**14000**	**9600**	**7000**	**11000**	**3000** J	**3300** J	**3100** J
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**1600**	**390**	**120**	**500** J	**1400**	**960**	**870**	**800**	**300**	**330**	**290**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1000**	**570**	**140**	**390** J	**1100**	**1000**	**870**	**1100**	**310**	**340**	**330**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**1200**	**150** J	**70**	**270** J	**880**	**420** J	**390** J	**540**	**180**	**200**	**190**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**26**	**9**	**2.8**	**12**	**23**	**18**	**16**	**22**	**7.8**	**8**	**7.9**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**16**	**14**	**3.1**	**9.4**	**24**	**22**	**20**	**26**	**7**	**7.1**	**7.7**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**38**	**14**	**5.3**	**18**	**38**	**28**	**26**	**42**	**19**	**17**	**19**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**51**	**27**	**8.3**	**23**	**64**	**62**	**53**	**63**	**19**	**21**	**20**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**19**	**7.8**	**2.8**	**10**	**19**	**16**	**15**	**22**	**8.2**	**8**	**8.1**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**30**	**20**	**6.2**	**17**	**44**	**45**	**38**	**43**	**13**	**13**	**14**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**3.3**	**1.3** J	**1.6** J	0.99 U	1.7 U	**3.6**	**2.8**	1.7 U	0.67 U	0.66 U	**0.92** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**19**	**15**	**4.5**	**11**	**31**	**26**	**24**	**28**	**12**	**13**	**13**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**13**	**4.7**	**3.3**	**6.1**	**13**	**11**	**9.5**	**19**	**12**	**11**	**13**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**15**	**5.7**	**3.2**	**7.6** J	**14**	**12**	**11**	**14**	**6.4**	**6.2**	**5.8**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**14**	**5.8**	**3.4**	**7.7**	**14**	**12**	**11**	**19**	**12**	**12**	**13**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**35**	**38**	**7.5**	**21**	**49**	**55**	**50**	**61**	**25**	**27**	**31**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**17**	**5.4**	**4.9**	**8.7**	**15**	**14**	**11**	**29**	**18**	**19**	**21**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**100**	**74**	**19**	**52**	**130**	**120**	**110**	**140**	**56**	**59**	**64**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1900**	**1100**	**260**	**690**	**2100**	**1800**	**1500**	**2000**	**570**	**650**	**620**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**2300**	**380**	**150**	**590**	**1800**	**1000**	**940**	**1200**	**360**	**420**	**380**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**380**	**250**	**76**	**180**	**540**	**490**	**430**	**560**	**190**	**200**	**200**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**540**	**160**	**62**	**230**	**490**	**390**	**350**	**510**	**170** J	**170** J	**170** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**160**	**130**	**35**	**99**	**270**	**240**	**210**	**260**	**94**	**93**	**100**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**210** J	**120** J	**50**	**120**	**250** J	**290** J	**240** J	**340** J	**140** J	**140** J	**140**
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**230**	**230**	**45**	**140**	**340**	**430**	**380**	**390**	**150**	**150**	**170**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**380** J	**380** J	**98**	**290**	**570** J	**820** J	**700** J	**590** J	**290**	**300** J	**350**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	6712-1	6713-1	6772-1-D	6772-1	6823-1-C	6823-1	6960-1-C	6960-1	6960-2-C	6960-2	706-1-C
			Location ID	MidBlind_6712-1	MidBlind_6713-1	MidBlind_6772-1-D	MidBlind_6772-1	MidBlind_6823-1-C	MidBlind_6823-1	MidBlind_6960-1-C	MidBlind_6960-1	MidBlind_6960-2-C	MidBlind_6960-2	MidBlind_706-1-C
			Sample Date	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/6/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	1-6	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24000**	**30000**	**4300**	**4900** J	**1200**	**850**	**540**	**520**	**420**	**470**	**12000**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**3400**	**2300**	**310**	**340**	**94**	**79**	**57**	**57**	**43**	**50**	**980**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2400**	**3000**	**460**	**500**	**160**	**110**	**57**	**56**	**44**	**48**	**1400**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**2400**	**840**	**130** J	**130** J	**90** J	**78** J	**38**	**34**	**30**	**35**	**580**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**63**	**43**	**7.2**	**7.4**	**4.4**	**3.8**	**1.5** J	**1.5** J	**1.2** J	**1.1** J	**22**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**59**	**43**	**7.8**	**7.6**	**5.4**	**4.1**	**1.7** J	**1.6** J	**1.1** J	**1.4** J	**24**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**130**	**63**	**11**	**11**	**10**	**12**	**3.3**	**3.7**	**2.9**	**2.6**	**42**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**160**	**120**	**21**	**22**	**14**	**11**	**3.6**	**4**	**2.8**	**3**	**64**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**61**	**28**	**5.8**	**5.8**	**4.2**	**5.2**	**2.4** J	**2.1** J	**1.8** J	**1.9** J	**38**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**110**	**88**	**15**	**15**	**10**	**7.9**	**2.8**	**2.9**	**2.1** J	**2.3** J	**51**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**13**	**5.8**	0.78 U	0.65 U	0.67 U	**2.5** J	**1.1** J	**1** J	**0.94** J	**0.84** J	1.3 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**82**	**44**	**10**	**10**	**8.4**	**7**	**1.8** J	**2.1** J	**1.5** J	**1.7** J	**19**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**54**	**20**	**4.4**	**4.1**	**4.7**	**8.8**	**2** J	**2.3** J	**1.9** J	**1.9** J	**17**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**41**	**24**	**4.3**	**4.2**	**3.8**	**3.5**	**2.1** J	**2.5** J	**2** J	**2.3** J	**29**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**53**	**24**	**8.1** J	**4.6** J	**4.5**	**7.2**	**2.5** J	**2.7**	**2** J	**2.3** J	**20**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**160**	**160**	**35**	**32**	**17**	**26**	**2.1**	**2.2**	**2.1**	**2.1**	**17**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**66**	**23**	**5**	**5.2**	**5.7**	**14**	**3.5**	**3.6**	**3**	**3.5**	**23**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**380**	**300**	**62**	**59**	**35**	**44**	**7.8**	**8.3**	**6.8**	**7.3**	**93**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**4300**	**5400**	**820**	**870**	**280**	**200**	**100**	**110**	**80**	**88**	**2600**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**4900**	**2200**	**310**	**320**	**170**	**150**	**76**	**73**	**59**	**71**	**1200**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**1300**	**1000**	**180**	**180**	**120**	**96**	**36**	**39**	**28**	**31**	**570**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**1400** J	**760** J	**130**	**130**	**100**	**92**	**43**	**40**	**29**	**32**	**840** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**770**	**370**	**79**	**80**	**67**	**56**	**17**	**18**	**13**	**14**	**140**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**830** J	**460** J	**77**	**77** J	**70** J	**83**	**43**	**41**	**32**	**29**	**530** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**1200**	**670**	**140**	**160**	**120**	**130**	**18**	**18**	**12**	**16**	**110**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**1900** J	**1100** J	**220** J	**240** J	**240** J	**250**	**90**	**93**	**60**	**65**	**380** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	706-1	706-2-C	706-2	7124-1	7346-1	7500-1	7500-2	7530-1	7530-2	7727-1	7734-1
			Location ID	MidBlind_706-1	MidBlind_706-2-C	MidBlind_706-2	MidBlind_7124-1	MidBlind_7346-1	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-2	MidBlind_7727-1	MidBlind_7734-1
			Sample Date	11/13/2006	11/13/2006	11/13/2006	11/6/2006	11/6/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
			Sample Depth (in)	0-1	1-6	1-6	0-1	0-1	0-1	1-6	0-1	1-6	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**13000**	**14000**	**17000**	**2600**	**15000**	**62000**	**53000**	**100** J	**100** J	**4100**	**75400**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**980**	**1200**	**1200**	**220**	**1400**	**7900**	**7400**	**7.5**	**7.1**	**330**	**3100**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1500**	**1600**	**1900**	**320**	**1700**	**5200**	**4700**	**18**	**17**	**510**	**5800**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**590**	**760**	**730**	**150** J	**540** J	**5000**	**4800**	**5.4**	**5.6**	**170**	**1100**
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**24**	**28**	**33**	**8.8**	**34**	**150**	**130**	0.82 U	**0.43** J	**8.9**	**59**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**29**	**29**	**38**	**12**	**38**	**100**	**94**	**0.83** J	**0.78** J	**15**	**68**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**44**	**49**	**53**	**16**	**59**	**250**	**220**	**0.72** J	**0.72** J	**25**	**95**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**74**	**79**	**94**	**29**	**93**	**310**	**280**	**1.5** J	**1.5** J	**31**	**190**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**42**	**52**	**55**	**8.2**	**30**	**110**	**110**	**0.42** J	**0.42** J	**11**	**54**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**59**	**62**	**75**	**22**	**61**	**180**	**160**	**1.2** J	**1.2** J	**28**	**130**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.1 U	1.7 U	1.7 U	**1.5** J	**4.2**	**6.9**	**10**	0.26 U	0.36 U	0.8 U	1.9 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24**	**24**	**30**	**19**	**49**	**130**	**120**	**0.76** J	**1** J	**16**	**57**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**18**	**17**	**16**	**6.2**	**19**	**61**	**59**	**0.3** J	**0.24** J	**19**	**42**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**31**	**38**	**43**	**6.8**	**20**	**86**	**77**	**0.51** J	**0.61** J	**7.9**	**46**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**22**	**24**	**23**	**7.5**	**22**	**83**	**78**	0.42 U	**0.54** J	**19**	**46**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**24**	**30**	**28**	**34**	**140**	**270**	**270**	**0.74**	**0.88**	**29**	**150**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**23**	**23**	**20**	**7.3**	**20**	**85**	**77**	**0.42** J	**0.26** J	**41**	**63**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**110**	**120**	**130**	**71**	**250**	**670**	**630**	**2.4**	**2.9**	**75**	**380**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**3000**	**3100**	**3700**	**590**	**3200**	**9500**	**8600**	**36**	**33**	**880**	**11000**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**1200**	**1600**	**1600**	**300**	**1400**	**10000**	**9900**	**9.3**	**10**	**380**	**3000**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**700**	**700**	**870**	**260**	**790**	**2400**	**2200**	**15**	**11**	**290**	**1400**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**920** J	**1100** J	**1200** J	**160** J	**620** J	**3100** J	**2900** J	**6.7**	**6.3**	**200**	**1400** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**180**	**170**	**220**	**160**	**410**	**1100**	**1000**	**6.1**	**5.5**	**120**	**360**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**580** J	**710** J	**710** J	**150**	**510** J	**1200** J	**1100** J	**3.2**	**5.9**	**180**	**1100** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**150**	**170**	**180**	**320**	**710**	**1600**	**1500**	**6.6**	**5**	**160**	**480**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**490** J	**510** J	**560** J	**520** J	**1400** J	**2500** J	**2300** J	**13**	**12**	**330**	**810** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	7734-2-M	7759-1-D	7759-1	7780-1	7886-1-D	7886-1-M	8046-1-D	8046-1	8046-2-D	8046-2	8090-1
			Location ID	MidBlind_7734-2-M	MidBlind_7759-1-D	MidBlind_7759-1	MidBlind_7780-1	MidBlind_7886-1-D	MidBlind_7886-1-M	MidBlind_8046-1-D	MidBlind_8046-1	MidBlind_8046-2-D	MidBlind_8046-2	MidBlind_8090-1
			Sample Date	11/13/2006	10/23/2006	10/23/2006	11/6/2006	11/6/2006	11/6/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/23/2006
			Sample Depth (in)	1-6	0-1	0-1	0-1	0-1	0-1	0-1	0-1	1-6	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**35000**	**16000** J	**17000** J	**4400**	**1500**	**1400**	**5100** J	**5300** J	**5000** J	**5200** J	**1800** J
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**2200**	**1100** J	**1300** J	**400**	**130**	**140**	**360**	**330**	**350**	**340**	**110** J
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3300**	**1700** J	**1900** J	**560**	**210**	**180**	**500**	**530**	**520**	**550**	**200** J
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**920** J	**350** J	**420** J	**250** J	**100** J	**100** J	**170**	**180**	**210**	**190**	**57** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**48**	**21**	**26**	**13**	**8.7** J	**5** J	**7.3**	**7.8**	**8.1**	**7.9**	**3.9**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**46**	**20** J	**30** J	**9.6**	**7.1**	**5.1**	**8.7**	**8.6**	**9.6**	**9**	**4.3**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**86**	**28** J	**40** J	**18**	**19** J	**13** J	**14**	**15**	**15**	**15**	**6.1**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**140**	**69**	**86**	**30**	**17**	**13**	**21**	**23**	**24**	**22**	**11**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**49**	**14** D	**23** J	**9**	**7.2**	**5.5**	**6.3**	**6.8**	**7.7**	**7.1**	**3.1**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**80**	**46**	**61**	**20**	**14** J	**9.4** J	**15**	**16**	**17**	**16**	**7.6**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**3**	3 U	4.4 U	0.76 U	**1.7** J	0.47 U	0.86 U	0.56 U	0.84 U	0.84 U	1.1 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**45**	**27**	**38**	**8.4**	**9.9** J	**6.5** J	**9.9**	**11**	**12**	**11**	**5.3**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**41**	**12** J	**17** J	**4**	**9**	**8.2**	**5.6**	**5.7**	**6.4**	**7.6**	**2.6**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**37**	**10** J	**17** J	**5.7**	**4.8**	**4.2**	**5.6**	**5.9**	**6**	**6**	**2.7** J
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**42**	**15**	**21**	**4.3**	**7.6**	**7**	**6.8**	**7**	**7.6**	**9**	**3.3**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**130**	**87**	**100**	**13**	**19**	**19**	**15**	**16**	**18**	**23**	**9.2**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**60**	**21**	**29**	**3.1**	**12**	**13**	**8.1**	**8.1**	**8.9**	**10**	**3.7**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**290**	**170**	**210**	**42**	**43**	**37**	**43**	**46**	**50**	**54**	**22**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**6500**	**3100**	**3400**	**880**	**380**	**320**	**930**	**980**	**980**	**1000**	**400**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**2300**	**960**	**1100**	**630**	**210**	**210**	**380**	**410**	**440**	**430**	**140**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**1100**	**520**	**710**	**200**	**160**	**120**	**210**	**210**	**220**	**210**	**89**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**1300** J	**300** J	**420**	**270**	**130**	**110**	**150**	**170**	**180**	**170**	**63**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**340**	**190**	**270**	**80**	**87**	**60**	**73**	**77**	**85**	**78**	**43**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**890** J	**180** J	**270** J	**87**	**99** J	**90** J	**100** J	**110** J	**120** J	**110** J	**45**
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**480**	**300**	**450**	**96**	**94**	**89**	**110**	**110**	**130**	**130**	**56**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**940** J	**400** J	**470** J	**140** J	**200** J	**210** J	**220** J	**220** J	**250**	**240** J	**130**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	816-1	8193-1	8196-1-D	8196-1-M	8196-2-D	8196-2	8275-1-C	8275-1	8282-1	8282-2	8302-1-D
			Location ID	MidBlind_816-1	MidBlind_8193-1	MidBlind_8196-1-D	MidBlind_8196-1-M	MidBlind_8196-2-D	MidBlind_8196-2	MidBlind_8275-1-C	MidBlind_8275-1	MidBlind_8282-1	MidBlind_8282-2	MidBlind_8302-1-D
			Sample Date	11/6/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/23/2006	10/23/2006	10/30/2006	10/30/2006	11/6/2006
			Sample Depth (in)	0-1	0-1	0-1	0-1	1-6	1-6	0-1	0-1	0-1	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12000**	**8400**	**18000**	**17000**	**20000**	**18000**	**2800** J	**3700** J	**8700** J	**4500** J	**3600**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**940**	**610**	**3100**	**3300**	**3800**	**4000**	**270** J	**400** J	**980**	**390**	**320**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1100**	**1000**	**2500**	**2200**	**2300**	**2300**	**290** J	**400** J	**910**	**470**	**320**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**400** J	**410**	**2400**	**2600**	**3000**	**3000** J	**170** J	**260** J	**400**	**210**	**120** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**17**	**18**	**280** J	**270** J	**200** J	**290** J	**9.3**	**14**	**17**	**9.7**	**4.5**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**15**	**30**	**130** J	**43** J	**36**	**41**	**8.2**	**11**	**13**	**7.6**	**5**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**24**	**34**	**550**	**570**	**530**	**600**	**25**	**36**	**19**	**11**	**6**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**43**	**76**	**360** J	**210** J	**200**	**210**	**25**	**35**	**38**	**20**	**13**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**10**	**21**	**270** J	**160** J	**130** J	**160** J	**12**	**18**	**10**	**5.5**	**2.9**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**30**	**56**	**180** J	**89** J	**84**	**92**	**18**	**21**	**25**	**14**	**9.7**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.4 U	1.5 U	**150** J	**26** J	**19**	**25**	1.8 U	3 U	1.4 U	0.67 U	**1.4** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**36**	**46**	**130** J	**45** J	**37**	**40**	**12**	**17**	**22**	**14**	**6.2**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**8**	**14**	**240** J	**150** J	**180**	**140**	**18**	**24**	**3.5**	**1.9** J	**1.6** J
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**9.6**	**17**	**150** J	**64** J	**50**	**68**	**8.7** J	**14** J	**5.6**	**3.9**	**2.5**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**9**	**18**	**210** J	**120** J	**140**	**120**	**16**	**23**	**6.3**	**3.3**	**2.1** J
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**84**	**130**	**46** J	**32** J	**26**	**24**	**19**	**31**	**27**	**14**	**7.7**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**9.3**	**22**	**180**	**180**	**220**	**160**	**28**	**38**	**4**	**2.1**	**1.7**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**160**	**220**	**500**	**310**	**300**	**300**	**55**	**81**	**78**	**43**	**24**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**2000**	**1800**	**5000**	**4000**	**4000**	**4300**	**550**	**740**	**1700**	**890**	**570**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**980**	**850**	**5000**	**5500** J	**6100**	**6400** J	**350**	**560**	**950**	**480**	**270**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**360**	**730**	**2200**	**1700**	**1500**	**1700**	**220**	**290**	**290**	**160**	**100**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**330** J	**430**	**2500** J	**2600** J	**2200** J	**2600** J	**220**	**400**	**290**	**150**	**77**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**170**	**430**	**450**	**530**	**400**	**460**	**110**	**180**	**130**	**73**	**38**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**190** J	**390** J	**1400** J	**1100** J	**1100** J	**1000** J	**220** J	**460** J	**110**	**53**	**36** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**300**	**840**	**370**	**430**	**410**	**350**	**170**	**330**	**170**	**85**	**45**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**440** J	**1500**	**770** J	**800** J	**900** J	**680** J	**380**	**760** J	**260**	**130**	**98** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

				Sample ID	8302-1	8314-1	8314-2	8463-1	8520-1	8532-1	8664-1-D	8664-1-M	8689-1	8734-1-C	8734-1
				Location ID	MidBlind_8302-1	MidBlind_8314-1	MidBlind_8314-2	MidBlind_8463-1	MidBlind_8520-1	MidBlind_8532-1	MidBlind_8664-1-D	MidBlind_8664-1-M	MidBlind_8689-1	MidBlind_8734-1-C	MidBlind_8734-1
				Sample Date	11/6/2006	11/13/2006	11/13/2006	10/30/2006	11/6/2006	10/30/2006	10/23/2006	10/23/2006	10/30/2006	11/6/2006	11/6/2006
				Sample Depth (in)	0-1	0-1	1-6	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**												
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**3000**	**10000**	**12000**	**6100** J	**2900**	**27000**	**3600** J	**4400** J	**3000** J	**6400**	**5500**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**240**	**1300**	**1600**	**240**	**290**	**3300**	**290** J	**280** J	**300**	**560**	**480**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**300**	**920**	**1100**	**460**	**290**	**2700**	**450** J	**470** J	**290**	**630**	**530**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**130** J	**930**	**1200**	**96**	**170** J	**2500**	**180** J	**190** J	**220**	**300** J	**360** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**4.6**	**24**	**30**	**6.4**	**8.6**	**63**	**10**	**9.9**	**7.6**	**14**	**10**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5.2**	**16**	**19**	**9.1**	**6.2**	**68**	**13**	**13**	**7.5**	**12**	**9.4**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**6.3**	**38**	**46**	**11** J	**21**	**110**	**20**	**21**	**13**	**18**	**23**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12**	**47**	**58**	**20**	**17**	**200**	**34**	**28**	**19**	**28**	**26**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**3.1**	**19**	**24**	**4.5** J	**7.9**	**57**	**11**	**11**	**6**	**9.2**	**9.8**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**9**	**31**	**38**	**17**	**11**	**130**	**21**	**20**	**13**	**22**	**19**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**1.8** J	1.4 U	**11**	**2.1** J	0.95 U	**8.9**	1.6 U	1.7 U	0.94 U	2 U	2.1 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**6.2**	**18**	**22**	**7.5**	**7.7**	**97**	**18**	**16**	**9.8**	**15**	**12**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**1.8** J	**11**	**13**	**3.8**	**14**	**43**	**12**	**11**	**4.9**	**5.6**	**14**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.6**	**17**	**19**	**3.4**	**5.2**	**45**	**7.8** J	**8** J	**4.5**	**6.9**	**7.1**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**2.3** J	**14**	**17**	**3.1**	**11**	**54**	**13**	**12**	**5**	**5.8**	**11**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**7.6**	**43**	**44**	**9.5**	**29**	**170**	**46**	**42**	**20**	**21**	**11**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**1.8**	**14**	**17**	**4.2**	**22**	**61**	**20**	**16** J	**5.7**	**7.5**	**18**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**24**	**110**	**120**	**33**	**55**	**410**	**89**	**83**	**44**	**60**	**49**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**530**	**1600**	**2000**	**880**	**530**	**5000**	**820**	**880**	**510**	**1200**	**990**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**280**	**1900**	**2400**	**200**	**370**	**5000**	**380**	**390**	**430**	**640**	**710**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**100**	**380**	**440**	**190**	**140**	**1600**	**270**	**260**	**160**	**260**	**220**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**84**	**540**	**670**	**99**	**170**	**1400** J	**200**	**200**	**140**	**230**	**280**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**38**	**150**	**180**	**53**	**66**	**820**	**160**	**150**	**75**	**86**	**85**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**38** J	**280** J	**350** J	**55** J	**130** J	**750** J	**180** J	**170** J	**77** J	**110** J	**170** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**44**	**220**	**260**	**60**	**130**	**1100**	**310**	**290**	**110**	**100**	**99**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**87** J	**350** J	**430** J	**130** J	**250** J	**1900** J	**640** J	**660** J	**230** J	**180** J	**220** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	876-1	876-2	8820-1-C	8820-1-D	8820-1	8927-1	9084-1	9144-1	923-1	9278-1	9339-1-C
			Location ID	MidBlind_876-1	MidBlind_876-2	MidBlind_8820-1-C	MidBlind_8820-1-D	MidBlind_8820-1	MidBlind_8927-1	MidBlind_9084-1	MidBlind_9144-1	MidBlind_923-1	MidBlind_9278-1	MidBlind_9339-1-C
			Sample Date	11/13/2006	11/13/2006	11/6/2006	11/6/2006	11/6/2006	10/30/2006	10/23/2006	10/30/2006	11/6/2006	11/6/2006	11/6/2006
			Sample Depth (in)	0-1	1-6	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**120000**	**92000**	**16000**	**20000**	**18000**	**13000**	**19000** J	**9500** J	**3900**	**27000**	**5600**
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**5300**	**4600**	**1600**	**1900**	**1700**	**1100**	**2000** J	**1300**	**330**	**4100**	**400**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**9100**	**7400**	**1700**	**2200**	**1900**	**1400**	**1700** J	**990**	**410**	**2900**	**530**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**3800**	**3300**	**1200**	**1400**	**1300**	**720**	**1400** J	**710**	**210** J	**2700**	**200** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**350**	**310**	**47**	**54**	**54**	**33**	**44**	**25**	**9.7**	**81**	**7.8**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**130**	**100**	**42**	**52**	**50**	**36**	**42**	**21**	**7.7**	**78**	**7.8**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**440**	**390**	**120**	**130**	**120**	**77**	**87**	**39**	**20**	**150**	**11**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**480**	**410**	**130**	**150**	**140**	**87**	**110**	**61**	**23**	**190**	**20**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**240**	**200**	**52**	**50**	**53**	**36**	**39** D	**22**	**8.8**	**69**	**5.6**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**300**	**260**	**73**	**94**	**86**	**59**	**71**	**38**	**16**	**130**	**15**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**18**	**17**	**6.3**	**8.6**	**7.5**	**5.2**	**4.4**	**3.4**	0.79 U	**16**	0.79 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**98**	**81**	**50**	**63**	**56**	**47**	**57**	**29**	**12**	**96**	**13**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**54**	**43**	**71**	**72**	**65**	**51**	**38**	**11**	**11**	**49**	**3.2**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**160**	**130**	**33**	**35**	**35**	**26**	**25** J	**19**	**6.6**	**55**	**4.2**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**120**	**100**	**56**	**59**	**56**	**51**	**43**	**17**	**9.9**	**58**	**3.7**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**75**	**55**	**120**	**160**	**130**	**110**	**120**	**47**	**32**	**190**	**15**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**44**	**35**	**95**	**96**	**98**	**91**	**56**	**14**	**13**	**54**	**3.1**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**560**	**460**	**280**	**340**	**300**	**240**	**270**	**120**	**64**	**440**	**45**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**17000**	**14000**	**3100**	**4000**	**3600**	**2600**	**3200**	**1800**	**740**	**5200**	**980**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**8200**	**6900**	**2600**	**2900**	**2800**	**1700**	**2600**	**1600**	**430**	**5600**	**430**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**3700**	**3000**	**1000**	**1200**	**1200**	**770**	**1000**	**500**	**190**	**1600**	**170**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**4400** J	**3600** J	**1200**	**1300**	**1200**	**830** J	**930** J	**650**	**200** J	**1800** J	**160** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**720**	**620**	**450**	**560**	**490**	**420**	**480**	**220**	**95**	**890**	**70**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**2300** J	**1800** J	**750** J	**860** J	**850** J	**630** J	**580** J	**450** J	**150** J	**1100** J	**72**
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**420**	**380**	**740**	**930**	**870**	**640**	**620**	**330**	**190**	**1400**	**98**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**780** J	**710** J	**1500** J	**1800** J	**1800** J	**1600** J	**1200** J	**750** J	**280** J	**2200** J	**170** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	9339-1	9386-1	9386-2	9482-1	9496-1	9496-2	9507-1	9532-1	9645-1-C	9645-1	9645-2-C
			Location ID	MidBlind_9339-1	MidBlind_9386-1	MidBlind_9386-2	MidBlind_9482-1	MidBlind_9496-1	MidBlind_9496-2	MidBlind_9507-1	MidBlind_9532-1	MidBlind_9645-1-C	MidBlind_9645-1	MidBlind_9645-2-C
			Sample Date	11/6/2006	10/30/2006	10/30/2006	11/6/2006	11/13/2006	11/13/2006	11/6/2006	11/6/2006	11/13/2006	11/13/2006	11/13/2006
			Sample Depth (in)	0-1	0-1	1-6	0-1	0-1	1-6	0-1	0-1	0-1	0-1	1-6
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**12000**	**42000**	**38000**	**9000**	**3300**	**3000**	**8100**	**15000**	**1000**	**1300**	**1800** J
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**1300**	**4300**	**3300**	**790**	**270**	**240**	**910**	**2000**	**99**	**97**	**180**
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**990**	**4200**	**3700**	**950**	**380**	**330**	**930**	**1600**	**99**	**130**	**180** J
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**850** J	**2100**	**1900**	**460** J	**140**	**130**	**680**	**1100**	**65**	**55**	**120** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**27**	**98**	**92**	**22**	**6.3**	**5.7**	**24**	**41**	**2.3** J	**2.3** J	**3.7**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**23**	**69**	**51**	**20**	**7.4**	**6.7**	**24**	**34**	**2.4** J	**2.6**	**4.2** J
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**47**	**150**	**130**	**39**	**9.6**	**8.8**	**57**	**68**	**3.4**	**3.1**	**6** J
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**64**	**220**	**180**	**52**	**16**	**14**	**58**	**81**	**6.2**	**6.6**	**12** J
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**22**	**84** J	**71**	**19**	**4.6**	**4.3**	**27**	**27**	**2.1** J	**1.7** J	**3.5**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**41**	**140**	**110**	**34**	**14**	**12**	**39**	**59**	**4.4**	**4.8**	**7.6** J
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	1.7 U	9.4 U	4.4 U	**2.4** J	0.87 U	1.1 U	**3.7**	**6.7**	**1** J	**1** J	**1.8** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**36**	**74**	**51**	**27**	**5.9**	**5**	**28**	**46**	**3.6**	**3.2**	**6.4** J
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**18**	**30**	**22**	**17**	**2.8**	**2.7**	**32**	**19**	**1.2** J	**0.97** J	**2.3** J
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**24**	**54**	**40**	**14**	**3.3**	**3**	**18**	**25**	**2.2** J	**2.3** J	**3.4**
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**19**	**38**	**32**	**18**	**3.2**	**3**	**32**	**23**	**2.4** J	**2.2** J	**3.1** J
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**68**	**65**	**47**	**65**	**3.3**	**3.3**	**70**	**110**	**7**	**5**	**13** J
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**21**	**31**	**19**	**23**	**3.5**	**3.6**	**54**	**19**	**1.8**	**1.5**	**2.8** J
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**160**	**300**	**240**	**130**	**22**	**20**	**160**	**230**	**16**	**13**	**28**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**1800**	**8200**	**7000**	**1700**	**700**	**620**	**1800**	**2700**	**180**	**230**	**320**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**1700**	**5000**	**4500**	**1000**	**320**	**290**	**1400**	**2400**	**130**	**110**	**230**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**530**	**1700**	**1300**	**430**	**160**	**140**	**500**	**710**	**57**	**61**	**110**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**550**	**2100** J	**1700**	**420**	**110** J	**100** J	**630** J	**750** J	**45**	**40**	**79**
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**320**	**510**	**380**	**220**	**60**	**55**	**290**	**330**	**31**	**25**	**55**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**280** J	**890** J	**690** J	**300** J	**51** J	**48** J	**430** J	**380** J	**29**	**28**	**52**
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**460**	**620**	**430**	**390**	**27**	**30**	**440**	**430**	**57**	**39**	**89**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**890** J	**720** J	**460** J	**700** J	**45** J	**46** J	**1000** J	**750** J	**73**	**58**	**130**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE C-2, part 2 of 2
Dioxin and Furan Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	9645-2	9672-1-D	9672-1	9672-2-D	9672-2	9712-1	9712-2	9812-1	9947-1	9961-1	9974-1
			Location ID	MidBlind_9645-2	MidBlind_9672-1-D	MidBlind_9672-1	MidBlind_9672-2-D	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2	MidBlind_9812-1	MidBlind_9947-1	MidBlind_9961-1	MidBlind_9974-1
			Sample Date	11/13/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/6/2006	10/23/2006	11/6/2006	10/23/2006
			Sample Depth (in)	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	0-1	0-1	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**	**SL**											
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**1200** J	**95000**	**95000**	**6400** J	**6400** J	**25000**	**27000**	**940**	**8100** J	**4000**	**7200** J
DIOXIN	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	ng/kg	--	**130**	**10000**	**9400**	**930**	**820**	**2300**	**2800**	**87**	**750** J	**390**	**440** J
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**120** J	**11000**	**11000**	**660**	**690**	**2100**	**2400**	**140**	**780** J	**470**	**710** J
DIOXIN	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	ng/kg	--	**75** J	**4200**	**4500**	**490**	**410**	**1100**	**1200**	**69** J	**470** J	**170** J	**190** J
DIOXIN	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	ng/kg	--	**2.9**	**210**	**250**	**17**	**16**	**42**	**47**	**2.8**	**17**	**9.5**	**8.8**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**2.8** J	**190**	**210**	**13**	**14**	**34**	**35**	**2.9**	**19**	**13**	**10**
DIOXIN	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**4** J	**330**	**430**	**23**	**25**	**57**	**62**	**4.2**	**40**	**16**	**11**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**7.4** J	**460**	**480**	**34**	**34**	**95**	**110**	**6.6**	**51**	**30**	**27**
DIOXIN	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.5** J	**140** J	**170** J	**12**	**12**	**37**	**38**	**3.7**	**18**	**9.2**	**6.1**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	ng/kg	--	**5** J	**320**	**370**	**22**	**24**	**62**	**70**	**6**	**34**	**24**	**19**
DIOXIN	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	ng/kg	--	**0.96** J	**13**	**14**	1.1 U	1.1 U	**3.1**	2.9 U	**0.87** J	**2.2** J	**1.8** J	0.87 U
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	ng/kg	--	**4** J	**220**	**230**	**13**	**17**	**34**	**37**	**2.3** J	**40**	**16**	**34**
DIOXIN	1,2,3,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**1.6** J	**83**	**110**	**5.5**	**6.1**	**13**	**14**	**1.5**	**20**	**7.1**	**3**
DIOXIN	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	ng/kg	--	**2.5** J	**100**	**110**	**9.8**	**11**	**30**	**29**	**3.8**	**12** J	**6.9**	**5.2** J
DIOXIN	2,3,4,7,8-PENTACHLORODIBENZOFURAN	ng/kg	--	**1.9** J	**83**	**100**	**8**	**8.8**	**20**	**21**	**1.6**	**23**	**7.9**	**4.7**
DIOXIN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	ng/kg	--	**6.9** J	**290**	**300**	**19** J	**28** J	**62**	**160**	**1.7**	**75**	**39**	**53**
DIOXIN	2,3,7,8-TETRACHLORODIBENZOFURAN	ng/kg	--	**1.3** J	**97**	**110**	**5.7**	**6.4**	**14**	**19**	**1.6**	**28**	**9.1**	**3.8**
DIOXIN	2005 WHO Mammalian TEQ	ng/kg	90	**17**	**880**	**950**	**60**	**73**	**170**	**290**	**10**	**160**	**75**	**110**
DIOXIN	TOTAL HEPTACHLORO-DIBENZODIOXIN	ng/kg	--	**210**	**20000**	**21000**	**1200**	**1300**	**3700**	**4300**	**260**	**1400**	**860**	**1400**
DIOXIN	TOTAL HEPTACHLORO-DIBENZOFURAN	ng/kg	--	**160**	**11000**	**11000**	**1100**	**950**	**2600**	**3000**	**130** J	**930**	**380**	**450**
DIOXIN	TOTAL HEXACHLORO-DIBENZODIOXIN	ng/kg	--	**66**	**3900**	**4400**	**320**	**310**	**750**	**850**	**74**	**490**	**250**	**250**
DIOXIN	TOTAL HEXACHLORO-DIBENZOFURAN	ng/kg	--	**53**	**3600** J	**4100** J	**340**	**340**	**900** J	**960** J	**80**	**380**	**180**	**160** J
DIOXIN	TOTAL PENTACHLORO-DIBENZODIOXIN	ng/kg	--	**31**	**1200**	**1300**	**120**	**120**	**290**	**340**	**20**	**270**	**140**	**120**
DIOXIN	TOTAL PENTACHLORO-DIBENZOFURAN	ng/kg	--	**37**	**2100** J	**2400** J	**180** J	**280** J	**470** J	**490** J	**41**	**290** J	**150** J	**79** J
DIOXIN	TOTAL TETRACHLORO-DIBENZODIOXIN	ng/kg	--	**55**	**1400**	**1500**	**140**	**160**	**370**	**500**	**13**	**400**	**240**	**170**
DIOXIN	TOTAL TETRACHLORO-DIBENZOFURAN	ng/kg	--	**75**	**2200** J	**2500** J	**220** J	**280** J	**570** J	**630** J	**32** J	**750** J	**430** J	**250**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
D = Analyzed at a secondary dilution factor
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

Appendix D
Additional Chemical Summary Statistics and Analytical Results

TABLE D-1
Additional Chemicals Summary Statistics
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
GENERAL CHEMISTRY																
CYANIDE, TOTAL	µg/kg	68	82	0.83	0.0066	0.0358	12.2	1,350	153	79.3	220	1.43	194	100	32	--
TOTAL ORGANIC CARBON	mg/kg	77	82	0.94	73	73	2,310	64,000	21,278	20,200	13,856	0.65	23,824	--	--	--
SULFIDE	mg/kg	4	82	0.05	86	226	103	265	53.8	96	27.6	0.51	58.9	--	--	--
HERBICIDES																
2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/kg	11	82	0.13	1.76	4.61	8.39	83.8	5.59	2.00	15.1	2.70	8.36	1,400	--	--
2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/kg	1	82	0.01	2.13	5.58	24	24	1.50	2.39	2.52	1.68	1.97	--	--	--
SILVEX (2,4,5-TP)	µg/kg	--	82	0.00	1.85	4.86	--	--	1.07	2.08	0.17	0.16	1.10	2,200	--	--
METALS																
CHROMIUM, TOTAL	µg/kg	82	82	1.00	--	--	783	46,700	8,148	6,350	6,785	0.83	9,395	3,300	77	--
COBALT	µg/kg	82	82	1.00	--	--	402	7,420	2,444	2,230	1,302	0.53	2,683	800	76	--
ARSENIC	µg/kg	77	82	0.94	194	785	195	13,100	4,229	3,490	3,164	0.75	4,810	4,600	29	--
SELENIUM	µg/kg	5	82	0.06	456	1180	918	6,850	495	510	1,069	2.16	691	410	5	77
SILVER	µg/kg	6	82	0.07	50.8	132	77.7	1,680	76.6	57.0	231	3.01	119	1,000	2	--
LEAD	µg/kg	82	82	1.00	--	--	3,360	666,000	39,163	19,350	79,248	2.02	53,727	400,000	1	--
MERCURY	µg/kg	71	82	0.87	3.89	4.27	8.64	168	42.6	36.4	30.4	0.71	48.2	130	1	--
ANTIMONY	µg/kg	16	82	0.20	208	1,610	248	4530	663	527	912	1.38	831	4,300	1	--
BARIUM	µg/kg	82	82	1.00	--	--	7,750	100,000	36,897	34,850	17,990	0.49	40,203	1,300,000	--	--
COPPER	µg/kg	82	82	1.00	--	--	2,840	54,900	16,472	14,900	10,139	0.62	18,335	5,800,000	--	--
NICKEL	µg/kg	82	82	1.00	--	--	1,620	19,400	7,205	6,710	3,397	0.47	7,829	100,000	--	--
VANADIUM	µg/kg	82	82	1.00	--	--	2,250	25,100	11,094	10,700	4,694	0.42	11,956	72,000	--	--
BERYLLIUM	µg/kg	79	82	0.96	35	49.1	54.1	1,110	278	249	171	0.62	309	51,000	--	--
ZINC	µg/kg	52	82	0.63	55.8	276	7,430	190,000	37,763	29,650	46,563	1.23	46,321	2,400,000	--	--
CADMIUM	µg/kg	48	82	0.59	15.3	946	32.6	856	188	213	133	0.71	212	6,000	--	--
TIN	µg/kg	13	82	0.16	484	2,610	532	158,000	2,763	559	17,668	6.39	6,010	--	--	--
THALLIUM	µg/kg	--	82	0.00	183	990	--	--	122	205	72.4	0.59	136	2,300	--	--
PCBs																
PCB-1262 (AROCLOR 1262)	µg/kg	3	82	0.04	7.59	409	98.7	973	28.8	8.86	116	4.02	50.1	--	--	--
PCB-1260 (AROCLOR 1260)	µg/kg	2	82	0.02	5.76	310	60.4	77.3	10.4	6.72	21.3	2.05	14.3	--	--	--
PCB-1248 (AROCLOR 1248)	µg/kg	1	82	0.01	8.3	447	433	433	17.9	9.62	54.0	3.02	27.8	--	--	--
PCB-1268 (AROCLOR 1268)	µg/kg	1	82	0.01	10.3	553	81.3	81.3	16.5	11.9	34.8	2.11	22.9	--	--	--
PCB-1016 (AROCLOR 1016)	µg/kg	--	82	0.00	5.71	307	--	--	8.68	6.56	18.9	2.18	12.2	--	--	--
PCB-1221 (AROCLOR 1221)	µg/kg	--	82	0.00	9.75	525	--	--	14.8	11.2	32.4	2.18	20.8	--	--	--
PCB-1232 (AROCLOR 1232)	µg/kg	--	82	0.00	10.7	575	--	--	16.2	12.3	35.4	2.18	22.8	--	--	--
PCB-1242 (AROCLOR 1242)	µg/kg	--	82	0.00	12.5	672	--	--	19.0	14.4	41.4	2.18	26.6	--	--	--
PCB-1254 (AROCLOR 1254)	µg/kg	--	82	0.00	6.9	372	--	--	10.5	7.93	22.9	2.18	14.7	--	--	--
SUMMED PCB	µg/kg	82	82	1.00	--	--	38.755	2,085	143	45.6	285	1.99	195	3,000,000	--	--
PESTICIDES																
4,4'-DDE	µg/kg	56	82	0.68	0.829	4.48	0.985	1,190	70.7	4.41	205	2.90	108	45,000	--	--
4,4'-DDT	µg/kg	50	82	0.61	0.957	5.05	1.04	2,650	114	4.13	425	3.74	192	57,000	--	--
4,4'-DDD	µg/kg	43	82	0.52	0.631	3.33	0.904	610	20.1	1.18	80.5	4.00	34.9	95,000	--	--
HEPTACHLOR EPOXIDE	µg/kg	16	82	0.20	0.882	90.1	1.02	111	4.21	1.04	13.8	3.29	6.75	3,100	--	--
DIELDRIN	µg/kg	15	82	0.18	0.638	65.1	1.01	21.3	1.99	0.757	4.70	2.36	2.85	1,100	--	--
METHOXYCHLOR	µg/kg	11	82	0.13	1.06	109	2.94	19.3	3.21	1.26	7.25	2.26	4.54	16,000	--	--
CHLORDANE	µg/kg	8	82	0.10	0.851	86.8	2.49	327	18.9	0.994	68.1	3.61	31.4	31,000	--	--
ALPHA BHC	µg/kg	6	82	0.07	0.808	82.5	0.909	10.6	1.92	0.943	5.26	2.73	2.89	18	--	2
ENDOSULFAN SULFATE	µg/kg	6	82	0.07	0.777	78.2	3.13	46.6	3.43	0.887	8.88	2.59	5.07	--	--	--
ENDOSULFAN I	µg/kg	5	82	0.06	0.489	49.9	0.864	33.8	1.47	0.572	4.77	3.26	2.34	--	--	--
ENDOSULFAN II	µg/kg	14	82	0.17	0.544	54.3	0.787	8.44	1.76	0.629	3.76	2.14	2.45	--	--	--
SUM of ENDOSULFAN I and II	µg/kg	82	82	1.00	--	--	0.522	52.1	3.22	0.606	7.9	2.46	4.67	1,400,000	--	--
ALDRIN	µg/kg	4	82	0.05	0.638	65.1	0.799	3.04	1.39	0.748	4.07	2.94	2.13	1,000	--	--
BETA BHC	µg/kg	4	82	0.05	0.872	89	1.55	29.7	2.31	1.02	6.39	2.76	3.49	37	--	2
DELTA BHC	µg/kg	4	82	0.05	0.787	80.3	0.995	4.13	1.74	0.911	5.03	2.89	2.67	--	--	--

TABLE D-1
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Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
ENDRIN	µg/kg	3	82	0.04	0.776	79.2	9.36	22.3	2.13	0.905	5.62	2.64	3.17	65,000	--	--
ENDRIN ALDEHYDE	µg/kg	3	82	0.04	0.797	81.4	1.51	9.88	1.80	0.93	5.17	2.87	2.75	--	--	--
GAMMA BHC (LINDANE)	µg/kg	1	82	0.01	0.626	63	5.93	5.93	1.35	0.714	3.97	2.94	2.08	20	--	2
HEPTACHLOR	µg/kg	--	82	0.00	0.638	65.1	--	--	1.33	0.733	4.08	3.07	2.08	5,600	--	--
TOXAPHENE	µg/kg	--	82	0.00	9.96	1,020	--	--	20.8	11.5	63.8	3.07	32.5	860	--	1
SEMIVOLATILE ORGANICS																
PENTACHLOROPHENOL	µg/kg	5	82	0.06	31	81.6	36.5	404	28.7	35.2	57.5	2.00	39.3	22	5	77
PHENANTHRENE	µg/kg	75	82	0.91	5.7	6.75	7.77	9,650	224	39.2	1,094	4.88	425	5,300	1	--
FLUORANTHENE	µg/kg	66	82	0.80	9.72	11.5	11.7	16,100	390	64	1,843	4.72	729	5,500	1	--
BENZO(A)PYRENE	µg/kg	51	82	0.62	8.68	10.6	9.21	5,930	163	26.2	681	4.18	288	2,000	1	--
Sum of 2,3,&4 Methylphenol	µg/kg	82	82	1.00	--	--	14	45.6	16.5	15.8	4.15	0.25	17.3	1,400	--	--
BENZO(B)FLUORANTHENE	µg/kg	78	82	0.95	6.99	7.33	27.4	7,140	229	71.6	815	3.57	379	20,000	--	--
BENZO(G,H,I)PERYLENE	µg/kg	70	82	0.85	29.7	35	33.7	3,740	204	143	450	2.21	286	2,500,000	--	--
PYRENE	µg/kg	67	82	0.82	17.1	20.2	18.2	13,100	346	64.3	1,500	4.33	622	480,000	--	--
BENZO(K)FLUORANTHENE	µg/kg	60	82	0.73	9.5	11.7	12	2,340	85.2	38.3	268	3.15	135	200,000	--	--
CHRYSENE	µg/kg	49	82	0.60	11.6	16.5	17.3	6,370	182	32.6	740	4.07	318	2,000,000	--	--
BIS(2-ETHYLHEXYL) PHTHALATE	µg/kg	43	82	0.52	16.7	43.7	18.5	3,080	109	25.5	394	3.62	181	2,800,000	--	--
INDENO(1,2,3-C,D)PYRENE	µg/kg	42	82	0.51	25.2	35.7	28.3	4,790	181	33.6	602	3.32	292	20,000	--	--
ANTHRACENE	µg/kg	36	82	0.44	5.25	7.77	8.21	810	28.0	6.5	102	3.64	46.8	41,000	--	--
2-METHYLNAPHTHALENE	µg/kg	20	82	0.24	7.53	24.5	8.31	259	11.2	8.76	29.5	2.64	16.6	57,000	--	--
DIBENZ(A,H)ANTHRACENE	µg/kg	19	82	0.23	32.9	48.3	38.4	1,230	54.3	38.2	150	2.76	81.9	2,000	--	--
DI-N-BUTYL PHTHALATE	µg/kg	15	82	0.18	7.02	22.9	8.26	59.4	7.21	8.08	9.08	1.26	8.88	11,000	--	--
BENZYL BUTYL PHTHALATE	µg/kg	12	82	0.15	8.04	21.2	9.59	630	16.0	9.21	70.0	4.36	28.9	26,000	--	--
NAPHTHALENE	µg/kg	12	82	0.15	27.9	91	37.6	514	37.9	32.0	78.4	2.07	52.3	870	--	--
BENZO(A)ANTHRACENE	µg/kg	10	82	0.12	6.23	16.3	73.3	5,360	113	7.07	619	5.45	227	20,000	--	--
FLUORENE	µg/kg	10	82	0.12	5.92	8.7	9.33	379	12.3	6.73	45.7	3.72	20.7	5,300	--	--
DIBENZOFURAN	µg/kg	9	82	0.11	4.49	6.65	8.47	132	6.28	5.1	16.4	2.61	9.30	1,700	--	--
2,3,4,6-TETRACHLOROPHENOL	µg/kg	6	82	0.07	14.3	46.5	16	450	20.0	16.2	67.4	3.37	32.4	--	--	--
ACENAPHTHENE	µg/kg	4	82	0.05	7.59	19.8	13.5	234	8.17	8.53	25.9	3.17	12.9	4,400	--	--
ACENAPHTHYLENE	µg/kg	4	82	0.05	7.62	11.3	30.8	847	17.2	8.61	94.0	5.48	34.4	5,900	--	--
HEXACHLOROBENZENE	µg/kg	3	82	0.04	10.2	33.1	12.6	193	8.96	11.5	21.3	2.38	12.9	350	--	--
2,4,6-TRICHLOROPHENOL	µg/kg	2	82	0.02	6.04	19.7	25.2	29.2	4.15	6.82	3.79	0.91	4.85	2,400	--	--
ACETOPHENONE	µg/kg	2	82	0.02	8.65	28.2	64.7	65.7	6.58	9.75	9.41	1.43	8.31	30,000	--	--
DIETHYL PHTHALATE	µg/kg	1	82	0.01	5.73	18.7	13.2	13.2	3.51	6.46	1.38	0.39	3.76	2,200	--	--
1,2,4,5-TETRACHLOROBENZENE	µg/kg	--	82	0.00	8.41	27.4	--	--	4.96	9.46	1.25	0.25	5.19	3,400	--	--
1,2-DICHLOROBENZENE	µg/kg	--	82	0.00	52.4	171	--	--	30.9	58.9	7.78	0.25	32.3	360	--	--
1,3-DICHLOROBENZENE	µg/kg	--	82	0.00	54.6	178	--	--	32.2	61.4	8.11	0.25	33.7	170	--	1
1,3-DINITROBENZENE	µg/kg	--	82	0.00	7.81	25.4	--	--	4.61	8.79	1.16	0.25	4.82	--	--	--
1,4-DICHLOROBENZENE	µg/kg	--	82	0.00	49.6	162	--	--	29.3	55.8	7.38	0.25	30.6	290	--	--
1,4-DIOXANE	µg/kg	--	82	0.00	349	1140	--	--	206	393	51.9	0.25	215	1,700	--	--
1,4-NAPHTHOQUINONE	µg/kg	--	82	0.00	11.8	38.6	--	--	6.99	13.3	1.76	0.25	7.31	--	--	--
1-NAPHTHYLAMINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
2,2'-OXYBIS(1-CHLOROPROPANE)	µg/kg	--	82	0.00	34.4	112	--	--	20.3	38.7	5.09	0.25	21.2	--	--	--
2,4,5-TRICHLOROPHENOL	µg/kg	--	82	0.00	7.91	25.8	--	--	4.67	8.91	1.17	0.25	4.88	39,000	--	--
2,4-DICHLOROPHENOL	µg/kg	--	82	0.00	26.2	85.5	--	--	15.5	29.5	3.89	0.25	16.2	380	--	--
2,4-DIMETHYLPHENOL	µg/kg	--	82	0.00	57.6	188	--	--	33.9	64.8	8.54	0.25	35.5	7,400	--	--
2,4-DINITROPHENOL	µg/kg	--	82	0.00	20.1	65.5	--	--	11.9	22.6	2.98	0.25	12.4	--	--	--
2,4-DINITROTOLUENE	µg/kg	--	82	0.00	28.5	92.7	--	--	16.8	32	4.22	0.25	17.6	430	--	--
2,6-DICHLOROPHENOL	µg/kg	--	82	0.00	14.1	45.8	--	--	8.30	15.8	2.08	0.25	8.68	--	--	--
2,6-DINITROTOLUENE	µg/kg	--	82	0.00	6.03	19.6	--	--	3.56	6.79	0.89	0.25	3.72	--	--	--
2-Acetylaminofluorene	µg/kg	--	82	0.00	13.6	44.5	--	--	8.05	15.35	2.02	0.25	8.42	--	--	--
2-CHLORONAPHTHALENE	µg/kg	--	82	0.00	25.6	83.4	--	--	15.1	28.8	3.79	0.25	15.8	620,000	--	--
2-CHLOROPHENOL	µg/kg	--	82	0.00	26.2	85.5	--	--	15.5	29.5	3.89	0.25	16.2	440	--	--

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Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
2-METHYLPHENOL (O-CRESOL)	µg/kg	--	82	0.00	17.8	57.9	--	--	10.5	20	2.63	0.25	11.0	--	--	--
2-NAPHTHYLAMINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
2-NITROANILINE	µg/kg	--	82	0.00	7.99	26	--	--	4.71	8.99	1.18	0.25	4.93	--	--	--
2-NITROPHENOL	µg/kg	--	82	0.00	10.1	33.1	--	--	5.98	11.4	1.51	0.25	6.26	400	--	--
3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/kg	--	82	0.00	10.2	33.3	--	--	6.02	11.5	1.51	0.25	6.30	--	--	--
3,3'-DICHLOROBENZIDINE	µg/kg	--	82	0.00	59.2	193	--	--	34.9	66.7	8.78	0.25	36.6	2,000	--	--
3,3'-DIMETHYLBENZIDINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
3-METHYLCHOLANTHRENE	µg/kg	--	82	0.00	18.5	60.3	--	--	10.9	20.8	2.74	0.25	11.4	--	--	--
3-NITROANILINE	µg/kg	--	82	0.00	6.97	22.7	--	--	4.11	7.85	1.03	0.25	4.30	--	--	--
4,6-DINITRO-2-METHYLPHENOL	µg/kg	--	82	0.00	13.2	43.1	--	--	7.80	14.9	1.96	0.25	8.16	830	--	--
4-AMINOBIPHENYL	µg/kg	--	82	0.00	10	32.6	--	--	5.90	11.3	1.48	0.25	6.17	--	--	--
4-BROMOPHENYL PHENYL ETHER	µg/kg	--	82	0.00	13	42.4	--	--	7.67	14.6	1.93	0.25	8.03	--	--	--
4-CHLORO-3-METHYLPHENOL	µg/kg	--	82	0.00	10.5	34.2	--	--	6.19	11.8	1.55	0.25	6.48	280	--	--
4-CHLOROANILINE	µg/kg	--	82	0.00	43.2	141	--	--	25.5	48.6	6.43	0.25	26.6	--	--	--
4-CHLOROPHENYL PHENYL ETHER	µg/kg	--	82	0.00	4.92	16	--	--	2.90	5.54	0.73	0.25	3.03	--	--	--
4-NITROANILINE	µg/kg	--	82	0.00	40.8	133	--	--	24.1	46.0	6.04	0.25	25.2	--	--	--
4-NITROPHENOL	µg/kg	--	82	0.00	8.74	28.5	--	--	5.15	9.83	1.30	0.25	5.39	--	--	--
4-NITROQUINOLINE-1-OXIDE	µg/kg	--	82	0.00	8.5	27.7	--	--	5.01	9.56	1.26	0.25	5.24	--	--	--
5-NITRO-O-TOLUIDINE	µg/kg	--	82	0.00	11.1	36.2	--	--	6.55	12.5	1.65	0.25	6.85	--	--	--
7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/kg	--	82	0.00	13.6	44.5	--	--	8.05	15.4	2.02	0.25	8.42	--	--	--
ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
ANILINE	µg/kg	--	82	0.00	45.2	147	--	--	26.6	50.8	6.69	0.25	27.9	330	--	--
ARAMITE (TOTAL)	µg/kg	--	82	0.00	72.3	235	--	--	42.6	81.3	10.7	0.25	44.6	--	--	--
BENZYL ALCOHOL	µg/kg	--	82	0.00	7.66	25	--	--	4.52	8.62	1.14	0.25	4.73	200,000	--	--
BIS(2-CHLOROETHOXY) METHANE	µg/kg	--	82	0.00	5.43	17.7	--	--	3.20	6.11	0.81	0.25	3.35	--	--	--
BIS(2-CHLOROETHYL) ETHER	µg/kg	--	82	0.00	38	124	--	--	22.4	42.7	5.64	0.25	23.4	100	--	1
CHLOROBENZILATE	µg/kg	--	82	0.00	19.8	64.5	--	--	11.7	22.3	2.93	0.25	12.21	--	--	--
DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/kg	--	82	0.00	29.2	95.1	--	--	17.2	32.9	4.33	0.25	18.02	--	--	--
DIMETHOATE	µg/kg	--	82	0.00	54.3	177	--	--	32.0	61.1	8.06	0.25	33.5	--	--	--
DIMETHYL PHTHALATE	µg/kg	--	82	0.00	20.7	67.6	--	--	12.2	23.3	3.08	0.25	12.8	790,000	--	--
DI-N-OCTYLPHTHALATE	µg/kg	--	82	0.00	7.32	23.9	--	--	4.32	8.24	1.09	0.25	4.52	6,900,000	--	--
DINOSEB	µg/kg	--	82	0.00	55.4	181	--	--	32.7	62.4	8.24	0.25	34.2	200	--	--
DIPHENYLAMINE	µg/kg	--	82	0.00	28.5	92.7	--	--	16.8	32	4.22	0.25	17.6	--	--	--
DISULFOTON	µg/kg	--	82	0.00	9.13	29.7	--	--	5.39	10.3	1.35	0.25	5.63	--	--	--
ETHYL METHANESULFONATE	µg/kg	--	82	0.00	12.6	41	--	--	7.43	14.2	1.86	0.25	7.77	--	--	--
FAMPHUR	µg/kg	--	82	0.00	29.5	96.2	--	--	17.4	33.2	4.38	0.25	18.2	--	--	--
HEXACHLOROBUTADIENE	µg/kg	--	82	0.00	34.1	111	--	--	20.1	38.3	5.05	0.25	21.0	91	--	1
HEXACHLOROCYCLOPENTADIENE	µg/kg	--	81	0.00	25.8	84.1	--	--	15.2	29	3.85	0.25	15.9	30,000	--	--
HEXACHLOROETHANE	µg/kg	--	82	0.00	46.5	152	--	--	27.5	52.4	6.93	0.25	28.7	430	--	--
HEXACHLOROPHENE	µg/kg	--	82	0.00	698	2,270	--	--	412	786	103	0.25	431	--	--	--
HEXACHLOROPROPENE	µg/kg	--	82	0.00	46.4	151	--	--	27.4	52.3	6.86	0.25	28.6	--	--	--
ISODRIN	µg/kg	--	82	0.00	19.5	63.4	--	--	11.5	21.9	2.88	0.25	12.0	--	--	--
ISOPHORONE	µg/kg	--	82	0.00	4.87	15.9	--	--	2.87	5.48	0.72	0.25	3.00	11,000	--	--
ISOSAFROLE	µg/kg	--	82	0.00	16.9	55.2	--	--	9.98	19	2.51	0.25	10.4	--	--	--
KEPONE	µg/kg	--	82	0.00	1,750	5,690	--	--	1,030	1,960	259	0.25	1077	--	--	--
METHAPYRILENE	µg/kg	--	82	0.00	40.6	132	--	--	24.0	45.7	6.01	0.25	25.1	--	--	--
METHYL METHANESULFONATE	µg/kg	--	82	0.00	19.9	64.8	--	--	11.7	22.4	2.95	0.25	12.3	--	--	--
NITROBENZENE	µg/kg	--	82	0.00	36	117	--	--	21.2	40.5	5.32	0.25	22.2	330	--	--
N-NITROSODIETHYLAMINE	µg/kg	--	82	0.00	18.4	60	--	--	10.9	20.7	2.73	0.25	11.4	--	--	--
N-NITROSODIMETHYLAMINE	µg/kg	--	82	0.00	42	137	--	--	24.8	47.3	6.25	0.25	25.9	--	--	--
N-NITROSO-DI-N-BUTYLAMINE	µg/kg	--	82	0.00	10.2	33.2	--	--	6.02	11.5	1.51	0.25	6.29	--	--	--
N-NITROSODI-N-PROPYLAMINE	µg/kg	--	82	0.00	7.91	25.8	--	--	4.67	8.91	1.17	0.25	4.88	330	--	--
N-NITROSODIPHENYLAMINE	µg/kg	--	82	0.00	11.5	37.6	--	--	6.80	13	1.71	0.25	7.12	5,400	--	--

TABLE D-1
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Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
N-NITROSOMETHYLETHYLAMINE	µg/kg	--	82	0.00	15.8	51.4	--	--	9.30	17.7	2.34	0.25	9.73	--	--	--
N-NITROSOMORPHOLINE	µg/kg	--	82	0.00	18.6	60.7	--	--	11.0	21.0	2.76	0.25	11.5	--	--	--
N-NITROSOPIPERIDINE	µg/kg	--	82	0.00	11.3	36.9	--	--	6.68	12.7	1.68	0.25	6.98	--	--	--
N-NITROSOPYRROLIDINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/kg	--	82	0.00	9.89	32.2	--	--	5.83	11.1	1.46	0.25	6.10	--	--	--
O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/kg	--	82	0.00	18.1	58.9	--	--	10.7	20.4	2.68	0.25	11.2	--	--	--
O-TOLUIDINE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
PARATHION, ETHYL (PARATHION)	µg/kg	--	82	0.00	17.9	58.3	--	--	10.5	20.1	2.65	0.25	11.0	--	--	--
PARATHION, METHYL	µg/kg	--	82	0.00	11.8	38.6	--	--	6.99	13.3	1.76	0.25	7.31	46	--	--
P-DIMETHYLAMINOAZOBENZENE	µg/kg	--	82	0.00	12.7	41.4	--	--	7.49	14.3	1.88	0.25	7.84	--	--	--
PENTACHLOROBENZENE	µg/kg	--	82	0.00	27.9	91	--	--	16.5	31.4	4.14	0.25	17.2	9,500	--	--
PENTACHLORONITROBENZENE	µg/kg	--	82	0.00	19.4	63.1	--	--	11.4	21.8	2.87	0.25	11.9	37,000	--	--
PENTOCHLORETHANE	µg/kg	--	82	0.00	11.8	38.6	--	--	6.99	13.3	1.76	0.25	7.31	--	--	--
PHENACETIN	µg/kg	--	82	0.00	12.3	40	--	--	7.24	13.8	1.82	0.25	7.57	--	--	--
PHENOL	µg/kg	--	82	0.00	7.24	23.6	--	--	4.27	8.14	1.07	0.25	4.46	4,200	--	--
PHORATE	µg/kg	--	82	0.00	9.18	29.9	--	--	5.41	10.3	1.36	0.25	5.66	--	--	--
P-PHENYLENEDIAMINE	µg/kg	--	82	0.00	28.5	92.7	--	--	16.8	32	4.22	0.25	17.6	--	--	--
PRONAMIDE	µg/kg	--	82	0.00	11	35.8	--	--	6.49	12.4	1.63	0.25	6.79	--	--	--
PYRIDINE	µg/kg	--	82	0.00	52	170	--	--	30.7	58.6	7.73	0.25	32.1	400	--	--
SAFROLE	µg/kg	--	82	0.00	14.8	48.3	--	--	8.74	16.7	2.20	0.25	9.14	--	--	--
SYM-TRINITROBENZENE	µg/kg	--	82	0.00	349	1,140	--	--	206	393	51.9	0.25	215	--	--	--
TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/kg	--	82	0.00	698	2,270	--	--	412	786	103	0.25	431	--	--	--
VOLATILE ORGANICS																
TOLUENE	µg/kg	48	82	0.59	25.2	45.4	36	7,010	1,179	133	1,828	1.55	1,515	2,800	14	--
ACRYLONITRILE	µg/kg	4	82	0.05	31.1	220	189	563	37.6	39.9	75.4	2.01	51.4	100	4	2
METHYLENE CHLORIDE	µg/kg	3	82	0.04	20.9	148	87.4	456	23.0	26.7	52.0	2.27	32.5	100	2	1
XYLENES, TOTAL	µg/kg	16	82	0.20	25.6	177	32	1,470	65.9	33.2	175	2.66	98.1	700	1	--
ACETONE	µg/kg	5	82	0.06	16.3	57	127	1,880	48.7	20.9	220	4.51	89.1	15,000	--	--
ETHYL BENZENE	µg/kg	5	82	0.06	9.27	63.9	25.6	229	12.8	11.7	30.7	2.40	18.4	360	--	--
CHLOROFORM	µg/kg	3	82	0.04	6.15	43.5	27.5	35	5.39	7.93	5.46	1.01	6.40	1,600	--	--
CHLOROMETHANE	µg/kg	2	82	0.02	20.3	143	87	113	16.6	25.8	15.4	0.93	19.4	2,300	--	--
STYRENE	µg/kg	2	82	0.02	6.7	46.9	143	157	8.33	8.52	22.7	2.72	12.5	2,200	--	--
BENZENE	µg/kg	1	82	0.01	4.54	32.1	67.4	67.4	4.04	5.79	7.28	1.80	5.38	100	--	--
PROPIONITRILE, ETHYL CYANIDE	µg/kg	1	82	0.01	43.6	309	506	506	37.2	55.8	54.9	1.47	47.3	--	--	--
1,1,1,2-TETRACHLOROETHANE	µg/kg	--	82	0.00	7.68	54.4	--	--	5.51	9.80	2.87	0.52	6.04	1,500	--	--
1,1,1-TRICHLOROETHANE	µg/kg	--	82	0.00	5.37	38	--	--	3.85	6.85	2.00	0.52	4.22	4,000	--	--
1,1,2,2-TETRACHLOROETHANE	µg/kg	--	82	0.00	7.86	55.6	--	--	5.64	10	2.93	0.52	6.18	170	--	--
1,1,2-TRICHLOROETHANE	µg/kg	--	82	0.00	4.98	35.2	--	--	3.57	6.35	1.86	0.52	3.91	100	--	--
1,1-DICHLOROETHANE	µg/kg	--	82	0.00	6.94	49.1	--	--	4.98	8.85	2.59	0.52	5.46	15,000	--	--
1,1-DICHLOROETHENE	µg/kg	--	82	0.00	15.7	111	--	--	11.3	20.0	5.86	0.52	12.3	62	--	1
1,2,3-TRICHLOROPROPANE	µg/kg	--	82	0.00	10.7	75.7	--	--	7.68	13.6	4.00	0.52	8.41	840	--	--
1,2-DIBROMO-3-CHLOROPROPANE	µg/kg	--	82	0.00	37.8	267	--	--	27.1	48.2	14.1	0.52	29.7	10	--	82
1,2-DIBROMOETHANE (EDB)	µg/kg	--	82	0.00	6.55	46.3	--	--	4.70	8.35	2.45	0.52	5.15	20	--	3
1,2-DICHLOROETHANE	µg/kg	--	82	0.00	4.98	35.2	--	--	3.57	6.35	1.86	0.52	3.91	100	--	--
1,2-DICHLOROPROPANE	µg/kg	--	82	0.00	4.89	34.6	--	--	3.51	6.24	1.83	0.52	3.85	100	--	--
2-HEXANONE	µg/kg	--	82	0.00	36.1	255	--	--	25.9	46.0	13.5	0.52	28.4	20,000	--	--
ACETONITRILE	µg/kg	--	82	0.00	197	1,400	--	--	142	252	73.9	0.52	155	2,800	--	--
ACROLEIN	µg/kg	--	82	0.00	102	723	--	--	73.3	130	38.2	0.52	80.3	410	--	1
ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/kg	--	82	0.00	43.6	309	--	--	31.3	55.7	16.3	0.52	34.3	--	--	--
BROMODICHLOROMETHANE	µg/kg	--	82	0.00	5.89	41.7	--	--	4.23	7.52	2.20	0.52	4.63	1,200	--	--
BROMOFORM	µg/kg	--	82	0.00	7.38	52.2	--	--	5.30	9.41	2.76	0.52	5.80	1,600	--	--
BROMOMETHANE	µg/kg	--	82	0.00	65.7	465	--	--	47.2	83.8	24.5	0.52	51.7	200	--	3
CARBON DISULFIDE	µg/kg	--	82	0.00	4.76	33.7	--	--	3.42	6.07	1.78	0.52	3.74	16,000	--	--

TABLE D-1
Additional Chemicals Summary Statistics
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Analyte	Units	No. of Detected Results	No. of Samples	Frequency of Detection	Minimum Reported Nondetected Concentration	Maximum Reported Nondetected Concentration	Minimum Reported Detected Concentration	Maximum Reported Detected Concentration	Mean Concentration[a]	Median Concentration[a]	Standard Deviation	Coefficient of Variation	Upper 95% Confidence Concentration	MDEQ SL[b]	No. of Detected Results Exceeding SL	No. of Nondetected Results Exceeding SL
CARBON TETRACHLORIDE	µg/kg	--	82	0.00	5.24	37.1	--	--	3.76	6.68	1.96	0.52	4.12	100	--	--
CHLOROBENZENE	µg/kg	--	82	0.00	7.2	51	--	--	5.17	9.19	2.69	0.52	5.66	940	--	--
CHLOROETHANE	µg/kg	--	82	0.00	26.4	187	--	--	19.0	33.7	9.87	0.52	20.8	8,600	--	--
CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/kg	--	82	0.00	43.6	309	--	--	31.3	55.7	16.3	0.52	34.3	--	--	--
CIS-1,3-DICHLOROPROPENE	µg/kg	--	82	0.00	5.02	35.5	--	--	3.60	6.4	1.87	0.52	3.95	--	--	--
DIBROMOCHLOROMETHANE	µg/kg	--	82	0.00	3.93	27.8	--	--	2.82	5.01	1.47	0.52	3.09	1,600	--	--
DIBROMOMETHANE	µg/kg	--	82	0.00	6.81	48.2	--	--	4.89	8.69	2.54	0.52	5.36	1,600	--	--
DICHLORODIFLUOROMETHANE	µg/kg	--	82	0.00	15.9	112	--	--	11.4	20.3	5.92	0.52	12.5	95,000	--	--
ETHYL METHACRYLATE	µg/kg	--	82	0.00	43.6	309	--	--	31.3	55.7	16.3	0.52	34.3	--	--	--
ISOBUTANOL	µg/kg	--	82	0.00	43.6	309	--	--	31.3	55.7	16.3	0.52	34.3	46,000	--	--
METHYL ETHYL KETONE (2-BUTANONE)	µg/kg	--	82	0.00	13.6	96.3	--	--	9.78	17.4	5.08	0.52	10.7	44,000	--	--
METHYL IODIDE (IODOMETHANE)	µg/kg	--	82	0.00	39.5	280	--	--	28.4	50.4	14.8	0.52	31.1	--	--	--
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/kg	--	82	0.00	7.55	53.4	--	--	5.42	9.63	2.82	0.52	5.94	36,000	--	--
METHYL METHACRYLATE	µg/kg	--	82	0.00	43.6	309	--	--	31.3	55.7	16.3	0.52	34.3	--	--	--
METHYLACRYLONITRILE	µg/kg	--	82	0.00	218	1,540	--	--	157	278	81.3	0.52	172	--	--	--
TETRACHLOROETHENE (PCE)	µg/kg	--	82	0.00	8.38	59.3	--	--	6.02	10.7	3.13	0.52	6.59	100	--	--
TRANS-1,2-DICHLOROETHENE	µg/kg	--	82	0.00	7.16	50.6	--	--	5.14	9.13	2.67	0.52	5.63	2,000	--	--
TRANS-1,3-DICHLOROPROPENE	µg/kg	--	82	0.00	6.15	43.5	--	--	4.42	7.85	2.30	0.52	4.84	--	--	--
TRANS-1,4-DICHLORO-2-BUTENE	µg/kg	--	82	0.00	31.5	223	--	--	22.6	40.1	11.8	0.52	24.8	--	--	--
TRICHLOROETHENE (TCE)	µg/kg	--	82	0.00	7.73	54.7	--	--	5.55	9.85	2.89	0.52	6.08	100	--	--
TRICHLOROFLUOROMETHANE	µg/kg	--	82	0.00	11	77.8	--	--	7.90	14	4.11	0.52	8.65	52,000	--	--
VINYL ACETATE	µg/kg	--	82	0.00	42.7	302	--	--	30.7	54.5	15.9	0.52	33.6	13,000	--	--
VINYL CHLORIDE	µg/kg	--	82	0.00	15.3	108	--	--	11.0	19.5	5.70	0.52	12.0	40	--	3

[a] One-half the MDL was used to calcluate the mean and median where concentrations were nondetected.
[b] SL = the selected MDEQ Screening Level
-- = not applicable

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

				Sample ID	1139-1	1139-2	1251-1	1251-2	1438-1	1438-2	1517-1	1517-1-C	1517-2	1517-2-C	1582-1
				Location ID	MidBlind_1139-1	MidBlind_1139-2	MidBlind_1251-1	MidBlind_1251-2	MidBlind_1438-1	MidBlind_1438-2	MidBlind_1517-1	MidBlind_1517-1-C	MidBlind_1517-2	MidBlind_1517-2-C	MidBlind_1582-1
				Sample Date	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006
				Sample Depth (in)	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	SOIL
Group	**Analyte**	**Units**	**SL**												
GEN	CYANIDE, TOTAL	µg/Kg	100		**180**	**220**	**110** J	0.0081 U	0.0076 U	0.0073 U	**59** J	**26** J	**80** J	**50** J	**200**
GEN	SULFIDE	mg/kg	--		100 UJ	100 UJ	**130**	110 U	100 U	98 U	110 U	**110**	110 U	100 U	98 U
GEN	TOTAL ORGANIC CARBON	mg/kg	--		**30000**	**22000**	**64000**	**48000**	**27000**	**20000**	**36000**	**29000**	**43000**	**20000**	**29000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	--		2.6 U	2.5 U	2.9 U	2.7 U	2.5 U	2.4 U	2.6 U	2.7 U	**24**	2.5 U	2.4 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	1400		2.1 U	2.1 U	2.4 U	2.2 U	2.1 U	2 U	2.2 U	2.2 U	**46** J	2.1 U	2 UJ
HERB	DINOSEB	µg/Kg	200		67 U	65 U	74 U	71 U	66 UJ	64 U	68 U	69 U	69 U	65 U	64 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2200		2.2 U	2.2 U	2.5 U	2.4 U	2.2 U	2.1 U	2.3 U	2.3 U	2.3 U	2.2 U	2.1 U
MET	ANTIMONY	µg/Kg	4300		250 U	240 U	1100 U	1500 UJ	240 U	230 U	1000 U	1200 U	**1900** J	1500 U	**480** J
MET	ARSENIC	µg/Kg	4600		**3400**	**3000**	**5700**	**6100**	**3400**	**3100**	**6000**	**4200**	**6600**	**4100**	**770** J
MET	BARIUM	µg/Kg	1300000		**46000**	**40000**	**41000**	**41000**	**45000**	**44000**	**39000**	**35000**	**40000**	**37000**	**24000**
MET	BERYLLIUM	µg/Kg	51000		**290**	**260**	**390**	**420** J	**310**	**320**	**330**	**280**	**340**	**270**	**170** J
MET	CADMIUM	µg/Kg	6000		**210** J	**190** J	630 U	580 U	**290**	**340**	430 U	280 U	450 U	230 U	**120** J
MET	CHROMIUM, TOTAL	µg/Kg	3300		**7900**	**7000**	**6000**	**6200**	**7500**	**7500**	**7500**	**5700**	**7600**	**6100**	**5400**
MET	COBALT	µg/Kg	800		**3300**	**3000**	**1900**	**2000**	**2700**	**2800**	**2300**	**2100**	**2700**	**2300**	**2000**
MET	COPPER	µg/Kg	5800000		**16000**	**15000**	**28000**	**21000**	**11000**	**11000**	**15000**	**11000**	**17000**	**10000**	**8300**
MET	LEAD	µg/Kg	400000		**20000**	**19000**	**27000**	**30000**	**33000**	**30000**	**21000**	**11000**	**28000**	**12000**	**8300**
MET	MERCURY	µg/Kg	130		**90**	**64**	**84**	**74**	**45**	**40**	**56**	**42**	**65**	**34**	**51**
MET	NICKEL	µg/Kg	100000		**8900**	**8100**	**8200**	**8100**	**6900**	**6700**	**7500**	**6400**	**8000**	**6700**	**6200**
MET	SELENIUM	µg/Kg	410		550 U	520 U	590 U	570 U	530 U	510 U	550 U	560 U	560 U	530 U	510 U
MET	SILVER	µg/Kg	1,000		61 U	58 U	66 U	63 U	59 U	57 U	62 U	62 U	63 U	59 U	57 U
MET	THALLIUM	µg/Kg	2300		220 U	210 U	240 U	230 U	210 U	210 U	220 U	220 U	230 U	210 U	210 U
MET	TIN	µg/Kg	--		580 U	550 U	630 U	600 U	570 U	540 U	590 U	590 U	600 U	560 U	540 U
MET	VANADIUM	µg/Kg	72000		**13000**	**12000**	**13000**	**14000**	**13000**	**13000**	**13000**	**12000**	**14000**	**13000**	**9400**
MET	ZINC	µg/Kg	2400000		66 U	63 U	72 U	69 U	**39000**	**35000**	67 U	67 U	68 U	64 U	**21000**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	--		7 U	6.7 U	7.6 U	7.2 U	6.8 U	6.5 U	7 U	7 U	7.1 U	6.7 U	6.5 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	--		12 U	11 U	13 U	12 U	12 U	11 U	12 U	12 U	12 U	11 U	11 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	--		13 U	12 U	14 U	13 U	13 U	12 U	13 U	13 U	13 U	13 U	12 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	--		15 U	15 U	17 U	16 U	15 U	14 U	15 U	15 U	15 U	15 U	14 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	--		10 U	9.7 U	11 U	10 U	9.9 U	9.4 U	10 U	10 U	10 U	9.7 U	9.4 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	--		8.4 U	8 U	9.2 U	8.7 U	8.2 U	7.8 U	8.5 U	8.5 U	8.5 U	8.1 U	7.8 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	--		7 U	6.7 U	7.7 U	7.3 U	6.9 U	6.5 U	7.1 U	7.1 U	7.1 U	6.7 U	6.6 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	--		9.3 U	8.8 U	10 U	9.6 U	9 U	8.6 U	9.4 U	9.4 U	9.4 U	8.9 U	8.6 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	--		13 U	12 U	14 U	13 U	12 U	12 U	13 U	13 U	13 U	12 U	12 U
PCB	SUMMED PCB	µg/Kg	3,000,000		**47**	**45**	**51**	**49**	**46**	**44**	**48**	**48**	**48**	**45**	**44**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	10		50 U	50 U	120 U	270 U	49 U	45 U	64 U	57 U	55 U	55 U	61 U
PEST	4,4'-DDD	µg/Kg	95000		0.75 U	**0.9** J	**6** J	**1.3** J	**1.1** J	**2.6** J	0.76 U	**1.7** J	0.76 U	**1.2** J	0.7 U
PEST	4,4'-DDE	µg/Kg	45000		**10** J	**16** J	**15** J	**14** J	**6** J	**6.8** J	**5.5** J	**4.6** J	**7.5** J	**4** J	**5** J
PEST	4,4'-DDT	µg/Kg	57000		**6** J	**9.8** J	**18** J	**17** J	**5** J	**7.6** J	**4.8** J	**2.8** J	**5.4** J	**2.8** J	1.1 U
PEST	ALDRIN	µg/Kg	1000		0.78 U	0.74 U	0.85 U	0.8 U	0.76 U	0.72 U	0.79 U	0.79 U	0.79 U	0.75 U	0.73 U
PEST	ALPHA BHC	µg/Kg	18		0.99 U	0.94 U	1.1 U	1 U	0.96 U	0.92 U	1 U	1 U	1 U	0.94 U	0.92 U
PEST	BETA BHC	µg/Kg	37		1.1 U	1 U	1.2 U	1.1 U	1 U	0.99 U	1.1 U	1.1 U	1.1 U	1 U	0.99 U
PEST	CHLORDANE	µg/Kg	31000		1 U	**2.5** J	1.1 U	1.1 U	1 U	0.97 U	1.1 U	1.1 U	1.1 U	0.99 U	0.97 U
PEST	DELTA BHC	µg/Kg	--		0.96 U	0.92 U	1 UJ	0.99 U	0.94 U	0.89 U	0.97 U	0.97 U	0.97 U	0.92 U	0.89 U
PEST	DIELDRIN	µg/Kg	1100		0.78 U	0.74 U	0.85 U	0.8 U	0.76 U	0.72 U	0.79 U	0.79 U	0.79 U	0.75 U	0.73 U
PEST	DIMETHOATE	µg/Kg	--		66 U	64 U	72 U	69 U	65 U	63 U	67 U	68 U	68 U	64 U	62 U
PEST	DISULFOTON	µg/Kg	--		11 U	11 U	12 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
PEST	ENDOSULFAN I	µg/Kg	--		0.6 U	0.57 U	0.65 U	0.62 UJ	0.58 U	0.56 U	0.6 U	0.6 U	0.61 U	0.57 U	**0.86** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	1139-1	1139-2	1251-1	1251-2	1438-1	1438-2	1517-1	1517-1-C	1517-2	1517-2-C	1582-1
			Location ID	MidBlind_1139-1	MidBlind_1139-2	MidBlind_1251-1	MidBlind_1251-2	MidBlind_1438-1	MidBlind_1438-2	MidBlind_1517-1	MidBlind_1517-1-C	MidBlind_1517-2	MidBlind_1517-2-C	MidBlind_1582-1
			Sample Date	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006
			Sample Depth (in)	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	SOIL
Group	**Analyte**	**Units**	**SL**											
PEST	ENDOSULFAN II	µg/Kg	--	0.65 U	0.62 U	0.71 U	**1.9** J	0.63 U	0.6 U	0.66 U	0.66 U	0.66 U	0.62 U	0.6 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	1,400,000	**0.62**	**0.59**	**0.68**	**2.2**	**0.61**	**0.58**	**0.63**	**0.63**	**0.63**	**0.6**	**1.2**
PEST	ENDOSULFAN SULFATE	µg/Kg	--	0.93 U	0.89 U	1 UJ	0.96 U	0.91 U	0.87 U	0.94 U	0.94 U	0.95 U	0.9 U	0.87 U
PEST	ENDRIN	µg/Kg	65000	0.95 U	0.9 U	1 U	0.98 U	0.92 U	0.88 U	0.96 U	0.96 U	0.96 U	0.91 U	0.88 U
PEST	ENDRIN ALDEHYDE	µg/Kg	--	0.97 U	0.93 U	1.1 U	1 U	0.95 U	0.9 U	0.98 U	0.98 U	0.99 U	0.93 U	0.91 U
PEST	FAMPHUR	µg/Kg	--	36 UJ	35 UJ	39 UJ	38 UJ	35 UJ	34 UJ	36 UJ	37 UJ	37 UJ	35 UJ	34 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	20	0.75 U	0.72 U	0.82 U	0.78 U	0.73 U	0.7 U	0.76 U	0.76 U	0.76 U	0.72 U	0.7 U
PEST	HEPTACHLOR	µg/Kg	5600	0.78 U	0.74 U	0.85 U	0.8 U	0.76 U	0.72 U	0.79 U	0.79 U	0.79 U	0.75 U	0.73 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	3100	1.1 U	1 U	1.2 U	1.1 U	**1.3** J	1 U	1.1 U	1.1 U	1.1 U	1 U	1 U
PEST	KEPONE	µg/Kg	--	2100 U	2000 U	2300 U	2200 U	2100 U	2000 U	2200 U	2200 U	2200 U	2100 U	2000 U
PEST	METHOXYCHLOR	µg/Kg	16000	1.3 U	1.2 U	1.4 U	1.3 U	1.3 U	1.2 U	1.3 U	1.3 U	1.3 U	1.2 U	1.2 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	--	12 U	12 U	13 U	13 U	12 U	11 U	12 U	12 U	12 U	12 U	11 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	--	22 U	21 U	24 U	23 U	22 U	21 U	22 U	23 U	23 U	21 U	21 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	--	22 U	21 U	24 U	23 U	21 U	21 U	22 U	22 U	22 U	21 U	21 U
PEST	PARATHION, METHYL	µg/Kg	46	14 U	14 U	16 U	15 U	14 U	14 U	15 U	15 U	15 U	14 U	14 U
PEST	PHORATE	µg/Kg	--	11 U	11 U	12 U	12 UJ	11 UJ	11 UJ	11 U	12 UJ	12 UJ	11 UJ	11 U
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	--	850 U	820 U	930 U	890 U	840 U	810 U	860 U	870 U	870 U	820 U	800 U
PEST	TOXAPHENE	µg/Kg	860	12 U	12 U	13 U	13 U	12 U	11 U	12 U	12 U	12 U	12 U	11 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	3400	10 U	9.8 U	11 U	11 U	10 U	9.7 U	10 U	11 U	11 U	9.9 U	9.6 U
SVOC	1,3-DINITROBENZENE	µg/Kg	--	9.5 U	9.1 U	10 U	9.9 U	9.4 U	9 U	9.6 U	9.7 U	9.8 U	9.2 U	9 U
SVOC	1,4-DIOXANE	µg/Kg	1700	420 U	410 U	470 U	440 UJ	420 UJ	400 UJ	430 U	440 UJ	440 UJ	410 UJ	400 U
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	--	14 U	14 U	16 U	15 U	14 UJ	14 U	15 U	15 U	15 U	14 U	14 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	--	42 U	40 U	46 U	44 U	41 U	40 U	42 U	43 U	43 U	40 U	39 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	--	17 U	17 U	19 U	18 U	17 U	17 U	18 U	18 U	18 U	17 U	16 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	39000	9.6 U	9.3 U	11 U	10 U	9.5 U	9.1 U	9.7 U	9.9 U	9.9 U	9.3 U	9.1 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	2400	7.3 U	7.1 U	8.1 UJ	7.7 U	7.2 U	7 U	7.4 UJ	7.5 U	7.6 U	7.1 U	6.9 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	380	32 U	31 U	35 UJ	33 U	31 U	30 U	32 UJ	33 U	33 U	31 U	30 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	7400	70 U	67 U	77 U	73 U	69 U	67 U	71 U	72 U	72 U	68 U	66 U
SVOC	2,4-DINITROPHENOL	µg/Kg	--	24 U	24 U	27 U	26 U	24 UJ	23 U	25 U	25 U	25 U	24 U	23 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	430	35 U	33 U	38 U	36 U	34 U	33 U	35 U	36 U	36 U	33 U	33 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	--	17 U	17 U	19 U	18 U	17 U	16 U	17 U	18 U	18 U	17 U	16 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	--	7.3 U	7.1 U	8 U	7.7 U	7.2 U	7 U	7.4 U	7.5 U	7.6 U	7.1 U	6.9 U
SVOC	2-Acetylaminofluorene	µg/Kg	--	17 U	16 U	18 U	17 U	16 U	16 U	17 U	17 U	17 U	16 U	16 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	620000	31 U	30 U	34 U	33 U	31 U	30 U	32 U	32 U	32 U	30 U	29 U
SVOC	2-CHLOROPHENOL	µg/Kg	440	32 U	31 U	35 U	33 U	31 U	30 U	32 U	33 U	33 U	31 U	30 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	57000	9.1 U	8.8 U	10 U	9.6 U	9 U	8.7 U	9.3 U	9.4 U	**12** J	8.9 U	8.6 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	--	22 U	21 U	24 U	23 U	21 U	21 U	22 U	22 U	22 U	21 U	20 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
SVOC	2-NITROANILINE	µg/Kg	--	9.7 U	9.3 U	11 U	10 U	9.6 U	9.2 U	9.8 U	10 U	10 U	9.4 U	9.2 U
SVOC	2-NITROPHENOL	µg/Kg	400	12 U	12 U	14 U	13 U	12 U	12 U	13 U	13 U	13 U	12 U	12 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	--	12 U	12 U	14 U	13 U	12 U	12 U	13 U	13 U	13 U	12 U	12 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	2000	72 U	69 U	79 U	75 U	71 U	68 U	73 U	74 U	74 U	70 U	68 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	--	23 U	22 U	25 U	24 U	22 U	21 U	23 U	23 U	23 U	22 U	21 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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Midland Area Soils

				Sample ID	1139-1	1139-2	1251-1	1251-2	1438-1	1438-2	1517-1	1517-1-C	1517-2	1517-2-C	1582-1
				Location ID	MidBlind_1139-1	MidBlind_1139-2	MidBlind_1251-1	MidBlind_1251-2	MidBlind_1438-1	MidBlind_1438-2	MidBlind_1517-1	MidBlind_1517-1-C	MidBlind_1517-2	MidBlind_1517-2-C	MidBlind_1582-1
				Sample Date	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006
				Sample Depth (in)	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	SOIL
Group	**Analyte**	**Units**	**SL**												
SVOC	3-NITROANILINE	µg/Kg	--	8.5 U	8.2 U	9.3 U	8.9 U	8.4 U	8.1 U	8.6 U	8.7 U	8.7 U	8.2 U	8 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	830	16 U	16 U	18 U	17 U	16 U	15 U	16 U	17 U	17 U	16 U	15 U
SVOC	4-AMINOBIPHENYL	µg/Kg	--	12 U	12 U	13 U	13 U	12 U	12 U	12 U	13 U	13 U	12 U	12 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	--	16 U	15 U	17 U	17 U	16 U	15 U	16 U	16 U	16 U	15 U	15 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	280	13 U	12 U	14 U	13 U	13 U	12 U	13 U	13 U	13 U	12 U	12 U
SVOC	4-CHLOROANILINE	µg/Kg	--	52 U	51 U	58 U	55 U	52 U	50 U	53 U	54 U	54 U	51 U	50 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	--	6 U	5.8 U	6.6 U	6.3 U	5.9 U	5.7 U	6.1 U	6.1 U	6.2 U	5.8 U	5.6 U
SVOC	4-NITROANILINE	µg/Kg	--	50 U	48 U	55 U	52 U	49 U	47 U	50 U	51 U	51 U	48 U	47 U
SVOC	4-NITROPHENOL	µg/Kg	--	11 U	10 U	12 U	11 U	11 U	10 U	11 U	11 U	11 U	10 U	10 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	--	10 U	9.9 U	11 UJ	11 UJ	10 U	9.8 UJ	10 UJ	11 U	11 U	10 U	9.7 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	--	14 U	13 U	15 U	14 U	13 U	13 U	14 U	14 U	14 U	13 U	13 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	--	17 U	16 U	18 U	17 U	16 U	16 U	17 U	17 U	17 U	16 U	16 U
SVOC	ACENAPHTHENE	µg/Kg	4400	9.1 UJ	8.8 UJ	10 U	9.6 U	9 U	8.7 U	9.3 U	9.4 U	9.4 U	8.9 U	8.6 UJ
SVOC	ACENAPHTHYLENE	µg/Kg	5900	9.2 U	8.9 U	10 U	9.7 U	9.1 U	8.8 U	9.4 U	9.5 U	9.5 U	9 U	8.7 U
SVOC	ACETOPHENONE	µg/Kg	30000	11 U	10 U	12 U	11 U	10 U	10 U	11 U	11 U	11 U	10 U	9.9 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	--	420 U	410 U	470 U	440 UJ	420 U	400 UJ	430 U	440 U	440 U	410 U	400 U
SVOC	ANILINE	µg/Kg	330	55 U	53 U	60 U	58 U	54 U	52 U	56 U	56 U	57 U	53 U	52 U
SVOC	ANTHRACENE	µg/Kg	41000	6.4 U	6.1 U	**14** J	6.7 U	6.3 U	6.1 U	**15** J	6.6 U	**15** J	6.2 U	6 U
SVOC	ARAMITE (TOTAL)	µg/Kg	--	88 U	85 U	96 U	92 U	87 U	84 U	89 U	90 U	91 U	85 U	83 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	20000	7.5 U	7.2 U	8.2 U	7.9 U	7.4 U	7.1 U	**73** J	7.7 U	7.7 U	7.3 U	7.1 U
SVOC	BENZO(A)PYRENE	µg/Kg	2000	10 UJ	9.7 UJ	**120** J	11 UJ	**61** J	9.6 U	**82** J	**40** J	**73** J	**26** J	9.5 UJ
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	20000	**56** J	**54** J	**180** J	**45** J	**75** J	**57** J	**130** J	**59** J	**90** J	**57** J	**92** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	2500000	**170** J	**160** J	**160** J	**41** J	**80** J	**69** J	**100** J	**63** J	**100** J	**52** J	32 U
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	200000	11 U	11 U	**78** J	**13** J	**38** J	**20** J	**66** J	**27** J	**47** J	**14** J	**63** J
SVOC	BENZYL ALCOHOL	µg/Kg	200000	9.3 U	9 U	10 U	9.8 U	9.2 U	8.9 U	9.4 U	9.6 U	9.6 U	9 U	8.8 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	26000	9.8 U	9.4 U	11 U	10 UJ	9.6 U	9.3 U	9.9 U	10 U	10 U	9.4 U	9.2 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	--	6.6 U	6.4 U	7.2 U	6.9 U	6.5 U	6.3 U	6.7 U	6.8 U	6.8 U	6.4 U	6.2 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	100	46 U	44 U	51 U	48 U	46 U	44 U	47 U	47 U	48 U	45 U	44 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	2800000	20 U	19 U	**49** J	**43** J	**27** J	**93** J	**69** J	21 U	**66** J	**23** J	**31** J
SVOC	CHLOROBENZILATE	µg/Kg	--	24 U	23 U	26 U	25 U	24 U	23 U	24 U	25 U	25 U	23 U	23 U
SVOC	CHRYSENE	µg/Kg	2000000	**33** J	**33** J	**99** J	14 U	**17** J	13 U	**64** J	14 U	**31** J	13 U	**61** J
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	11000	8.5 U	8.2 U	9.4 U	**10** J	8.4 U	8.1 U	8.6 U	8.8 U	**9.8** J	8.3 U	8.1 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	6900000	8.9 UJ	8.6 UJ	9.8 UJ	9.3 UJ	8.8 U	8.5 U	9 UJ	9.1 UJ	9.2 UJ	8.6 UJ	8.4 U
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	--	35 U	34 U	39 U	37 U	35 U	34 U	36 U	36 UJ	37 UJ	34 UJ	34 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	2000	40 U	38 U	44 U	42 U	39 U	38 U	40 U	41 U	41 U	38 U	37 U
SVOC	DIBENZOFURAN	µg/Kg	1700	5.4 U	5.3 U	6 U	5.7 U	5.4 U	5.2 U	5.5 U	5.6 U	5.6 U	5.3 U	5.1 U
SVOC	DIETHYL PHTHALATE	µg/Kg	2200	7 U	6.7 U	7.7 U	7.3 U	6.9 U	6.6 U	7.1 U	7.2 U	7.2 U	6.7 U	6.6 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	790000	25 U	24 U	28 U	26 U	25 U	24 U	26 U	26 U	26 U	24 U	24 U
SVOC	DIPHENYLAMINE	µg/Kg	--	35 U	33 U	38 U	36 U	34 U	33 U	35 U	36 U	36 U	33 U	33 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	--	15 U	15 U	17 UJ	16 U	15 U	15 U	16 UJ	16 UJ	16 UJ	15 UJ	14 U
SVOC	FLUORANTHENE	µg/Kg	5500	11 UJ	**27** J	**210** J	**23** J	**95** J	**64** J	**130** J	**62** J	**110** J	11 U	**76** J
SVOC	FLUORENE	µg/Kg	5300	7.1 U	6.9 U	7.8 U	7.5 U	7 U	6.8 U	7.2 U	7.3 U	7.4 U	6.9 U	6.7 U
SVOC	HEXACHLOROBENZENE	µg/Kg	350	12 U	12 U	14 U	13 U	12 U	12 U	13 U	13 U	13 U	12 U	12 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	91	41 U	40 U	45 U	43 U	41 U	39 U	42 U	43 U	43 U	40 U	39 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	30000	31 U	30 U	34 U	33 U	**420** R	30 U	32 U	32 U	32 U	30 U	30 U
SVOC	HEXACHLOROETHANE	µg/Kg	430	57 U	55 U	62 U	59 U	56 U	54 U	57 U	58 U	58 U	55 U	53 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			Sample ID	1139-1	1139-2	1251-1	1251-2	1438-1	1438-2	1517-1	1517-1-C	1517-2	1517-2-C	1582-1
			Location ID	MidBlind_1139-1	MidBlind_1139-2	MidBlind_1251-1	MidBlind_1251-2	MidBlind_1438-1	MidBlind_1438-2	MidBlind_1517-1	MidBlind_1517-1-C	MidBlind_1517-2	MidBlind_1517-2-C	MidBlind_1582-1
			Sample Date	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006
			Sample Depth (in)	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
			Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	SOIL
Group	**Analyte**	**Units**	**SL**											
SVOC	HEXACHLOROPHENE	µg/Kg	--	850 UJ	820 UJ	930 UJ	890 UJ	840 UJ	810 UJ	860 UJ	870 UJ	870 UJ	820 UJ	800 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	--	56 U	54 U	62 U	59 U	56 U	54 U	57 U	58 U	58 U	55 U	53 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	20000	29 U	28 U	**240** J	31 U	**71** J	28 U	**110** J	30 U	**62** J	28 U	**43** J
SVOC	ISODRIN	µg/Kg	--	24 U	23 U	26 U	25 U	23 U	23 U	24 U	24 U	24 U	23 U	22 U
SVOC	ISOPHORONE	µg/Kg	11000	5.9 U	5.7 U	6.5 U	6.2 U	5.8 U	5.6 U	6 U	6.1 U	6.1 U	5.7 U	5.6 U
SVOC	ISOSAFROLE	µg/Kg	--	21 U	20 U	23 U	22 U	20 U	20 U	21 U	21 U	21 U	20 U	19 U
SVOC	METHAPYRILENE	µg/Kg	--	49 U	48 U	54 U	52 U	49 U	47 U	50 U	51 U	51 U	48 U	47 U
SVOC	METHYL METHANESULFONATE	µg/Kg	--	24 U	23 U	27 U	25 U	24 U	23 U	25 U	25 U	25 U	23 U	23 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	--	12 U	12 U	14 U	13 U	12 U	12 U	13 U	13 U	13 U	12 U	12 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	330	9.6 U	9.3 U	11 U	10 U	9.5 U	9.1 U	9.7 U	9.9 U	9.9 U	9.3 U	9.1 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	--	22 U	22 U	25 UJ	23 UJ	22 U	21 U	23 UJ	23 UJ	23 UJ	22 UJ	21 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	--	51 UJ	49 UJ	56 U	54 U	50 U	49 UJ	52 U	52 U	53 U	49 UJ	48 UJ
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	5400	14 U	14 U	15 U	15 U	14 U	13 U	14 U	14 U	14 U	14 U	13 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	--	19 U	18 U	21 U	20 U	19 U	18 U	19 U	20 U	20 U	19 U	18 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	--	23 U	22 U	25 U	24 U	22 U	22 U	23 U	23 U	23 U	22 U	21 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	--	14 U	13 U	15 U	14 U	14 U	13 U	14 U	14 U	14 U	13 U	13 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
SVOC	NAPHTHALENE	µg/Kg	870	34 U	33 U	37 U	36 U	34 U	32 U	34 U	35 U	35 U	33 U	32 U
SVOC	NITROBENZENE	µg/Kg	330	44 U	42 U	48 U	46 U	43 U	42 U	44 U	45 U	45 U	42 U	41 U
SVOC	O-TOLUIDINE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	--	15 U	15 U	17 U	16 U	15 U	15 U	16 U	16 U	16 U	15 U	15 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	--	35 U	33 U	38 UJ	36 UJ	34 UJ	33 UJ	35 UJ	36 UJ	36 UJ	33 UJ	33 U
SVOC	PENTACHLOROBENZENE	µg/Kg	9500	34 U	33 U	37 U	36 U	34 U	32 U	34 U	35 U	35 U	33 U	32 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	37000	24 U	23 U	26 U	25 U	23 U	22 U	24 U	24 U	24 U	23 U	22 U
SVOC	PENTACHLOROPHENOL	µg/Kg	22	38 UJ	36 UJ	41 UJ	40 U	37 UJ	36 UJ	38 UJ	39 U	39 U	36 U	36 UJ
SVOC	PHENACETIN	µg/Kg	--	15 U	14 U	16 U	16 U	15 U	14 U	15 U	15 U	15 U	14 U	14 U
SVOC	PHENANTHRENE	µg/Kg	5300	**9.6** J	**9.9** J	**87** J	**17** J	**37** J	**32** J	**90** J	**34** J	**66** J	**27** J	**42** J
SVOC	PHENOL	µg/Kg	4200	8.8 UJ	8.5 UJ	9.7 U	9.2 U	8.7 U	8.4 U	8.9 U	9 U	9.1 U	8.5 U	8.3 UJ
SVOC	PRONAMIDE	µg/Kg	--	13 U	13 U	15 U	14 U	13 U	13 U	14 U	14 U	14 U	13 U	13 U
SVOC	PYRENE	µg/Kg	480000	20 U	19 U	**140** J	**36** J	**110** J	**58** J	**130** J	**66** J	**120** J	**57** J	**74** J
SVOC	PYRIDINE	µg/Kg	400	63 UJ	61 UJ	69 U	66 U	62 U	60 U	64 U	65 U	65 U	61 U	60 UJ
SVOC	SAFROLE	µg/Kg	--	18 U	17 U	20 U	19 U	18 U	17 U	18 U	19 U	19 U	17 U	17 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	--	420 U	410 U	470 U	440 U	420 U	400 U	430 U	440 U	440 U	410 U	400 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	1500	10 U	10 U	24 U	54 U	10 U	9.1 U	13 U	12 U	11 U	11 U	13 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	4000	7.1 U	7.1 U	17 U	38 U	7 U	6.4 U	9 U	8.1 U	7.8 U	7.9 U	8.7 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	170	10 U	10 U	24 U	56 U	10 U	9.4 U	13 U	12 U	11 U	12 U	13 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	100	6.6 U	6.6 U	15 U	35 U	6.5 U	5.9 U	8.4 U	7.5 U	7.2 U	7.3 U	8.1 U
VOC	1,1-DICHLOROETHANE	µg/Kg	15000	9.2 U	9.1 U	22 U	49 U	9 U	8.3 U	12 U	11 U	10 U	10 U	11 U
VOC	1,1-DICHLOROETHENE	µg/Kg	62	21 U	21 U	49 U	110 U	20 U	19 U	26 U	24 U	23 U	23 U	25 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	840	14 U	14 U	33 U	76 U	14 U	13 U	18 U	16 U	16 U	16 U	17 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	20	8.6 U	8.6 U	20 U	46 U	8.5 U	7.8 U	11 U	9.9 U	9.5 U	9.6 U	11 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	360	64 U	61 U	70 U	67 U	63 U	61 U	64 U	65 U	66 U	62 U	60 U
VOC	1,2-DICHLOROETHANE	µg/Kg	100	6.6 U	6.6 U	15 U	35 U	6.5 U	5.9 U	8.4 U	7.5 U	7.2 U	7.3 U	8.1 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	100	6.5 UJ	6.4 UJ	15 U	35 U	6.3 U	5.8 U	8.2 U	7.4 U	7.1 U	7.2 U	7.9 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	170	66 U	64 U	73 U	70 U	65 U	63 U	67 U	68 U	68 U	64 U	63 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	290	60 UJ	58 UJ	66 U	63 U	60 U	57 U	61 U	62 U	62 U	58 U	57 UJ
VOC	2-HEXANONE	µg/Kg	20000	48 U	47 U	110 U	260 U	47 U	43 U	61 U	55 U	52 U	53 U	59 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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				Sample ID	1139-1	1139-2	1251-1	1251-2	1438-1	1438-2	1517-1	1517-1-C	1517-2	1517-2-C	1582-1
				Location ID	MidBlind_1139-1	MidBlind_1139-2	MidBlind_1251-1	MidBlind_1251-2	MidBlind_1438-1	MidBlind_1438-2	MidBlind_1517-1	MidBlind_1517-1-C	MidBlind_1517-2	MidBlind_1517-2-C	MidBlind_1582-1
				Sample Date	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006
				Sample Depth (in)	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
				Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	SOIL
Group	**Analyte**	**Units**	**SL**												
VOC	ACETONE	µg/Kg	15000		22 UJ	**130** J	51 UJ	**1900** J	21 UJ	19 UJ	28 UJ	25 UJ	24 UJ	24 U	27 U
VOC	ACETONITRILE	µg/Kg	2800		260 UJ	260 UJ	610 UJ	1400 UJ	260 UJ	240 UJ	330 UJ	300 UJ	290 U	290 UJ	320 UJ
VOC	ACROLEIN	µg/Kg	410		140 UJ	130 UJ	320 UJ	720 UJ	130 U	120 U	170 UJ	150 UJ	150 U	150 UJ	170 UJ
VOC	ACRYLONITRILE	µg/Kg	100		41 U	41 U	96 U	220 U	40 U	37 U	52 U	47 U	45 U	46 U	50 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	--		58 U	57 U	140 U	310 U	57 U	52 U	74 U	66 U	63 U	64 U	71 U
VOC	BENZENE	µg/Kg	100		6 U	6 U	14 U	32 U	5.9 U	5.4 U	7.6 U	6.9 U	6.6 U	6.6 U	7.4 U
VOC	BROMODICHLOROMETHANE	µg/Kg	1200		7.8 U	7.8 U	18 U	42 U	7.7 U	7 U	9.9 U	8.9 U	8.6 U	8.6 U	9.6 U
VOC	BROMOFORM	µg/Kg	1600		9.7 U	9.7 U	23 U	52 U	9.6 U	8.8 U	12 U	11 U	11 U	11 U	12 U
VOC	BROMOMETHANE	µg/Kg	200		87 U	86 U	200 U	470 U	85 U	78 U	110 U	99 U	95 U	96 U	110 U
VOC	CARBON DISULFIDE	µg/Kg	16000		6.3 U	6.3 U	15 U	34 U	6.2 U	5.7 U	8 U	7.2 U	6.9 U	7 U	7.7 U
VOC	CARBON TETRACHLORIDE	µg/Kg	100		6.9 U	6.9 U	16 U	37 U	6.8 U	6.2 U	8.8 U	7.9 U	7.6 U	7.7 U	8.5 U
VOC	CHLOROBENZENE	µg/Kg	940		9.5 U	9.5 U	22 U	51 U	9.4 U	8.6 U	12 U	11 U	10 U	11 U	12 U
VOC	CHLOROETHANE	µg/Kg	8600		35 U	35 U	82 UJ	190 UJ	34 UJ	32 UJ	45 UJ	40 UJ	38 UJ	39 UJ	43 U
VOC	CHLOROFORM	µg/Kg	1600		8.1 U	8.1 U	19 U	44 U	8 U	7.3 U	10 U	9.3 U	8.9 U	9 U	10 U
VOC	CHLOROMETHANE	µg/Kg	2300		27 UJ	27 UJ	63 U	140 U	26 U	24 U	34 U	31 U	29 U	30 U	33 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	--		58 U	57 U	140 U	310 U	57 U	52 U	74 U	66 U	63 U	64 U	71 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	--		6.6 U	6.6 U	16 U	36 U	6.5 U	6 U	8.5 U	7.6 U	7.3 U	7.4 U	8.1 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	1600		5.2 U	5.2 U	12 U	28 U	5.1 U	4.7 U	6.6 U	5.9 U	5.7 U	5.8 U	6.4 U
VOC	DIBROMOMETHANE	µg/Kg	1600		9 U	9 U	21 U	48 U	8.8 U	8.1 U	12 U	10 U	9.9 U	10 U	11 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	95000		21 U	21 U	49 U	110 U	21 UJ	19 UJ	27 U	24 U	23 U	23 U	26 U
VOC	ETHYL BENZENE	µg/Kg	360		12 UJ	12 UJ	28 U	64 U	12 U	11 U	15 U	14 U	13 U	13 U	15 UJ
VOC	ETHYL METHACRYLATE	µg/Kg	--		58 U	57 U	140 U	310 U	57 U	52 U	74 U	66 U	63 U	64 U	71 U
VOC	ISOBUTANOL	µg/Kg	46000		58 UJ	57 UJ	140 UJ	310 UJ	57 UJ	52 UJ	74 UJ	66 UJ	63 U	64 UJ	71 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	44000		18 U	18 U	42 U	96 U	18 U	16 U	23 U	21 U	20 U	20 U	22 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	--		52 UJ	52 UJ	120 U	280 U	51 U	47 U	67 U	60 U	57 U	58 U	64 UJ
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	36000		10 U	9.9 U	23 U	53 U	9.8 U	9 U	13 U	11 U	11 U	11 U	12 U
VOC	METHYL METHACRYLATE	µg/Kg	--		58 U	57 U	140 U	310 U	57 U	52 U	74 U	66 U	63 U	64 U	71 U
VOC	METHYLACRYLONITRILE	µg/Kg	--		290 U	290 U	680 U	1500 U	280 U	260 UJ	370 U	330 U	320 U	320 U	350 U
VOC	METHYLENE CHLORIDE	µg/Kg	100		28 U	28 U	65 U	150 U	27 U	25 U	35 U	32 U	**160**	31 U	34 U
VOC	PENTOCHLORETHANE	µg/Kg	--		14 U	14 U	16 U	15 U	14 U	14 U	15 U	15 U	15 U	14 U	14 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	--		58 UJ	57 UJ	140 UJ	310 UJ	57 UJ	52 UJ	74 UJ	66 UJ	63 U	64 UJ	71 UJ
VOC	STYRENE	µg/Kg	2200		8.8 U	8.7 U	21 U	47 U	8.6 U	7.9 U	11 U	10 U	9.6 U	9.7 U	11 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	100		11 U	11 U	26 U	59 U	11 U	10 U	14 U	13 U	12 U	12 U	14 U
VOC	TOLUENE	µg/Kg	2800		32 UJ	32 UJ	**5900**	**5600**	31 U	29 U	40 U	**4600**	**990**	**1300**	**290** J
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	2000		9.5 U	9.4 U	22 U	51 U	9.3 U	8.5 U	12 U	11 U	10 U	11 U	12 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	--		8.1 U	8.1 U	19 U	44 U	8 U	7.3 U	10 U	9.3 U	8.9 U	9 U	10 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	--		42 U	41 U	97 U	220 U	41 U	38 U	53 U	48 U	46 U	46 U	51 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	100		10 U	10 U	24 U	55 U	10 U	9.2 U	13 U	12 U	11 U	11 U	13 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	52000		15 U	15 U	34 U	78 U	14 U	13 U	19 U	17 U	16 UJ	16 U	18 U
VOC	VINYL ACETATE	µg/Kg	13000		56 U	56 U	130 U	300 U	55 U	51 U	72 U	65 U	62 U	63 U	69 U
VOC	VINYL CHLORIDE	µg/Kg	40		20 U	20 U	47 U	110 U	20 U	18 U	26 U	23 U	22 U	22 U	25 U
VOC	XYLENES, TOTAL	µg/Kg	700		33 U	33 U	77 U	180 U	32 U	30 U	42 U	38 U	36 U	37 U	41 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			1582-1-D	1582-2	2147-1	2147-2-D	2147-2-M	2753-1-D	2753-1-M	2753-2	2808-1	2808-2	2823-1
			MidBlind_1582-1-D	MidBlind_1582-2	MidBlind_2147-1	MidBlind_2147-2-D	MidBlind_2147-2-M	MidBlind_2753-1-D	MidBlind_2753-1-M	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	SOIL	SOIL	SOIL	SOIL	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	**170**	**860**	**220**	**45** J	**23** J	**88** J	**41** J	**140** J	**44** J	**27** J	**37** J
GEN	SULFIDE	mg/kg	97 U	94 U	96 U	90 U	90 U	93 U	93 U	92 U	88 U	86 U	99 U
GEN	TOTAL ORGANIC CARBON	mg/kg	**31000**	**24000**	**13000**	**9000**	**8500**	**22000**	**20000**	**20000**	**10000**	**8200**	**20000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.2 U	2.2 U	2.5 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	2 U	2 U	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.8 U	2 U
HERB	DINOSEB	µg/Kg	64 U	62 U	62 U	58 U	59 U	60 U	61 U	60 U	57 U	56 U	65 UJ
HERB	SILVEX (2,4,5-TP)	µg/Kg	2.1 U	2.1 U	2.1 U	2 U	2 U	2 U	2 U	2 U	1.9 U	1.9 U	2.1 U
MET	ANTIMONY	µg/Kg	**400** J	**340** J	230 U	220 U	220 UJ	220 U	220 UJ	220 U	210 U	210 U	1100 U
MET	ARSENIC	µg/Kg	**480** J	**1000** J	190 U	310 U	300 U	730 U	**880** J	790 U	**1200**	**1600**	**4100**
MET	BARIUM	µg/Kg	**22000**	**21000**	**15000**	**14000**	**14000** J	**31000**	**31000** J	**33000**	**17000**	**15000**	**39000**
MET	BERYLLIUM	µg/Kg	**160** J	**160** J	**110** J	**95** J	**110** J	**220** J	**200** J	**230** J	**130** J	**110** J	**280**
MET	CADMIUM	µg/Kg	**97** J	**110** J	23 U	21 U	21 U	**120** J	**79** J	**140** J	**140** J	**86** J	330 U
MET	CHROMIUM, TOTAL	µg/Kg	**5000**	**4800**	**9900**	**3200**	**3900**	**11000**	**10000** J	**11000**	**5700**	**4000**	**6100**
MET	COBALT	µg/Kg	**2000**	**2000**	**900**	**640**	**760**	**2200**	**2000** J	**2200**	**890**	**750**	**2500**
MET	COPPER	µg/Kg	**7900**	**7700**	**4700**	**2100**	**2800**	**10000**	**10000** J	**10000**	**5900**	**4600**	**18000**
MET	LEAD	µg/Kg	**7900**	**7700**	**28000**	**4800**	**5800**	**22000**	**20000** J	**20000**	**14000**	**12000**	**15000**
MET	MERCURY	µg/Kg	**51**	**49**	**23**	**18**	**17**	**58**	**61**	**60**	**17**	**18**	**32**
MET	NICKEL	µg/Kg	**6000**	**5400**	**2600**	**1900**	**2200**	**6000**	**5700** J	**6200**	**3400**	**2800**	**5900**
MET	SELENIUM	µg/Kg	510 U	500 U	500 U	470 U	480 U	490 U	490 U	490 U	460 U	460 U	520 U
MET	SILVER	µg/Kg	57 U	55 U	56 U	53 U	53 U	**88** J	**78** J	**81** J	51 U	51 U	58 U
MET	THALLIUM	µg/Kg	210 U	200 U	200 U	190 U	190 U	200 U	200 U	200 U	190 U	180 U	210 U
MET	TIN	µg/Kg	550 U	530 U	530 U	500 U	500 U	**620** J	**610** J	**530** J	490 U	480 U	560 U
MET	VANADIUM	µg/Kg	**8900**	**9100**	**5200**	**4100**	**5600**	**8800**	**7900**	**8800**	**4600**	**4300**	**11000**
MET	ZINC	µg/Kg	**21000**	**18000**	**17000**	**6800**	57 U	**36000**	**39000** J	**39000**	**20000**	**37000**	**120000**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	6.5 U	6.3 U	6.4 U	6 U	6 U	6.3 U	6.2 U	6.2 U	5.8 U	5.7 U	6.6 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	11 U	11 U	11 U	10 U	10 U	11 U	11 U	11 U	9.9 U	9.8 U	11 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	12 U	12 U	12 U	11 U	11 U	12 U	12 U	12 U	11 U	11 U	12 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	14 U	14 U	14 U	13 U	13 U	14 U	13 U	13 U	13 U	13 U	14 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	9.5 U	9.2 U	9.2 U	8.7 U	8.8 U	9.1 U	9 U	9 U	8.4 U	8.3 U	9.6 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	7.9 U	7.6 U	7.7 U	7.2 U	7.3 U	7.6 U	7.4 U	7.4 U	7 U	6.9 U	8 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	6.6 U	6.4 U	6.4 U	6 U	6.1 U	6.3 U	6.2 U	6.2 U	5.9 U	5.8 U	6.6 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	8.7 U	8.4 U	8.4 U	8 U	8 U	8.3 U	8.2 U	8.2 U	7.7 U	7.6 U	8.7 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
PCB	SUMMED PCB	µg/Kg	**44**	**43**	**43**	**41**	**41**	**43**	**42**	**42**	**39**	**39**	**45**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	59 U	48 U	56 U	43 U	47 U	43 U	46 U	41 U	49 U	44 U	44 U
PEST	4,4'-DDD	µg/Kg	0.7 U	**1.7** J	0.69 U	**0.86** J	0.65 U	**6** J	**2.9** J	**2.7** J	**2.1** J	**36** J	0.71 U
PEST	4,4'-DDE	µg/Kg	**5.7** J	0.92 U	0.92 U	**17** J	0.88 U	0.91 U	0.89 U	0.89 U	0.84 U	0.83 U	**1.2** J
PEST	4,4'-DDT	µg/Kg	**4.4** J	**7.7** J	**1.5** J	**2.4** J	0.99 U	**10** J	**11** J	**11** J	**20** J	**47**	1.1 U
PEST	ALDRIN	µg/Kg	0.73 U	0.71 U	0.71 U	0.67 U	0.67 U	0.7 U	0.69 U	0.69 U	0.65 U	0.64 U	0.74 U
PEST	ALPHA BHC	µg/Kg	0.92 U	0.89 U	0.9 U	0.85 U	0.85 U	0.89 U	0.87 U	0.87 U	0.82 U	0.81 U	0.93 U
PEST	BETA BHC	µg/Kg	1 U	**1.6** J	0.97 U	0.91 U	0.92 U	0.96 U	0.94 U	0.94 U	**3.1** J	0.87 U	1 U
PEST	CHLORDANE	µg/Kg	0.97 U	0.94 U	0.95 U	0.89 U	0.9 U	0.93 U	0.92 U	0.92 U	0.86 U	0.85 U	0.98 U
PEST	DELTA BHC	µg/Kg	0.9 U	0.87 U	0.88 U	0.83 U	0.83 U	0.86 U	0.85 U	0.85 U	0.8 U	0.79 U	0.91 U
PEST	DIELDRIN	µg/Kg	0.73 U	0.71 U	0.71 U	0.67 U	0.67 U	0.7 U	**1.6** J	**1.4** J	**1.2** J	0.64 U	0.74 U
PEST	DIMETHOATE	µg/Kg	62 U	60 U	61 U	57 U	58 U	59 U	60 U	59 U	56 U	55 U	63 U
PEST	DISULFOTON	µg/Kg	11 U	10 U	10 U	9.6 U	9.7 U	9.9 U	10 U	9.9 U	9.4 U	9.2 U	11 U
PEST	ENDOSULFAN I	µg/Kg	0.56 U	0.54 U	0.54 U	0.51 U	0.52 U	0.54 U	0.53 U	0.53 U	0.5 U	0.49 U	0.56 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			1582-1-D	1582-2	2147-1	2147-2-D	2147-2-M	2753-1-D	2753-1-M	2753-2	2808-1	2808-2	2823-1
			MidBlind_1582-1-D	MidBlind_1582-2	MidBlind_2147-1	MidBlind_2147-2-D	MidBlind_2147-2-M	MidBlind_2753-1-D	MidBlind_2753-1-M	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	SOIL	SOIL	SOIL	SOIL	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	0.61 U	**6.8** J	**8.4** J	0.56 U	0.56 U	**4.8** J	**2.4** J	**4.1** J	**7.6** J	**2.1** J	0.61 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**0.58**	**7**	**8.7**	**0.54**	**0.54**	**5.1**	**2.7**	**4.3**	**7.9**	**2.3**	**0.59**
PEST	ENDOSULFAN SULFATE	µg/Kg	0.87 U	0.85 U	0.85 U	0.8 U	0.81 U	0.84 U	0.83 U	0.83 U	0.78 U	**3.1** J	0.88 U
PEST	ENDRIN	µg/Kg	0.89 U	0.86 U	0.86 U	0.81 U	0.82 U	0.85 U	0.84 U	0.84 U	0.79 U	0.78 U	0.89 U
PEST	ENDRIN ALDEHYDE	µg/Kg	0.91 U	0.88 U	0.89 U	0.84 U	0.84 U	0.88 U	**2.1** J	**1.5** J	0.81 U	0.8 U	0.92 U
PEST	FAMPHUR	µg/Kg	34 UJ	33 UJ	33 UJ	31 UJ	31 UJ	32 UJ	33 UJ	32 UJ	30 UJ	30 UJ	34 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	0.7 U	0.68 U	0.69 U	0.65 U	0.65 U	0.68 U	0.67 U	0.67 U	0.63 U	**5.9** J	0.71 U
PEST	HEPTACHLOR	µg/Kg	0.73 U	0.71 U	0.71 U	0.67 U	0.67 U	0.7 U	0.69 U	0.69 U	0.65 U	0.64 U	0.74 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	**1.1** J	0.98 U	0.98 U	0.93 U	0.93 U	0.97 U	0.95 U	0.95 U	0.9 U	0.88 U	1 U
PEST	KEPONE	µg/Kg	2000 U	1900 U	2000 U	1800 U	1900 U	1900 U	1900 U	1900 U	1800 U	1800 U	2000 U
PEST	METHOXYCHLOR	µg/Kg	1.2 U	1.2 U	1.2 U	**2.9** J	1.1 U	1.2 U	1.2 U	1.2 U	1.1 U	1.1 U	1.2 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	11 U	11 U	11 U	10 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	21 U	20 U	20 U	19 U	19 U	20 U	20 U	20 U	19 U	18 U	21 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	21 U	20 U	20 U	19 U	19 U	19 U	20 U	19 U	18 U	18 U	21 U
PEST	PARATHION, METHYL	µg/Kg	14 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	12 U	12 U	14 U
PEST	PHORATE	µg/Kg	11 U	10 U	10 U	9.7 U	9.7 U	10 U	10 U	10 U	9.4 U	9.3 U	11 UJ
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	800 U	780 U	790 U	740 U	740 U	760 U	770 U	760 U	720 U	700 U	810 U
PEST	TOXAPHENE	µg/Kg	11 U	11 U	11 U	10 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	9.7 U	9.3 U	9.5 U	8.9 U	8.9 U	9.1 U	9.3 U	9.1 U	8.6 U	8.5 U	9.8 U
SVOC	1,3-DINITROBENZENE	µg/Kg	9 U	8.7 U	8.8 U	8.2 U	8.3 U	8.5 U	8.6 U	8.5 U	8 U	7.9 U	9.1 U
SVOC	1,4-DIOXANE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 UJ
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	14 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	12 U	12 U	14 UJ
SVOC	1-NAPHTHYLAMINE	µg/Kg	400 U	390 U	390 UJ	370 UJ	370 UJ	380 UJ	390 UJ	380 UJ	360 UJ	350 UJ	410 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	40 U	38 U	39 U	36 U	36 U	37 U	38 U	37 U	35 U	35 U	40 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	16 U	16 U	16 U	15 U	15 U	16 U	16 U	16 U	15 U	14 U	17 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	9.1 U	8.8 U	8.9 U	8.3 U	8.4 U	8.6 U	8.7 U	8.6 U	8.1 U	8 U	9.2 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	6.9 U	6.7 U	6.8 U	6.4 U	6.4 U	6.6 U	6.7 U	6.6 U	6.2 U	6.1 U	7 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	30 U	29 U	30 U	28 U	28 U	29 U	29 U	28 U	27 U	27 U	31 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	66 U	64 U	65 U	61 U	61 U	63 U	63 U	62 U	59 U	58 U	67 U
SVOC	2,4-DINITROPHENOL	µg/Kg	23 U	22 U	23 U	21 U	21 U	22 U	22 U	22 U	21 U	20 U	23 UJ
SVOC	2,4-DINITROTOLUENE	µg/Kg	33 U	32 U	32 U	30 U	30 U	31 U	31 U	31 U	29 U	29 U	33 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	16 U	16 U	16 U	15 U	15 U	15 U	16 U	15 U	14 U	14 U	16 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	6.9 U	6.7 U	6.8 U	6.4 U	6.4 U	6.5 U	6.6 U	6.5 U	6.2 U	6.1 U	7 U
SVOC	2-Acetylaminofluorene	µg/Kg	16 U	15 U	15 U	14 U	15 U	15 U	15 U	15 U	14 U	14 U	16 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	29 U	28 U	29 U	27 U	27 U	28 U	28 U	28 U	26 U	26 U	30 U
SVOC	2-CHLOROPHENOL	µg/Kg	30 U	29 U	30 U	28 U	28 U	29 U	29 U	28 U	27 U	27 U	31 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	8.7 U	8.4 U	8.5 U	7.9 U	8 U	8.2 U	**16** J	8.2 U	7.7 U	7.6 U	8.8 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	20 U	20 U	20 U	19 U	19 U	19 U	20 U	19 U	18 U	18 U	21 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
SVOC	2-NITROANILINE	µg/Kg	9.2 U	8.9 U	9 U	8.4 U	8.5 U	8.7 U	8.8 U	8.7 U	8.2 U	8.1 U	9.3 U
SVOC	2-NITROPHENOL	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	12 U	11 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	12 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	68 U	66 U	67 U	62 U	63 U	64 U	65 U	64 U	61 U	60 U	69 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	21 U	21 U	21 U	20 U	20 U	20 U	20 U	20 U	19 U	19 U	22 U

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U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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			MidBlind_1582-1-D	MidBlind_1582-2	MidBlind_2147-1	MidBlind_2147-2-D	MidBlind_2147-2-M	MidBlind_2753-1-D	MidBlind_2753-1-M	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	SOIL	SOIL	SOIL	SOIL	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	8 U	7.7 U	7.9 U	7.4 U	7.4 U	7.6 U	7.7 U	7.6 U	7.2 U	7 U	8.1 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	15 U	15 U	15 U	14 U	14 U	14 U	15 U	14 U	14 U	13 U	15 U
SVOC	4-AMINOBIPHENYL	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	15 U	14 U	15 U	14 U	14 U	14 U	14 U	14 U	13 U	13 U	15 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	12 U	12 U	12 U	11 U	11 U	11 U	12 U	11 U	11 U	11 U	12 U
SVOC	4-CHLOROANILINE	µg/Kg	50 U	48 U	49 U	46 U	46 U	47 U	48 U	47 U	44 U	44 U	50 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	5.7 U	5.5 U	5.5 U	5.2 U	5.2 U	5.3 U	5.4 U	5.3 U	5.1 U	5 U	5.7 U
SVOC	4-NITROANILINE	µg/Kg	47 U	45 U	46 U	43 U	43 U	44 U	45 U	44 U	42 U	41 U	48 U
SVOC	4-NITROPHENOL	µg/Kg	10 U	9.7 U	9.8 U	9.2 U	9.3 U	9.5 U	9.6 U	9.5 U	9 U	8.8 U	10 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	9.8 U	9.4 U	9.6 U	9 U	9 U	9.2 U	9.4 U	9.2 U	8.7 U	8.6 U	9.9 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	13 U	12 U	13 U	12 U	12 U	12 U	12 U	12 U	11 U	11 U	13 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	16 U	15 U	15 U	14 U	15 U	15 U	15 U	15 U	14 U	14 U	16 U
SVOC	ACENAPHTHENE	µg/Kg	8.7 UJ	8.4 UJ	8.5 UJ	7.9 UJ	8 UJ	8.2 UJ	8.3 UJ	8.2 UJ	7.7 UJ	7.6 UJ	8.8 U
SVOC	ACENAPHTHYLENE	µg/Kg	8.7 U	8.5 U	8.6 U	8 U	8.1 U	8.3 U	8.4 U	8.3 U	7.8 U	7.7 U	8.9 U
SVOC	ACETOPHENONE	µg/Kg	9.9 U	9.6 U	9.7 U	9.1 U	9.2 U	9.4 U	9.5 U	9.4 U	8.9 U	8.7 U	10 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
SVOC	ANILINE	µg/Kg	52 U	50 U	51 U	48 U	48 U	49 U	50 U	49 U	46 U	46 U	53 U
SVOC	ANTHRACENE	µg/Kg	6 U	**8.9** J	5.9 U	5.5 U	5.6 U	**12** J	**13** J	**12** J	**12** J	**10** J	6.1 U
SVOC	ARAMITE (TOTAL)	µg/Kg	83 U	80 U	81 U	76 U	77 U	78 U	80 U	78 U	74 U	73 U	84 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	7.1 U	6.9 U	7 U	6.5 U	6.6 U	6.7 U	6.8 U	6.7 U	6.3 U	6.2 U	7.2 U
SVOC	BENZO(A)PYRENE	µg/Kg	9.5 UJ	**37** J	9.4 UJ	8.8 UJ	8.8 UJ	9 UJ	**53** J	9 UJ	**71** J	**48** J	9.7 UJ
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**80** J	**86** J	**69** J	**45** J	**41** J	**110** J	**130** J	**100** J	**140** J	**100** J	**55** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**170** J	**160** J	**160** J	**150** J	**150** J	**180** J	**190** J	**170** J	**190** J	**160** J	**39** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	**62** J	**54** J	11 UJ	9.9 UJ	10 UJ	**59** J	10 UJ	**59** J	**64** J	9.5 UJ	11 U
SVOC	BENZYL ALCOHOL	µg/Kg	8.8 U	8.5 U	8.6 U	8.1 U	8.1 U	8.3 U	8.4 U	8.3 U	7.9 U	7.7 U	8.9 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	9.2 U	8.9 U	9.1 U	8.5 U	8.5 UJ	8.7 U	8.9 U	8.7 U	8.3 U	8.1 U	**22** J
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	6.2 U	6 U	6.1 U	5.7 U	5.8 U	5.9 U	6 U	5.9 U	5.6 U	5.5 U	6.3 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	44 U	42 U	43 U	40 U	40 U	41 U	42 U	41 U	39 U	38 U	44 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	**33** J	**28** J	19 U	18 U	18 U	18 U	18 U	18 U	17 U	17 U	**48** J
SVOC	CHLOROBENZILATE	µg/Kg	23 U	22 U	22 U	21 U	21 U	22 U	22 U	21 U	20 U	20 U	23 U
SVOC	CHRYSENE	µg/Kg	**57** J	**64** J	13 U	12 U	12 U	**77** J	**77** J	**74** J	**96** J	**68** J	13 U
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	8.1 U	7.8 U	7.9 U	7.4 U	7.4 U	7.6 U	7.7 U	7.6 U	7.2 U	7.1 U	**9.2** J
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8.4 U	8.1 U	8.2 UJ	7.7 UJ	7.8 UJ	8 UJ	8.1 UJ	7.9 UJ	7.5 UJ	7.4 UJ	8.5 UJ
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	34 U	32 U	33 U	31 U	31 U	32 U	32 U	32 U	30 U	29 U	34 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	37 U	36 U	37 U	34 U	35 U	35 U	36 U	35 U	**39** J	33 U	38 U
SVOC	DIBENZOFURAN	µg/Kg	5.2 U	5 U	5.1 U	4.7 U	4.8 U	4.9 U	4.9 U	4.9 U	4.6 U	4.5 U	5.2 U
SVOC	DIETHYL PHTHALATE	µg/Kg	6.6 U	6.4 U	6.5 U	6 U	6.1 U	6.2 U	6.3 U	6.2 U	5.9 U	5.8 U	6.7 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	24 U	23 U	23 U	22 U	22 U	23 U	23 U	23 U	21 U	21 U	24 U
SVOC	DIPHENYLAMINE	µg/Kg	33 U	32 U	32 U	30 U	30 U	31 U	31 U	31 U	29 U	29 U	33 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	14 U	14 U	14 U	13 U	13 U	14 U	14 U	14 U	13 U	13 U	15 U
SVOC	FLUORANTHENE	µg/Kg	**63** J	**85** J	**46** J	9.8 UJ	9.8 UJ	**130** J	**140** J	**120** J	**180** J	**100** J	**21** J
SVOC	FLUORENE	µg/Kg	6.7 U	6.5 U	6.6 U	6.2 U	6.2 U	6.4 U	6.5 U	6.4 U	6 U	5.9 U	6.8 U
SVOC	HEXACHLOROBENZENE	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	10 U	12 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	39 U	38 U	38 U	36 U	36 U	37 U	38 U	37 U	35 U	34 U	40 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	30 U	29 U	29 U	27 U	27 UJ	28 U	28 U	28 U	27 U	26 U	30 U
SVOC	HEXACHLOROETHANE	µg/Kg	53 U	52 U	52 U	49 U	49 U	51 U	51 U	50 U	48 U	47 U	54 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			1582-1-D	1582-2	2147-1	2147-2-D	2147-2-M	2753-1-D	2753-1-M	2753-2	2808-1	2808-2	2823-1
			MidBlind_1582-1-D	MidBlind_1582-2	MidBlind_2147-1	MidBlind_2147-2-D	MidBlind_2147-2-M	MidBlind_2753-1-D	MidBlind_2753-1-M	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	SOIL	SOIL	SOIL	SOIL	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	800 UJ	780 UJ	790 UJ	740 UJ	740 UJ	760 UJ	770 UJ	760 UJ	720 UJ	700 UJ	810 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	53 U	52 U	52 U	49 U	49 U	50 U	51 U	50 U	48 U	47 U	54 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	**29** J	**46** J	**35** J	25 U	26 U	**75** J	**94** J	**78** J	**120** J	**77** J	28 UJ
SVOC	ISODRIN	µg/Kg	22 U	22 U	22 U	21 U	21 U	21 U	21 U	21 U	20 U	20 U	23 U
SVOC	ISOPHORONE	µg/Kg	5.6 U	5.4 U	5.5 U	5.1 U	5.2 U	5.3 U	5.4 U	5.3 U	5 U	4.9 U	5.7 U
SVOC	ISOSAFROLE	µg/Kg	19 U	19 U	19 U	18 U	18 U	18 U	19 U	18 U	17 U	17 U	20 U
SVOC	METHAPYRILENE	µg/Kg	47 U	45 U	46 UJ	43 UJ	43 UJ	44 UJ	45 UJ	44 UJ	42 UJ	41 UJ	47 U
SVOC	METHYL METHANESULFONATE	µg/Kg	23 U	22 U	22 U	21 U	21 U	22 U	22 U	22 U	20 U	20 U	23 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	12 U	11 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U	10 U	12 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	9.1 U	8.8 U	8.9 U	8.3 U	8.4 U	8.6 U	8.7 U	8.6 U	8.1 U	8 U	9.2 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	21 U	20 U	21 U	19 U	20 U	20 U	20 U	20 U	19 U	19 U	21 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	48 UJ	47 UJ	47 UJ	44 UJ	45 UJ	46 UJ	46 UJ	46 UJ	43 UJ	42 UJ	49 U
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	13 U	13 U	13 UJ	12 UJ	12 UJ	13 UJ	13 UJ	13 UJ	12 UJ	12 UJ	13 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	18 U	18 U	18 UJ	17 UJ	17 UJ	17 UJ	17 UJ	17 UJ	16 UJ	16 UJ	18 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	21 U	21 U	21 U	20 U	20 U	20 U	21 U	20 U	19 U	19 U	22 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	13 U	13 U	13 U	12 U	12 U	12 U	13 U	12 U	12 U	11 U	13 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
SVOC	NAPHTHALENE	µg/Kg	32 U	31 U	31 U	29 U	30 U	30 U	31 U	30 U	29 U	28 U	33 U
SVOC	NITROBENZENE	µg/Kg	41 U	40 U	41 U	38 U	38 U	39 U	40 U	39 U	37 U	36 U	42 U
SVOC	O-TOLUIDINE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	15 U	14 U	14 U	13 U	14 U	14 U	14 U	14 U	13 U	13 U	15 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	33 U	32 U	32 U	30 U	30 U	31 U	31 U	31 U	29 U	29 U	33 UJ
SVOC	PENTACHLOROBENZENE	µg/Kg	32 U	31 U	31 U	29 U	30 U	30 U	31 U	30 U	29 U	28 U	33 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	22 U	22 U	22 U	20 U	21 U	21 U	21 U	21 U	20 U	20 U	23 U
SVOC	PENTACHLOROPHENOL	µg/Kg	36 UJ	34 UJ	35 UJ	33 UJ	33 UJ	34 UJ	34 UJ	34 UJ	32 UJ	31 UJ	36 U
SVOC	PHENACETIN	µg/Kg	14 U	14 U	14 U	13 U	13 U	13 U	14 U	13 U	13 U	12 U	14 U
SVOC	PHENANTHRENE	µg/Kg	**33** J	**41** J	**15** J	5.8 U	5.8 U	**48** J	**48** J	**43** J	**59** J	**34** J	**15** J
SVOC	PHENOL	µg/Kg	8.3 UJ	8 UJ	8.1 UJ	7.6 UJ	7.7 UJ	7.9 UJ	8 UJ	7.8 UJ	7.4 UJ	7.3 UJ	8.4 U
SVOC	PRONAMIDE	µg/Kg	13 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	11 U	11 U	13 U
SVOC	PYRENE	µg/Kg	**69** J	**45** J	**25** J	17 U	17 U	**77** J	**73** J	**67** J	**97** J	**59** J	**35** J
SVOC	PYRIDINE	µg/Kg	60 UJ	58 UJ	59 UJ	55 UJ	55 UJ	57 UJ	57 UJ	56 UJ	53 UJ	53 UJ	61 U
SVOC	SAFROLE	µg/Kg	17 U	16 U	17 U	16 U	16 U	16 U	16 U	16 U	15 U	15 U	17 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	400 U	390 U	390 U	370 U	370 U	380 U	390 U	380 U	360 U	350 U	410 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	12 U	9.7 U	11 U	8.8 U	9.6 U	8.7 U	9.3 U	8.3 U	10 U	9 U	9 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	8.4 U	6.8 U	8 U	6.2 U	6.7 U	6 U	6.5 U	5.8 U	7 U	6.3 U	6.3 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	12 U	9.9 U	12 U	9 U	9.8 U	8.8 U	9.5 U	8.5 U	10 U	9.2 U	9.2 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	7.8 U	6.3 U	7.4 U	5.7 U	6.2 U	5.6 U	6 U	5.4 U	6.5 U	5.8 U	5.8 U
VOC	1,1-DICHLOROETHANE	µg/Kg	11 U	8.7 U	10 U	8 U	8.6 U	7.8 U	8.4 U	7.5 U	9.1 U	8.1 U	8.1 U
VOC	1,1-DICHLOROETHENE	µg/Kg	25 U	20 U	23 U	18 U	20 U	18 U	19 U	17 U	20 U	18 U	18 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	17 U	14 U	16 U	12 U	13 U	12 U	13 U	12 U	14 U	13 U	13 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	10 U	8.2 U	9.7 U	7.5 U	8.1 U	7.4 U	7.9 U	7.1 U	8.5 U	7.7 U	7.7 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	60 U	58 U	59 U	55 U	56 U	57 U	58 U	57 U	54 U	53 U	61 U
VOC	1,2-DICHLOROETHANE	µg/Kg	7.8 U	6.3 U	7.4 U	5.7 U	6.2 U	5.6 U	6 U	5.4 U	6.5 U	5.8 U	5.8 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	7.7 U	6.2 U	7.3 U	5.6 U	6.1 U	5.5 U	5.9 U	5.3 U	6.4 U	5.7 U	5.7 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	63 U	61 U	61 U	58 U	58 U	59 U	60 U	59 U	56 U	55 U	64 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	57 UJ	55 UJ	56 UJ	52 UJ	53 UJ	54 UJ	55 UJ	54 UJ	51 UJ	50 UJ	58 U
VOC	2-HEXANONE	µg/Kg	57 U	45 U	54 U	41 U	45 U	41 U	44 U	39 U	47 U	42 U	42 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			1582-1-D	1582-2	2147-1	2147-2-D	2147-2-M	2753-1-D	2753-1-M	2753-2	2808-1	2808-2	2823-1
			MidBlind_1582-1-D	MidBlind_1582-2	MidBlind_2147-1	MidBlind_2147-2-D	MidBlind_2147-2-M	MidBlind_2753-1-D	MidBlind_2753-1-M	MidBlind_2753-2	MidBlind_2808-1	MidBlind_2808-2	MidBlind_2823-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	SOIL	SOIL	SOIL	SOIL	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	26 U	21 U	24 UJ	19 UJ	20 UJ	18 UJ	20 UJ	18 UJ	21 UJ	19 UJ	19 UJ
VOC	ACETONITRILE	µg/Kg	310 UJ	250 UJ	290 UJ	230 UJ	250 UJ	220 UJ	240 UJ	210 UJ	260 UJ	230 UJ	230 UJ
VOC	ACROLEIN	µg/Kg	160 UJ	130 UJ	150 UJ	120 UJ	130 UJ	120 UJ	120 UJ	110 UJ	130 UJ	120 UJ	120 UJ
VOC	ACRYLONITRILE	µg/Kg	49 U	39 U	46 U	36 U	39 U	35 U	38 U	34 U	41 U	36 U	36 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	68 U	55 U	65 U	50 U	54 U	49 U	53 U	47 U	57 U	51 U	51 U
VOC	BENZENE	µg/Kg	7.1 U	5.7 U	6.7 U	5.2 U	5.7 U	5.1 U	5.5 U	4.9 U	5.9 U	5.3 U	5.3 U
VOC	BROMODICHLOROMETHANE	µg/Kg	9.2 U	7.4 U	8.7 U	6.8 U	7.3 U	6.6 U	7.1 U	6.3 U	7.7 U	6.9 U	6.9 U
VOC	BROMOFORM	µg/Kg	12 U	9.3 U	11 U	8.5 U	9.2 U	8.3 U	8.9 U	7.9 U	9.6 U	8.6 U	8.7 U
VOC	BROMOMETHANE	µg/Kg	100 U	83 U	97 U	75 U	82 U	74 U	80 U	71 U	86 U	77 U	77 U
VOC	CARBON DISULFIDE	µg/Kg	7.5 U	6 U	7.1 U	5.5 U	5.9 U	5.4 U	5.8 U	5.1 U	6.2 U	5.6 U	5.6 U
VOC	CARBON TETRACHLORIDE	µg/Kg	8.2 U	6.6 U	7.8 U	6 U	6.5 U	5.9 U	6.3 U	5.6 U	6.8 U	6.1 U	6.1 U
VOC	CHLOROBENZENE	µg/Kg	11 U	9.1 U	11 U	8.3 U	9 U	8.1 U	8.7 U	7.8 U	9.4 U	8.4 U	8.5 U
VOC	CHLOROETHANE	µg/Kg	42 U	33 U	39 U	30 U	33 U	30 U	32 U	29 U	35 U	31 U	31 UJ
VOC	CHLOROFORM	µg/Kg	9.7 U	7.7 U	9.1 U	7.1 U	7.7 U	6.9 U	7.5 U	6.6 U	8 U	7.2 U	7.2 U
VOC	CHLOROMETHANE	µg/Kg	32 U	26 UJ	30 UJ	23 UJ	25 UJ	23 UJ	25 UJ	22 UJ	26 UJ	24 UJ	24 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	68 U	55 U	65 U	50 U	54 U	49 U	53 U	47 U	57 U	51 U	51 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	7.9 U	6.3 U	7.4 U	5.8 U	6.2 UJ	5.7 U	6.1 UJ	5.4 U	6.5 U	5.9 U	5.9 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	6.2 U	4.9 U	5.8 U	4.5 U	4.9 U	4.4 U	4.8 U	4.2 U	5.1 U	4.6 U	4.6 U
VOC	DIBROMOMETHANE	µg/Kg	11 U	8.6 U	10 U	7.8 U	8.5 U	7.7 U	8.2 U	7.3 U	8.9 U	8 U	8 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	25 U	20 U	24 U	18 U	20 U	18 U	19 U	17 U	21 U	19 U	19 U
VOC	ETHYL BENZENE	µg/Kg	14 UJ	11 UJ	13 U	10 U	11 U	10 U	11 U	9.7 U	12 U	11 U	11 U
VOC	ETHYL METHACRYLATE	µg/Kg	68 U	55 U	65 U	50 U	54 U	49 U	53 U	47 U	57 U	51 U	51 U
VOC	ISOBUTANOL	µg/Kg	68 UJ	55 UJ	65 U	50 U	54 U	49 U	53 U	47 U	57 U	51 U	51 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	21 U	17 U	20 U	16 U	17 U	15 U	17 U	15 U	18 U	16 U	16 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	62 UJ	50 UJ	59 UJ	45 UJ	49 UJ	**210** J	48 UJ	43 UJ	52 UJ	46 U	46 U
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	12 U	9.5 U	11 U	8.7 U	9.4 U	8.5 U	9.1 U	8.1 U	9.8 U	8.8 U	8.9 U
VOC	METHYL METHACRYLATE	µg/Kg	68 U	55 U	65 U	50 U	54 U	49 U	53 U	47 U	57 U	51 U	51 U
VOC	METHYLACRYLONITRILE	µg/Kg	340 U	280 U	320 U	250 U	270 U	250 U	260 U	240 U	280 U	260 U	260 U
VOC	METHYLENE CHLORIDE	µg/Kg	33 U	26 U	31 U	24 U	26 U	24 U	25 U	23 U	27 U	25 U	25 U
VOC	PENTOCHLORETHANE	µg/Kg	14 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	12 U	12 U	14 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	68 UJ	55 UJ	65 UJ	50 UJ	54 UJ	49 UJ	53 UJ	47 UJ	57 UJ	51 UJ	51 UJ
VOC	STYRENE	µg/Kg	10 U	8.4 U	9.8 U	7.6 U	8.3 U	7.5 U	8 U	7.1 U	8.7 U	7.8 U	7.8 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	13 U	11 U	12 U	9.6 U	10 U	9.4 U	10 U	9 U	11 U	9.8 U	9.8 U
VOC	TOLUENE	µg/Kg	**290** J	**210** J	36 UJ	28 UJ	30 UJ	27 UJ	29 UJ	26 UJ	**1000** J	28 UJ	28 U
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	11 U	9 U	11 U	8.2 U	8.9 U	8.1 U	8.7 U	7.7 U	9.3 U	8.4 U	8.4 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	9.7 U	7.7 U	9.1 U	7.1 U	7.7 U	6.9 U	7.5 UJ	6.6 U	8 U	7.2 U	7.2 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	49 U	40 U	47 U	36 U	39 U	35 U	38 U	34 U	41 U	37 U	37 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	12 U	9.7 U	12 U	8.9 U	9.6 U	8.7 U	9.4 U	8.3 U	10 U	9 U	9.1 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	17 U	14 U	16 U	13 U	14 U	12 U	13 U	12 U	14 U	13 U	13 U
VOC	VINYL ACETATE	µg/Kg	67 U	54 U	63 U	49 U	53 U	48 U	52 U	46 U	56 U	50 U	50 U
VOC	VINYL CHLORIDE	µg/Kg	24 U	19 U	23 U	18 U	19 UJ	17 U	19 UJ	17 U	20 U	18 U	18 U
VOC	XYLENES, TOTAL	µg/Kg	39 U	31 U	37 U	29 U	31 U	**190**	**210**	27 U	**230**	29 U	29 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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			2823-2	3374-1	3374-2	3672-1	3672-2	4460-1	4460-2	4507-1	4507-2	4528-1	4528-2
			MidBlind_2823-2	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3672-1	MidBlind_3672-2	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1	MidBlind_4528-2
			11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	**65** J	**170**	**170**	**65** J	**38** J	**96** J	**47** J	**100** J	**89** J	0.0066 U	0.0066 U
GEN	SULFIDE	mg/kg	100 U	93 U	89 U	100 U	100 U	96 U	93 U	94 U	94 U	88 U	88 U
GEN	TOTAL ORGANIC CARBON	mg/kg	**17000**	**20000**	**7600**	**31000**	73 U	**43000**	**41000**	**18000**	**21000**	**7300**	**5400**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.6 UJ	2.3 U	2.2 U	2.6 U	2.6 U	2.4 U	2.3 U	2.3 U	2.4 U	2.2 U	2.2 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	2.2 UJ	1.9 UJ	1.9 UJ	2.1 U	2.1 U	2 U	1.9 U	1.9 U	2 U	1.8 U	1.8 U
HERB	DINOSEB	µg/Kg	68 UJ	60 U	58 U	68 UJ	67 UJ	63 U	60 U	61 UJ	62 UJ	58 UJ	58 UJ
HERB	SILVEX (2,4,5-TP)	µg/Kg	2.3 UJ	2 U	2 U	2.3 U	2.2 U	2.1 U	2 U	2 U	2.1 U	1.9 U	1.9 U
MET	ANTIMONY	µg/Kg	1100 U	220 U	210 U	310 U	520 U	**250** J	220 U	1100 U	1100 U	210 U	210 U
MET	ARSENIC	µg/Kg	**4500**	**1600**	**1700**	**5600**	**5900**	**7900**	**12000**	**2100**	**2200**	**2900**	**2000**
MET	BARIUM	µg/Kg	**39000**	**33000**	**35000**	**40000**	**44000**	**41000**	**37000**	**32000**	**36000**	**13000**	**10000**
MET	BERYLLIUM	µg/Kg	**310**	**210** J	**220**	**340**	**370**	**230** J	**190** J	**220** J	**280**	**73** J	**54** J
MET	CADMIUM	µg/Kg	340 U	**180** J	**140** J	**340**	**340**	**290**	**310**	200 U	250 U	**110** J	**88** J
MET	CHROMIUM, TOTAL	µg/Kg	**5800**	**6400**	**6000**	**5700**	**6300**	**3500**	**3900**	**5700**	**7000**	**1000**	**780**
MET	COBALT	µg/Kg	**2600**	**2400**	**2400**	**2000**	**2200**	**1100**	**1500**	**1700**	**2000**	**520**	**400** J
MET	COPPER	µg/Kg	**19000**	**11000**	**11000**	**17000**	**18000**	**17000**	**22000**	**6900**	**7800**	**9100**	**7100**
MET	LEAD	µg/Kg	**14000**	**32000**	**20000**	**28000**	**30000**	**120000**	**75000**	**15000**	**17000**	**7000**	**4700**
MET	MERCURY	µg/Kg	**28**	**40**	**32**	**44**	**42**	**61**	**75**	**36**	**36**	3.9 U	4 U
MET	NICKEL	µg/Kg	**6100**	**7100**	**7200**	**6400**	**6700**	**4400**	**7600**	**4800**	**5700**	**1700**	**1800**
MET	SELENIUM	µg/Kg	550 U	480 U	470 U	550 U	**1200**	510 U	490 U	490 U	500 U	470 U	470 U
MET	SILVER	µg/Kg	61 U	54 U	53 U	61 U	60 U	56 U	54 U	55 U	56 U	52 U	52 U
MET	THALLIUM	µg/Kg	220 U	200 U	190 U	220 U	220 U	200 U	200 U	200 U	200 U	190 U	190 U
MET	TIN	µg/Kg	580 U	510 U	500 U	580 U	570 U	**1700** J	**30000**	520 U	**3700** J	500 U	500 U
MET	VANADIUM	µg/Kg	**12000**	**10000**	**11000**	**11000**	**12000**	**4500**	**5200**	**8500**	**11000**	**3000**	**2300**
MET	ZINC	µg/Kg	**97000**	**37000**	**29000**	**31000**	**32000**	**49000**	**40000**	60 U	60 U	**13000**	**7400**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	7 U	6.2 U	5.9 U	6.9 U	6.8 U	13 U	62 U	6.3 U	6.3 U	5.9 U	5.8 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	12 U	11 U	10 U	12 U	12 U	22 U	110 U	11 U	11 U	10 U	10 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	13 U	12 U	11 U	13 U	13 U	24 U	120 U	12 U	12 U	11 U	11 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	15 U	14 U	13 U	15 U	15 U	28 U	140 U	14 U	14 U	13 U	13 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	10 U	9 U	8.6 U	10 U	9.8 U	19 U	91 U	9.2 U	9.2 U	8.6 U	8.5 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	8.4 U	7.5 U	7.2 U	8.3 U	8.2 U	16 U	75 U	7.6 U	7.6 U	7.2 U	7.1 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	7 U	6.2 U	6 U	7 U	6.8 U	13 U	63 U	6.4 U	6.4 U	6 U	5.9 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	9.3 U	8.2 U	7.9 U	9.2 U	9 U	17 U	83 U	8.4 U	8.4 U	7.9 U	7.8 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	13 U	11 U	11 U	12 U	12 U	23 U	110 U	11 U	11 U	11 U	11 U
PCB	SUMMED PCB	µg/Kg	**47**	**42**	**40**	**47**	**46**	**87**	**420**	**43**	**43**	**40**	**40**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	49 U	40 U	50 U	98 U	46 U	54 U	53 U	45 U	48 U	41 U	43 U
PEST	4,4'-DDD	µg/Kg	0.75 U	**0.92** J	**1** J	**1.1** J	**3.2** J	1.4 U	**39** J	0.68 U	0.68 U	0.64 U	0.63 U
PEST	4,4'-DDE	µg/Kg	**2** J	**11** J	**6.6** J	**7.1** J	**9.1** J	**18** J	**520**	**4.7** J	**4.8** J	0.86 U	0.85 U
PEST	4,4'-DDT	µg/Kg	**2.8** J	**8.3** J	**7.4** J	**3.7** J	**4** J	2.1 U	**170** J	**4.1** J	**4** J	0.97 U	0.96 U
PEST	ALDRIN	µg/Kg	0.78 U	0.69 U	0.66 U	0.77 U	0.75 U	1.4 U	7 U	**0.8** J	**0.86** J	0.66 U	0.65 U
PEST	ALPHA BHC	µg/Kg	0.99 U	0.87 U	0.84 U	0.98 U	0.96 U	1.8 U	8.8 U	0.89 U	0.89 U	0.84 U	0.83 U
PEST	BETA BHC	µg/Kg	1.1 U	0.94 U	0.91 U	1.1 U	1 U	2 U	9.5 U	0.96 U	0.97 U	0.9 U	0.89 U
PEST	CHLORDANE	µg/Kg	1 U	0.92 U	0.88 U	1 U	1 U	**300**	9.3 U	0.94 U	0.94 U	0.88 U	0.87 U
PEST	DELTA BHC	µg/Kg	0.96 U	0.85 U	0.82 U	0.95 U	**1** J	1.8 U	8.6 U	0.87 U	0.87 U	0.82 U	0.81 U
PEST	DIELDRIN	µg/Kg	0.78 U	0.69 U	0.66 U	0.77 U	0.75 U	**2** J	7 U	0.7 U	0.71 U	0.66 U	0.65 U
PEST	DIMETHOATE	µg/Kg	66 U	58 U	57 U	66 U	65 U	61 U	59 U	60 U	61 U	57 U	57 U
PEST	DISULFOTON	µg/Kg	11 U	9.8 U	9.5 U	11 U	11 U	10 U	9.9 U	10 U	10 U	9.5 U	9.5 U
PEST	ENDOSULFAN I	µg/Kg	0.6 U	0.53 U	0.51 U	0.59 U	0.58 U	1.1 U	5.4 U	0.54 U	0.54 U	0.51 U	0.5 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			2823-2	3374-1	3374-2	3672-1	3672-2	4460-1	4460-2	4507-1	4507-2	4528-1	4528-2
			MidBlind_2823-2	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3672-1	MidBlind_3672-2	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1	MidBlind_4528-2
			11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	0.65 U	0.57 U	0.55 U	0.64 U	0.63 U	**6.5** J	5.8 U	0.59 U	0.59 U	0.55 U	0.54 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**0.62**	**0.55**	**0.53**	**0.62**	**0.6**	**7**	**5.6**	**0.56**	**0.56**	**0.53**	**0.52**
PEST	ENDOSULFAN SULFATE	µg/Kg	0.94 U	0.83 U	0.8 U	0.93 U	0.91 U	**27** J	8.4 U	0.84 U	0.85 U	0.79 U	0.78 U
PEST	ENDRIN	µg/Kg	0.95 U	0.84 U	0.81 U	0.94 U	0.92 U	1.8 U	8.5 U	0.86 U	0.86 U	0.81 U	0.79 U
PEST	ENDRIN ALDEHYDE	µg/Kg	0.97 U	0.86 U	0.83 U	0.96 U	0.94 U	1.8 U	8.7 U	0.88 U	0.88 U	0.83 U	0.82 U
PEST	FAMPHUR	µg/Kg	36 UJ	32 UJ	31 UJ	36 UJ	36 UJ	33 UJ	32 UJ	33 UJ	33 UJ	31 UJ	31 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	0.75 U	0.67 U	0.64 U	0.75 U	0.73 U	1.4 U	6.7 U	0.68 U	0.68 U	0.64 U	0.63 U
PEST	HEPTACHLOR	µg/Kg	0.78 U	0.69 U	0.66 U	0.77 U	0.75 U	1.4 U	7 U	0.7 U	0.71 U	0.66 U	0.65 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	1.1 U	**1.1** J	0.92 U	1.1 U	1 U	**8.1** J	9.7 U	0.97 U	0.98 U	0.92 U	0.9 U
PEST	KEPONE	µg/Kg	2100 U	1900 U	1800 U	2100 U	2100 U	2000 U	1900 U	1900 U	2000 U	1800 U	1800 U
PEST	METHOXYCHLOR	µg/Kg	1.3 U	1.2 U	1.1 U	1.3 U	**2.9** J	2.4 U	12 U	1.2 U	1.2 U	1.1 U	1.1 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	12 U	11 U	10 U	12 U	12 U	11 U	11 U	11 U	11 U	10 U	10 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	22 U	20 U	19 U	22 U	22 U	20 U	20 U	20 U	20 U	19 U	19 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	22 U	19 U	19 U	22 U	22 U	20 U	19 U	20 U	20 U	19 U	19 U
PEST	PARATHION, METHYL	µg/Kg	14 U	13 U	12 U	14 U	14 U	13 U	13 U	13 U	13 U	12 U	12 U
PEST	PHORATE	µg/Kg	11 UJ	9.9 U	9.6 U	11 UJ	11 UJ	10 U	10 U	10 UJ	10 UJ	9.6 UJ	9.6 UJ
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	850 U	750 U	730 U	850 U	840 U	790 U	760 U	770 U	780 U	730 U	730 U
PEST	TOXAPHENE	µg/Kg	12 U	11 U	10 U	12 U	12 U	22 U	110 U	11 U	11 U	10 U	10 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	10 U	9 U	8.8 U	10 U	10 U	9.5 U	9.2 U	9.3 U	9.4 U	8.8 U	8.8 U
SVOC	1,3-DINITROBENZENE	µg/Kg	9.5 U	8.4 U	8.2 U	9.5 U	9.4 U	8.8 U	8.5 U	8.6 U	8.7 U	8.2 U	8.2 U
SVOC	1,4-DIOXANE	µg/Kg	430 UJ	380 U	370 U	430 UJ	420 UJ	390 U	380 U	390 UJ	390 UJ	370 UJ	370 UJ
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	14 UJ	13 U	12 U	14 UJ	14 UJ	13 U	13 U	13 UJ	13 UJ	12 UJ	12 UJ
SVOC	1-NAPHTHYLAMINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	42 U	37 U	36 U	42 U	41 U	39 U	37 U	38 U	38 U	36 U	36 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	17 U	15 U	15 U	17 U	17 U	16 U	16 U	16 U	16 U	15 U	15 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	9.7 U	8.5 U	8.3 U	9.7 U	9.5 U	8.9 U	8.6 U	8.7 U	8.8 U	8.3 U	8.3 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	7.4 U	6.5 U	6.3 U	7.4 U	7.3 U	6.8 U	6.6 U	6.7 U	6.7 U	6.3 U	6.3 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	32 U	28 U	27 U	32 U	32 U	30 U	29 U	29 U	29 U	27 U	27 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	70 U	62 U	60 U	70 U	69 U	65 U	63 U	64 U	64 U	60 U	60 U
SVOC	2,4-DINITROPHENOL	µg/Kg	25 UJ	22 U	21 U	25 UJ	24 UJ	23 U	22 U	22 UJ	22 UJ	21 UJ	21 UJ
SVOC	2,4-DINITROTOLUENE	µg/Kg	35 U	31 U	30 U	35 U	34 U	32 U	31 U	31 U	32 U	30 U	30 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	17 U	15 U	15 U	17 U	17 U	16 U	15 U	16 U	16 U	15 U	15 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	7.4 U	6.5 U	6.3 U	7.4 U	7.3 U	6.8 U	6.6 U	6.7 U	6.7 U	6.3 U	6.3 U
SVOC	2-Acetylaminofluorene	µg/Kg	17 U	15 U	14 U	17 U	16 U	15 U	15 U	15 U	15 U	14 U	14 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	31 U	28 U	27 U	31 U	31 U	29 U	28 U	28 U	29 U	27 U	27 U
SVOC	2-CHLOROPHENOL	µg/Kg	32 U	28 U	27 U	32 U	32 U	30 U	29 U	29 U	29 U	27 U	27 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	9.2 U	8.1 U	7.9 U	9.2 U	9.1 U	**12** J	**16** J	8.3 U	8.4 U	7.9 U	7.9 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	22 U	19 U	19 U	22 U	21 U	20 U	19 U	20 U	20 U	19 U	19 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	2-NITROANILINE	µg/Kg	9.7 U	8.6 U	8.4 U	9.7 U	9.6 U	9 U	8.7 U	8.8 U	8.9 U	8.4 U	8.4 U
SVOC	2-NITROPHENOL	µg/Kg	12 U	11 U	11 U	12 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	12 U	11 U	11 U	12 U	12 U	12 U	11 U	11 U	11 U	11 U	11 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	72 U	64 U	62 U	72 U	71 U	67 U	64 U	65 U	66 U	62 U	62 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	23 U	20 U	19 U	23 U	22 U	21 U	20 U	20 U	21 U	19 U	19 U

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UJ = Undetected; Estimated detection limit
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			MidBlind_2823-2	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3672-1	MidBlind_3672-2	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1	MidBlind_4528-2
			11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	8.5 U	7.5 U	7.3 U	8.5 U	8.4 U	7.9 U	7.6 U	7.7 U	7.8 U	7.3 U	7.3 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	16 U	14 U	14 U	16 U	16 U	15 U	14 U	15 U	15 U	14 U	14 U
SVOC	4-AMINOBIPHENYL	µg/Kg	12 U	11 U	10 U	12 U	12 U	11 U	11 U	11 U	11 U	10 U	10 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	16 U	14 U	14 U	16 U	16 U	15 U	14 U	14 U	15 U	14 U	14 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	13 U	11 U	11 U	13 U	13 U	12 U	11 U	12 U	12 U	11 U	11 U
SVOC	4-CHLOROANILINE	µg/Kg	53 U	46 U	45 U	53 U	52 U	49 U	47 U	48 U	48 U	45 U	45 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	6 U	5.3 U	5.1 U	6 U	5.9 U	5.6 U	5.4 U	5.4 U	5.5 U	5.1 U	5.1 U
SVOC	4-NITROANILINE	µg/Kg	50 U	44 U	43 U	50 U	49 U	46 U	44 U	45 U	46 U	43 U	43 U
SVOC	4-NITROPHENOL	µg/Kg	11 U	9.4 U	9.1 U	11 U	11 U	9.9 U	9.5 U	9.7 U	9.8 U	9.1 U	9.1 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	10 U	9.1 U	8.9 U	10 U	10 U	9.6 U	9.2 U	9.4 U	9.5 U	8.9 U	8.9 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	14 U	12 U	12 U	14 U	13 U	13 U	12 U	12 U	12 U	12 U	12 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	17 U	15 U	14 U	17 U	16 U	15 U	15 U	15 U	15 U	14 U	14 U
SVOC	ACENAPHTHENE	µg/Kg	9.2 U	8.1 UJ	7.9 UJ	9.2 U	9.1 U	8.5 UJ	8.2 UJ	8.3 U	8.4 U	7.9 U	7.9 U
SVOC	ACENAPHTHYLENE	µg/Kg	9.3 U	8.2 U	8 U	9.3 U	9.2 U	8.6 U	8.3 U	8.4 U	8.5 U	8 U	8 U
SVOC	ACETOPHENONE	µg/Kg	11 U	9.3 U	9 U	11 U	10 U	9.8 U	9.4 U	9.6 U	9.7 U	9.1 U	9 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	ANILINE	µg/Kg	55 U	49 U	47 U	55 U	54 U	51 U	49 U	50 U	50 U	47 U	47 U
SVOC	ANTHRACENE	µg/Kg	6.4 U	5.6 U	5.5 U	6.4 U	6.3 U	**14** J	**23** J	**8.2** J	5.9 U	5.5 U	5.5 U
SVOC	ARAMITE (TOTAL)	µg/Kg	88 U	78 U	76 U	88 U	87 U	82 U	79 U	80 U	81 U	76 U	76 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	7.5 U	6.6 U	6.5 U	7.5 U	7.4 U	7 U	**160** J	6.8 U	6.9 U	6.5 U	6.5 U
SVOC	BENZO(A)PYRENE	µg/Kg	**18** J	**28** J	8.7 UJ	**78** J	**62** J	9.4 UJ	**170** J	**40** J	**24** J	8.7 U	**9.8** J
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**44** J	**75** J	**60** J	**110** J	**110** J	**170** J	**250** J	**69** J	**61** J	**34** J	**27** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**42** J	**170** J	**150** J	**120** J	**87** J	**210** J	**270** J	**51** J	**45** J	**39** J	**35** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	12 U	**56** J	**51** J	**34** J	**28** J	**92** J	**140** J	**27** J	**14** J	9.9 U	9.9 U
SVOC	BENZYL ALCOHOL	µg/Kg	9.3 U	8.2 U	8 U	9.3 U	9.2 U	8.6 U	8.3 U	8.5 U	8.6 U	8 U	8 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	9.8 UJ	8.7 U	8.4 U	9.8 U	9.7 U	9.1 U	8.7 U	**11** J	9 U	8.4 U	8.4 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	6.6 U	5.8 U	5.7 U	6.6 U	6.5 U	6.1 U	5.9 U	6 U	6.1 U	5.7 U	5.7 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	46 U	41 U	40 U	46 U	46 U	43 U	41 U	42 U	42 U	40 U	40 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	**63** J	**49** J	**44** J	**33** J	**38** J	**49** J	**62** J	**97** J	**86** J	17 U	17 U
SVOC	CHLOROBENZILATE	µg/Kg	24 U	21 U	21 U	24 U	24 U	22 U	22 U	22 U	22 U	21 U	21 U
SVOC	CHRYSENE	µg/Kg	14 U	**45** J	**38** J	**25** J	**25** J	**110** J	**180** J	12 U	12 U	12 U	12 U
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	8.6 U	7.6 U	**34** J	8.6 U	8.5 U	7.9 U	**11** J	7.8 U	7.8 U	7.3 U	7.3 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8.9 UJ	7.9 U	7.7 U	8.9 U	8.8 U	8.3 U	8 U	8.1 UJ	8.2 UJ	7.7 U	7.7 U
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	36 U	31 U	31 U	36 U	35 U	33 U	32 U	32 U	33 U	31 U	31 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	40 U	35 U	34 U	40 U	39 U	**44** J	**66** J	36 U	36 U	34 U	34 U
SVOC	DIBENZOFURAN	µg/Kg	5.5 U	4.8 U	4.7 U	5.5 U	5.4 U	5.1 U	4.9 U	5 U	5 U	4.7 U	4.7 U
SVOC	DIETHYL PHTHALATE	µg/Kg	7 U	6.2 U	6 U	7 U	6.9 U	6.5 U	6.2 U	6.3 U	6.4 U	6 U	6 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	25 U	22 U	22 U	25 U	25 U	23 U	23 U	23 U	23 U	22 U	22 U
SVOC	DIPHENYLAMINE	µg/Kg	35 U	31 U	30 U	35 U	34 U	32 U	31 U	31 U	32 U	30 U	30 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	15 U	14 U	13 U	15 U	15 U	14 U	14 U	14 U	14 U	13 U	13 U
SVOC	FLUORANTHENE	µg/Kg	**22** J	**41** J	**31** J	**120** J	**77** J	**140** J	**220** J	**70** J	**38** J	**15** J	**14** J
SVOC	FLUORENE	µg/Kg	7.2 U	6.3 U	6.1 U	7.2 U	7.1 U	6.6 U	6.4 U	6.5 U	6.6 U	6.1 U	6.1 U
SVOC	HEXACHLOROBENZENE	µg/Kg	12 U	11 U	11 U	12 U	12 U	12 U	11 U	11 U	11 U	11 U	11 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	42 U	37 U	36 U	42 U	41 U	38 U	37 U	38 U	38 U	36 U	36 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	32 U	28 U	27 U	32 U	31 U	29 U	28 U	29 U	29 U	27 U	27 U
SVOC	HEXACHLOROETHANE	µg/Kg	57 U	50 U	49 U	57 U	56 U	53 U	51 U	51 U	52 U	49 U	49 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			2823-2	3374-1	3374-2	3672-1	3672-2	4460-1	4460-2	4507-1	4507-2	4528-1	4528-2
			MidBlind_2823-2	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3672-1	MidBlind_3672-2	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1	MidBlind_4528-2
			11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	850 UJ	750 UJ	730 UJ	850 UJ	840 UJ	790 UJ	760 UJ	770 UJ	780 UJ	730 UJ	730 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	57 U	50 U	49 U	57 U	56 U	52 U	51 U	51 U	52 U	49 U	49 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	29 UJ	**28** J	25 U	**85** J	29 UJ	**71** J	**130** J	27 UJ	27 UJ	25 UJ	25 UJ
SVOC	ISODRIN	µg/Kg	24 U	21 U	20 U	24 U	23 U	22 U	21 U	22 U	22 U	20 U	20 U
SVOC	ISOPHORONE	µg/Kg	5.9 U	5.2 U	5.1 U	5.9 U	5.9 U	5.5 U	5.3 U	5.4 U	5.4 U	5.1 U	5.1 U
SVOC	ISOSAFROLE	µg/Kg	21 U	18 U	18 U	21 U	20 U	19 U	18 U	19 U	19 U	18 U	18 U
SVOC	METHAPYRILENE	µg/Kg	50 U	44 U	43 U	50 U	49 U	46 U	44 U	45 U	45 U	43 U	42 U
SVOC	METHYL METHANESULFONATE	µg/Kg	24 U	21 U	21 U	24 U	24 U	22 U	22 U	22 U	22 U	21 U	21 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	12 U	11 U	11 U	12 U	12 U	12 U	11 U	11 U	11 U	11 U	11 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	9.7 U	8.5 U	8.3 U	9.7 U	9.5 U	8.9 U	8.6 U	8.7 U	8.8 U	8.3 U	8.3 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	22 U	20 U	19 U	22 U	22 U	21 U	20 U	20 U	21 U	19 U	19 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	51 U	45 UJ	44 UJ	51 U	51 U	47 UJ	46 UJ	46 U	47 U	44 U	44 U
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	14 U	12 U	12 U	14 U	14 U	13 U	13 U	13 U	13 U	12 U	12 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	19 U	17 U	17 U	19 U	19 U	18 U	17 U	17 U	18 U	17 U	17 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	23 U	20 U	20 U	23 U	22 U	21 U	20 U	21 U	21 U	20 U	20 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	14 U	12 U	12 U	14 U	14 U	13 U	12 U	13 U	13 U	12 U	12 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	NAPHTHALENE	µg/Kg	34 U	30 U	29 U	34 U	34 U	32 U	30 U	31 U	31 U	29 U	29 U
SVOC	NITROBENZENE	µg/Kg	44 U	39 U	38 U	44 U	43 U	41 U	39 U	40 U	40 U	38 U	38 U
SVOC	O-TOLUIDINE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	16 U	14 U	13 U	16 U	15 U	14 U	14 U	14 U	14 U	13 U	13 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	35 UJ	31 U	30 U	35 UJ	34 UJ	32 U	31 U	31 UJ	32 UJ	30 UJ	30 UJ
SVOC	PENTACHLOROBENZENE	µg/Kg	34 U	30 U	29 U	34 U	34 U	32 U	30 U	31 U	31 U	29 U	29 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	24 U	21 U	20 U	24 U	23 U	22 U	21 U	21 U	22 U	20 U	20 U
SVOC	PENTACHLOROPHENOL	µg/Kg	38 U	33 UJ	32 UJ	38 UJ	37 UJ	35 UJ	34 UJ	34 U	35 U	32 UJ	32 UJ
SVOC	PHENACETIN	µg/Kg	15 U	13 U	13 U	15 U	15 U	14 U	13 U	14 U	14 U	13 U	13 U
SVOC	PHENANTHRENE	µg/Kg	**16** J	**20** J	**18** J	**44** J	**39** J	**62** J	**84** J	**52** J	**18** J	5.7 U	5.7 U
SVOC	PHENOL	µg/Kg	8.8 U	7.8 UJ	7.6 UJ	8.8 U	8.7 U	8.2 UJ	7.9 UJ	8 U	8.1 U	7.6 U	7.6 U
SVOC	PRONAMIDE	µg/Kg	13 U	12 U	12 U	13 U	13 U	12 U	12 U	12 U	12 U	12 U	12 U
SVOC	PYRENE	µg/Kg	**39** J	**45** J	**28** J	**120** J	**120** J	**150** J	**290** J	**110** J	**60** J	**19** J	**24** J
SVOC	PYRIDINE	µg/Kg	64 U	56 UJ	54 UJ	64 U	63 U	59 UJ	57 UJ	58 U	58 U	54 U	54 U
SVOC	SAFROLE	µg/Kg	18 U	16 U	16 U	18 U	18 U	17 U	16 U	16 U	17 U	16 U	16 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	430 U	380 U	370 U	430 U	420 U	390 U	380 U	390 U	390 U	370 U	370 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	9.9 U	8.2 U	10 U	20 U	9.4 U	11 U	11 U	9.1 U	9.8 U	8.3 U	8.7 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	6.9 U	5.7 U	7.1 U	14 U	6.6 U	7.7 U	7.6 U	6.3 U	6.9 U	5.8 U	6.1 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	10 U	8.4 U	10 U	20 U	9.7 U	11 U	11 U	9.3 U	10 U	8.5 U	8.9 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	6.4 U	5.3 U	6.6 U	13 U	6.1 U	7.2 U	7 U	5.9 U	6.4 U	5.4 U	5.7 U
VOC	1,1-DICHLOROETHANE	µg/Kg	8.9 U	7.4 U	9.2 U	18 U	8.5 U	10 U	9.8 U	8.2 U	8.9 U	7.5 U	7.9 U
VOC	1,1-DICHLOROETHENE	µg/Kg	20 U	17 U	21 U	41 U	19 U	23 U	22 U	19 U	20 U	17 U	18 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	14 U	11 U	14 U	28 U	13 U	15 U	15 U	13 U	14 U	12 U	12 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	8.4 U	7 U	8.7 U	17 U	8 U	9.4 U	9.2 U	7.7 U	8.4 U	7.1 U	7.4 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	64 U	56 U	55 U	64 U	63 U	59 U	57 U	58 U	58 U	55 U	55 U
VOC	1,2-DICHLOROETHANE	µg/Kg	6.4 U	5.3 U	6.6 U	13 U	6.1 U	7.2 U	7 U	5.9 U	6.4 U	5.4 U	5.7 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	6.3 U	5.2 U	6.5 U	13 U	6 U	7 U	6.9 U	5.8 U	6.3 U	5.3 U	5.6 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	67 U	59 U	57 U	67 U	66 U	62 U	59 U	60 U	61 U	57 U	57 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	61 U	53 UJ	52 UJ	61 U	60 U	56 UJ	54 UJ	55 U	55 U	52 U	52 U
VOC	2-HEXANONE	µg/Kg	46 U	38 U	48 U	93 U	44 U	52 U	51 U	43 U	46 U	39 U	41 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			2823-2	3374-1	3374-2	3672-1	3672-2	4460-1	4460-2	4507-1	4507-2	4528-1	4528-2
			MidBlind_2823-2	MidBlind_3374-1	MidBlind_3374-2	MidBlind_3672-1	MidBlind_3672-2	MidBlind_4460-1	MidBlind_4460-2	MidBlind_4507-1	MidBlind_4507-2	MidBlind_4528-1	MidBlind_4528-2
			11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	21 UJ	17 U	22 U	**630** J	20 U	24 U	23 U	19 UJ	21 UJ	18 UJ	19 UJ
VOC	ACETONITRILE	µg/Kg	250 UJ	210 UJ	260 UJ	510 UJ	240 UJ	280 UJ	280 UJ	230 UJ	250 UJ	210 UJ	220 UJ
VOC	ACROLEIN	µg/Kg	130 UJ	110 UJ	140 UJ	270 U	130 U	150 UJ	140 UJ	120 UJ	130 UJ	110 U	120 U
VOC	ACRYLONITRILE	µg/Kg	40 U	33 U	41 U	81 U	38 U	45 U	44 U	37 U	40 U	34 U	35 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	56 U	47 U	58 U	110 U	54 U	63 U	61 U	51 U	56 U	47 U	50 U
VOC	BENZENE	µg/Kg	5.8 U	4.8 U	6 U	12 U	5.6 U	6.5 U	6.4 U	5.4 U	5.8 U	4.9 U	5.2 U
VOC	BROMODICHLOROMETHANE	µg/Kg	7.6 U	6.3 U	7.8 U	15 U	7.2 U	8.5 U	8.3 U	6.9 U	7.6 U	6.4 U	6.7 U
VOC	BROMOFORM	µg/Kg	9.5 U	7.9 U	9.8 U	19 U	9.1 U	11 U	10 U	8.7 U	9.5 U	8 U	8.4 U
VOC	BROMOMETHANE	µg/Kg	84 U	70 U	87 U	170 U	81 U	94 U	93 U	77 U	84 U	71 U	75 U
VOC	CARBON DISULFIDE	µg/Kg	6.1 U	5.1 U	6.3 U	12 U	5.8 U	6.8 U	6.7 U	5.6 U	6.1 U	5.2 U	5.4 U
VOC	CARBON TETRACHLORIDE	µg/Kg	6.7 U	5.6 U	6.9 U	14 U	6.4 U	7.5 U	7.4 U	6.2 U	6.7 U	5.7 U	6 U
VOC	CHLOROBENZENE	µg/Kg	9.3 U	7.7 U	9.5 U	19 U	8.9 U	10 U	10 U	8.5 U	9.2 U	7.8 U	8.2 U
VOC	CHLOROETHANE	µg/Kg	34 UJ	28 U	35 U	69 UJ	33 UJ	38 U	37 U	31 UJ	34 UJ	29 UJ	30 UJ
VOC	CHLOROFORM	µg/Kg	7.9 U	6.6 U	8.1 U	16 U	7.6 U	8.9 U	8.7 U	7.3 U	7.9 U	6.7 U	7 U
VOC	CHLOROMETHANE	µg/Kg	**110**	22 U	27 U	53 U	25 U	29 U	29 U	24 U	26 U	22 U	23 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	56 U	47 U	58 U	110 U	54 U	63 U	61 U	51 U	56 U	47 U	50 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	6.5 U	5.4 U	6.6 U	13 U	6.2 U	7.2 U	7.1 U	5.9 U	6.4 U	5.5 U	5.7 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	5.1 U	4.2 U	5.2 U	10 U	4.8 U	5.7 U	5.5 U	4.6 U	5 U	4.3 U	4.5 U
VOC	DIBROMOMETHANE	µg/Kg	8.8 U	7.3 U	9 U	18 U	8.4 U	9.8 U	9.6 U	8 U	8.7 U	7.4 U	7.7 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	20 U	17 U	21 U	41 U	20 U	23 U	22 U	19 U	20 U	17 UJ	18 UJ
VOC	ETHYL BENZENE	µg/Kg	12 U	9.6 UJ	12 UJ	23 U	11 U	13 UJ	13 UJ	11 U	12 U	9.8 U	10 U
VOC	ETHYL METHACRYLATE	µg/Kg	56 U	47 U	58 U	110 U	54 U	63 U	61 U	51 U	56 U	47 U	50 U
VOC	ISOBUTANOL	µg/Kg	56 UJ	47 U	58 UJ	110 UJ	54 UJ	63 UJ	61 UJ	51 UJ	56 UJ	47 UJ	50 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	18 U	15 U	18 U	35 U	17 U	20 U	19 U	16 U	18 U	15 U	16 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	51 U	42 UJ	52 UJ	100 U	49 U	57 UJ	56 UJ	47 U	51 U	43 U	45 U
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	9.7 U	8.1 U	10 U	20 U	9.3 U	11 U	11 U	8.9 U	9.7 U	8.2 U	8.6 U
VOC	METHYL METHACRYLATE	µg/Kg	56 U	47 U	58 U	110 U	54 U	63 U	61 U	51 U	56 U	47 U	50 U
VOC	METHYLACRYLONITRILE	µg/Kg	280 U	230 U	290 U	570 U	270 U	310 U	310 U	260 U	280 U	240 UJ	250 UJ
VOC	METHYLENE CHLORIDE	µg/Kg	27 U	22 U	28 U	54 U	26 U	30 U	29 U	25 U	27 U	23 U	24 U
VOC	PENTOCHLORETHANE	µg/Kg	14 U	13 U	12 U	14 U	14 U	13 U	13 U	13 U	13 U	12 U	12 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	56 UJ	47 UJ	58 UJ	110 UJ	54 UJ	63 UJ	61 UJ	51 UJ	56 UJ	**510** J	50 UJ
VOC	STYRENE	µg/Kg	8.5 U	7.1 U	8.8 U	17 U	8.2 U	9.5 U	9.3 U	7.8 U	8.5 U	7.2 U	7.5 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	11 U	8.9 U	11 U	22 U	10 U	12 U	12 U	9.9 U	11 U	9.1 U	9.5 U
VOC	TOLUENE	µg/Kg	**1600**	26 UJ	**1600** J	**1500**	**720**	35 UJ	34 UJ	28 U	**4300**	**160**	**7000**
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	9.2 U	7.6 U	9.5 U	19 U	8.8 U	10 U	10 U	8.4 U	9.2 U	7.8 U	8.1 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	7.9 U	6.6 U	8.1 U	16 U	7.6 U	8.9 U	8.7 U	7.3 U	7.9 U	6.7 U	7 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	41 U	34 U	42 U	82 U	39 U	45 U	44 U	37 U	40 U	34 U	36 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	9.9 U	8.2 U	10 U	20 U	9.5 U	11 U	11 U	9.1 U	9.9 U	8.4 U	8.8 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	14 U	12 U	15 U	29 U	14 U	16 U	16 U	13 U	14 U	12 U	13 U
VOC	VINYL ACETATE	µg/Kg	55 U	46 U	57 U	110 U	53 U	61 U	60 U	50 U	55 U	46 U	49 U
VOC	VINYL CHLORIDE	µg/Kg	20 U	16 U	20 U	40 U	19 U	22 U	22 U	18 U	20 U	17 U	17 U
VOC	XYLENES, TOTAL	µg/Kg	32 U	**190**	33 U	65 U	31 U	**330**	**340**	29 U	32 U	27 U	28 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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			4995-1	4995-2	5338-1	5338-2	5583-1	5583-2	5620-1	5620-1-C	5620-2	5620-2-C	5685-1
			MidBlind_4995-1	MidBlind_4995-2	MidBlind_5338-1	MidBlind_5338-2	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1	MidBlind_5620-1-C	MidBlind_5620-2	MidBlind_5620-2-C	MidBlind_5685-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	0.0069 U	**42** J	**98** J	**130**	**310**	**140** J	**91** J	**79** J	**260**	**77** J	**58** J
GEN	SULFIDE	mg/kg	92 U	230 U	98 U	96 U	100 U	96 U	97 U	97 U	96 U	95 U	**100**
GEN	TOTAL ORGANIC CARBON	mg/kg	**14000**	**12000**	**23000**	**25000**	**32000**	**2300**	**39000**	**35000**	**39000**	**47000**	**30000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.3 U	5.6 U	2.5 U	2.4 U	2.5 U	2.4 U	2.5 U	2.4 U	2.4 U	2.4 U	2.6 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	1.9 U	4.6 U	2 UJ	2 UJ	2.1 U	2 U	2 U	2 U	2 U	2 U	2.1 U
HERB	DINOSEB	µg/Kg	61 U	150 U	64 U	63 U	67 UJ	63 UJ	63 U	62 U	63 U	61 U	67 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2 U	4.9 U	2.1 U	2.1 U	2.2 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.3 U
MET	ANTIMONY	µg/Kg	430 U	540 U	**4500**	230 U	830 U	440 U	980 U	1100 U	1200 U	1500 U	820 U
MET	ARSENIC	µg/Kg	**1800**	**3200**	**4800**	**5700**	**3500**	**5300**	**12000**	**11000**	**13000**	**13000**	**3500**
MET	BARIUM	µg/Kg	**24000**	**65000**	**53000**	**51000**	**46000**	**42000**	**84000**	**76000**	**100000**	**70000**	**34000**
MET	BERYLLIUM	µg/Kg	**170** J	**490** J	**280**	**300**	**420**	**360**	**490**	**490**	**450**	**540**	**250** J
MET	CADMIUM	µg/Kg	**66** J	35 U	**220** J	**220** J	**120** J	**110** J	950 U	750 U	890 U	860 U	**270**
MET	CHROMIUM, TOTAL	µg/Kg	**4300**	**18000**	**6800**	**6600**	**11000**	**9100**	**4600**	**4700**	**4400**	**3900**	**5700**
MET	COBALT	µg/Kg	**1400**	**3600**	**3100**	**3200**	**5100**	**4500**	**2500**	**2600**	**2200**	**2500**	**1900**
MET	COPPER	µg/Kg	**8500**	**37000**	**24000**	**13000**	**15000**	**14000**	**27000**	**25000**	**30000**	**29000**	**13000**
MET	LEAD	µg/Kg	**7900**	**23000**	**670000**	**45000**	**13000**	**13000**	**210000**	**150000**	**180000**	**130000**	**41000**
MET	MERCURY	µg/Kg	**22**	**58**	**52**	**57**	**32**	4.3 U	**93**	**110**	**97**	**100**	**39**
MET	NICKEL	µg/Kg	**4000**	**13000**	**8000**	**8900**	**14000**	**12000**	**7100**	**7100**	**6600**	**7500**	**6200**
MET	SELENIUM	µg/Kg	490 U	1200 U	520 U	510 U	540 U	510 U	510 U	510 U	510 U	500 U	540 U
MET	SILVER	µg/Kg	54 U	130 U	58 U	56 U	60 U	57 U	57 U	57 U	56 U	55 U	60 U
MET	THALLIUM	µg/Kg	200 U	480 U	210 U	200 U	220 U	200 U	210 U	210 U	200 U	200 U	220 U
MET	TIN	µg/Kg	520 U	1300 U	**160000**	**540** J	570 U	540 U	**1600** J	**1800** J	**980** J	**1100** J	**630** J
MET	VANADIUM	µg/Kg	**8500**	**21000**	**11000**	**11000**	**18000**	**17000**	**11000**	**12000**	**11000**	**13000**	**8100**
MET	ZINC	µg/Kg	**18000**	**57000**	**67000**	**55000**	**41000**	**36000**	**180000**	**140000**	**160000**	**150000**	**55000**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	12 U	15 U	6.5 U	6.5 U	6.8 U	6.5 U	64 U	65 U	63 U	63 U	6.9 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	21 U	26 U	11 U	11 U	12 U	11 U	110 U	110 U	110 U	110 U	12 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	23 U	28 U	12 U	12 U	13 U	12 U	120 U	120 U	120 U	120 U	13 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	27 U	33 U	14 U	14 U	15 U	14 U	140 U	140 U	140 U	140 U	15 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	18 U	22 U	9.5 U	9.4 U	9.8 U	9.4 U	94 U	94 U	92 U	91 U	10 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	15 U	18 U	7.9 U	7.8 U	8.2 U	7.8 U	78 U	78 U	77 U	76 U	8.3 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	12 U	15 U	6.6 U	6.5 U	6.8 U	6.5 U	65 U	65 U	64 U	63 U	6.9 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	16 U	20 U	8.7 U	8.6 U	9 U	8.6 U	86 U	86 U	84 U	83 U	9.2 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	22 U	27 U	12 U	12 U	12 U	12 U	120 U	120 U	110 U	110 U	12 U
PCB	SUMMED PCB	µg/Kg	**83**	**100**	**44**	**44**	**46**	**44**	**440**	**440**	**430**	**420**	**47**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	51 U	130 U	54 U	42 U	48 U	39 U	44 U	49 U	53 U	74 U	49 U
PEST	4,4'-DDD	µg/Kg	**7** J	**3** J	**3.1** J	**1.6** J	0.73 U	**1.2** J	**58** J	**72** J	**89** J	**61** J	**4.1** J
PEST	4,4'-DDE	µg/Kg	**31** J	**82** J	**18** J	**24**	**2.4** J	**4.6** J	**430**	**540**	**740**	**520**	1 U
PEST	4,4'-DDT	µg/Kg	**4.2** J	**14** J	**10** J	**12** J	1.1 U	1.1 U	**450**	**580**	**720** J	**510** J	1.1 U
PEST	ALDRIN	µg/Kg	1.4 U	1.7 U	0.73 U	0.72 U	0.75 U	0.72 U	7.2 U	7.2 U	7.1 U	7 U	0.77 U
PEST	ALPHA BHC	µg/Kg	1.7 U	2.1 U	0.92 U	0.92 U	0.96 U	0.91 U	9.1 U	9.2 U	9 U	8.9 U	0.97 U
PEST	BETA BHC	µg/Kg	1.9 U	2.3 U	0.99 U	0.99 U	1 U	0.99 U	9.8 U	9.9 U	9.7 U	9.6 U	1.1 U
PEST	CHLORDANE	µg/Kg	**150**	**300**	0.97 U	0.96 U	1 U	0.96 U	9.6 U	9.7 U	9.5 U	9.3 U	1 U
PEST	DELTA BHC	µg/Kg	1.7 U	2.1 U	0.9 U	0.89 U	0.93 U	0.89 U	8.9 U	8.9 U	8.7 U	8.6 U	0.95 U
PEST	DIELDRIN	µg/Kg	1.4 U	1.7 U	**7.2** J	**7.3** J	0.75 U	0.72 U	7.2 U	7.2 U	7.1 U	7 U	0.77 U
PEST	DIMETHOATE	µg/Kg	59 U	140 U	62 U	62 U	65 U	62 U	62 U	61 U	61 U	60 U	66 U
PEST	DISULFOTON	µg/Kg	10 U	24 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U	10 U	11 U
PEST	ENDOSULFAN I	µg/Kg	1.1 U	1.3 U	0.56 U	0.55 U	0.58 U	0.55 U	5.5 U	5.6 U	5.4 U	5.4 U	0.59 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			4995-1	4995-2	5338-1	5338-2	5583-1	5583-2	5620-1	5620-1-C	5620-2	5620-2-C	5685-1
			MidBlind_4995-1	MidBlind_4995-2	MidBlind_5338-1	MidBlind_5338-2	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1	MidBlind_5620-1-C	MidBlind_5620-2	MidBlind_5620-2-C	MidBlind_5685-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	**1.5** J	**2.3** J	0.61 U	0.6 U	0.63 U	0.6 U	6 U	6 U	5.9 U	5.8 U	**0.79** J
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**2**	**2.9**	**0.58**	**0.58**	**0.6**	**0.58**	**5.8**	**5.8**	**5.7**	**5.6**	**1.1**
PEST	ENDOSULFAN SULFATE	µg/Kg	**19** J	**47** J	0.87 U	0.87 U	0.9 U	0.87 U	8.6 U	8.7 U	8.5 U	8.4 U	0.92 U
PEST	ENDRIN	µg/Kg	1.7 U	2 U	0.89 U	0.88 U	0.92 U	0.88 U	8.8 U	8.8 U	8.6 U	8.5 U	0.94 U
PEST	ENDRIN ALDEHYDE	µg/Kg	1.7 U	**9.9** J	0.91 U	0.9 U	0.94 U	0.9 U	9 U	9.1 U	8.9 U	8.7 U	0.96 U
PEST	FAMPHUR	µg/Kg	32 UJ	78 UJ	34 UJ	34 UJ	36 UJ	34 UJ	34 UJ	33 UJ	33 UJ	33 UJ	36 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	1.3 U	1.6 U	0.7 U	0.7 U	0.73 U	0.7 U	7 U	7 U	6.9 U	6.8 U	0.74 U
PEST	HEPTACHLOR	µg/Kg	1.4 U	1.7 U	0.73 U	0.72 U	0.75 U	0.72 U	7.2 U	7.2 U	7.1 U	7 U	0.77 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	**6.7** J	**27** J	**2.2** J	**1.6** J	1 U	1 U	10 U	10 U	9.8 U	9.7 U	**14** J
PEST	KEPONE	µg/Kg	1900 U	4600 U	2000 U	2000 U	2100 U	2000 U	2000 U	2000 U	2000 U	1900 U	2100 U
PEST	METHOXYCHLOR	µg/Kg	2.3 U	2.8 U	1.2 U	1.2 U	1.3 U	1.2 U	12 U	**19** J	12 U	12 U	**8.1** J
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	11 U	26 U	11 U	11 U	12 U	11 U	11 U	11 U	11 U	11 U	12 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	20 U	48 U	21 U	21 U	22 U	21 U	21 U	20 U	21 U	20 U	22 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	20 U	47 U	21 U	20 U	22 U	20 U	21 U	20 U	20 U	20 U	22 U
PEST	PARATHION, METHYL	µg/Kg	13 U	31 U	14 U	14 U	14 U	14 U	14 U	13 U	13 U	13 U	14 U
PEST	PHORATE	µg/Kg	10 U	24 U	11 U	10 U	11 UJ	11 UJ	11 U	10 U	10 U	10 U	11 UJ
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	760 U	1800 U	800 U	790 U	840 U	800 U	800 U	780 U	790 U	770 U	850 U
PEST	TOXAPHENE	µg/Kg	22 U	26 U	11 U	11 U	12 U	11 U	110 U	110 U	110 U	110 U	12 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	9.2 U	22 U	9.6 U	9.6 U	10 U	9.6 U	9.6 U	9.4 U	9.5 U	9.3 U	10 U
SVOC	1,3-DINITROBENZENE	µg/Kg	8.5 U	21 U	9 U	8.9 U	9.4 U	8.9 U	8.9 U	8.8 U	8.8 U	8.6 U	9.5 U
SVOC	1,4-DIOXANE	µg/Kg	380 U	920 U	400 U	400 U	420 UJ	400 UJ	400 U	390 U	400 U	390 U	420 UJ
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	13 U	31 U	14 U	14 U	14 UJ	14 UJ	14 U	13 U	13 U	13 U	14 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	380 U	920 U	400 UJ	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	38 U	91 U	39 U	39 U	41 U	39 U	39 U	39 U	39 U	38 U	42 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	16 U	38 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	16 U	17 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	8.6 U	21 U	9.1 U	9 U	9.5 U	9 U	9.1 U	8.9 U	9 U	8.7 U	9.6 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	6.6 U	16 U	6.9 U	6.9 U	7.3 U	6.9 U	6.9 UJ	6.8 UJ	6.8 UJ	6.7 UJ	7.3 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	29 U	69 U	30 U	30 U	32 U	30 U	30 UJ	29 UJ	30 UJ	29 UJ	32 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	63 U	150 U	66 U	65 U	69 U	66 U	66 U	65 U	65 U	63 U	70 U
SVOC	2,4-DINITROPHENOL	µg/Kg	22 U	53 U	23 U	23 U	24 UJ	23 UJ	23 U	23 U	23 UJ	22 U	24 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	31 U	75 U	33 U	32 U	34 U	32 U	33 U	32 U	32 U	31 U	35 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	15 U	37 U	16 U	16 U	17 U	16 U	16 U	16 U	16 U	16 U	17 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	6.6 U	16 U	6.9 U	6.9 U	7.3 U	6.9 U	6.9 U	6.8 U	6.8 U	6.7 U	7.3 U
SVOC	2-Acetylaminofluorene	µg/Kg	15 U	36 U	16 U	16 U	16 U	16 U	16 U	15 U	15 U	15 U	17 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	28 U	67 U	29 U	29 U	31 U	29 U	29 U	29 U	29 U	28 U	31 U
SVOC	2-CHLOROPHENOL	µg/Kg	29 U	69 U	30 U	30 U	32 U	30 U	30 U	29 U	30 U	29 U	32 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	**13** J	**77** J	8.6 U	8.6 U	9.1 U	8.6 U	**25** J	**27** J	**28** J	**38** J	9.2 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	19 U	47 U	20 U	20 U	21 U	20 U	20 U	20 U	20 U	20 U	22 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	2-NITROANILINE	µg/Kg	8.7 U	21 U	9.2 U	9.1 U	9.6 U	9.1 U	9.1 U	9 U	9 U	8.8 U	9.7 U
SVOC	2-NITROPHENOL	µg/Kg	11 U	27 U	12 U	12 U	12 U	12 U	12 U	11 U	12 U	11 U	12 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	11 U	27 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	11 U	12 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	65 U	160 U	68 U	67 U	71 U	68 U	68 U	67 U	67 U	65 U	72 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	20 U	49 U	21 U	21 U	22 U	21 U	21 U	21 U	21 U	20 U	23 U

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U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
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			4995-1	4995-2	5338-1	5338-2	5583-1	5583-2	5620-1	5620-1-C	5620-2	5620-2-C	5685-1
			MidBlind_4995-1	MidBlind_4995-2	MidBlind_5338-1	MidBlind_5338-2	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1	MidBlind_5620-1-C	MidBlind_5620-2	MidBlind_5620-2-C	MidBlind_5685-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	7.6 U	18 U	8 U	7.9 U	8.4 U	7.9 U	8 U	7.8 U	7.9 U	7.7 U	8.5 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	14 U	35 U	15 U	15 U	16 U	15 U	15 U	15 U	15 U	15 U	16 U
SVOC	4-AMINOBIPHENYL	µg/Kg	11 U	26 U	12 U	11 U	12 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	14 U	34 U	15 U	15 U	16 U	15 U	15 U	15 U	15 U	14 U	16 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	12 U	28 U	12 U	12 U	13 U	12 U	12 U	12 U	12 U	12 U	13 U
SVOC	4-CHLOROANILINE	µg/Kg	47 U	110 U	50 U	49 U	52 U	49 U	49 U	48 U	49 U	48 U	52 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	5.4 U	13 U	5.6 U	5.6 U	5.9 U	5.6 U	5.6 U	5.5 U	5.6 U	5.4 U	6 U
SVOC	4-NITROANILINE	µg/Kg	45 U	110 U	47 U	46 U	49 U	47 U	47 U	46 U	46 U	45 U	50 U
SVOC	4-NITROPHENOL	µg/Kg	9.5 U	23 U	10 U	9.9 U	11 U	10 U	10 U	9.8 U	9.9 U	9.6 U	11 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	9.3 U	22 U	9.7 U	9.7 U	10 U	9.7 U	9.7 UJ	9.5 UJ	9.6 UJ	9.4 UJ	10 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	12 U	29 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	12 U	14 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	15 U	36 U	16 U	16 U	16 U	16 U	16 U	15 U	15 U	15 U	17 U
SVOC	ACENAPHTHENE	µg/Kg	8.2 UJ	20 UJ	8.6 UJ	8.6 UJ	9.1 U	8.6 U	8.6 U	8.5 U	8.5 U	8.3 U	9.2 U
SVOC	ACENAPHTHYLENE	µg/Kg	**130** J	**850** J	8.7 U	8.7 U	9.2 U	8.7 U	8.7 U	8.6 U	8.6 U	8.4 U	9.3 U
SVOC	ACETOPHENONE	µg/Kg	9.4 U	23 U	9.9 U	9.8 U	10 U	9.9 U	9.9 U	9.7 U	9.8 U	9.5 U	11 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	ANILINE	µg/Kg	49 U	120 U	52 U	51 U	54 U	52 U	52 U	51 U	51 U	50 U	55 U
SVOC	ANTHRACENE	µg/Kg	**65** J	**420** J	6 U	6 U	**31** J	**12** J	**41** J	**27** J	**23** J	**24** J	**9.2** J
SVOC	ARAMITE (TOTAL)	µg/Kg	79 U	190 U	83 U	82 U	87 U	82 U	83 U	81 U	82 U	80 U	88 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	6.7 U	16 U	7.1 U	7 U	7.4 U	7 U	**210** J	**170** J	7 U	**120** J	7.5 U
SVOC	BENZO(A)PYRENE	µg/Kg	**110** J	**380** J	9.5 UJ	9.4 UJ	**170** J	**98** J	**250** J	**180** J	**150** J	**120** J	**53** J
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**110** J	**450** J	**130** J	**110** J	**210** J	**130** J	**270** J	**240** J	**210** J	**170** J	**79** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**240** J	**860** J	**210** J	**200** J	**210** J	**110** J	**280** J	**220** J	**170** J	**140** J	**62** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	**69** J	**220** J	**73** J	**66** J	**60** J	**58** J	**120** J	**90** J	**84** J	**76** J	**39** J
SVOC	BENZYL ALCOHOL	µg/Kg	8.4 U	20 U	8.8 U	8.7 U	9.2 U	8.7 U	8.8 U	8.6 U	8.7 U	8.4 U	9.3 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	**9.6** J	21 U	**13** J	**19** J	9.7 U	9.2 U	9.2 U	**78** J	**80** J	**57** J	9.8 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	5.9 U	14 U	6.2 U	6.2 U	6.5 U	6.2 U	6.2 U	6.1 U	6.1 U	6 U	6.6 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	41 U	100 U	44 U	43 U	46 U	43 U	43 U	43 U	43 U	42 U	46 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	18 U	44 U	19 U	19 U	20 U	19 U	**120** J	**110** J	**90** J	**79** J	**150** J
SVOC	CHLOROBENZILATE	µg/Kg	22 U	52 U	23 U	23 U	24 U	23 U	23 U	22 U	22 U	22 U	24 U
SVOC	CHRYSENE	µg/Kg	**170** J	**930**	**83** J	**74** J	**120** J	**50** J	**250** J	**170** J	**130** J	**120** J	**19** J
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	7.7 U	19 U	8.1 U	8 U	8.5 U	8 U	**12** J	**17** J	**16** J	**27** J	8.5 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8 UJ	19 UJ	8.4 UJ	8.3 UJ	8.8 U	8.3 U	8.4 UJ	8.2 UJ	8.3 UJ	8.1 UJ	8.9 U
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	32 U	77 U	34 U	33 U	35 U	33 U	33 U	33 U	33 U	32 U	36 UJ
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	**72** J	**260** J	**38** J	**40** J	**47** J	37 U	37 U	**88** J	37 U	**66** J	40 U
SVOC	DIBENZOFURAN	µg/Kg	**8.5** J	**49** J	5.1 U	5.1 U	5.4 U	5.1 U	**16** J	**13** J	5.1 U	**16** J	5.5 U
SVOC	DIETHYL PHTHALATE	µg/Kg	6.3 U	15 U	6.6 U	6.5 U	6.9 U	6.5 U	6.6 U	6.4 U	6.5 U	6.3 U	7 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	23 U	55 U	24 U	24 U	25 U	24 U	24 U	23 U	24 U	23 U	25 U
SVOC	DIPHENYLAMINE	µg/Kg	31 U	75 U	33 U	32 U	34 U	32 U	33 U	32 U	32 U	31 U	35 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	14 U	33 U	14 U	14 U	15 U	14 U	14 UJ	14 UJ	14 UJ	14 UJ	15 UJ
SVOC	FLUORANTHENE	µg/Kg	**120** J	**570** J	**110** J	**73** J	**250** J	**130** J	**460**	**340** J	**240** J	**220** J	**100** J
SVOC	FLUORENE	µg/Kg	**24** J	**170** J	6.7 U	6.7 U	7.1 U	6.7 U	6.7 U	6.6 U	6.6 U	**9.3** J	7.1 U
SVOC	HEXACHLOROBENZENE	µg/Kg	11 U	27 U	12 U	12 U	12 U	**54** J	12 U	11 U	12 U	11 U	12 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	37 U	90 U	39 U	39 U	41 U	39 U	39 U	38 U	39 U	38 U	41 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	28 U	68 U	30 U	29 U	31 U	29 U	30 U	29 U	29 U	28 U	31 U
SVOC	HEXACHLOROETHANE	µg/Kg	51 U	120 U	53 U	53 U	56 U	53 U	53 U	52 U	53 U	51 U	57 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			4995-1	4995-2	5338-1	5338-2	5583-1	5583-2	5620-1	5620-1-C	5620-2	5620-2-C	5685-1
			MidBlind_4995-1	MidBlind_4995-2	MidBlind_5338-1	MidBlind_5338-2	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1	MidBlind_5620-1-C	MidBlind_5620-2	MidBlind_5620-2-C	MidBlind_5685-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	760 UJ	1800 UJ	800 UJ	790 UJ	840 UJ	800 UJ	800 UJ	780 UJ	790 UJ	770 UJ	850 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	51 U	120 U	53 U	53 U	56 U	53 U	53 U	52 U	53 U	51 U	56 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	**81** J	**430** J	**63** J	**61** J	**200** J	**53** J	**410**	**280** J	**180** J	**180** J	29 U
SVOC	ISODRIN	µg/Kg	21 U	51 U	22 U	22 U	23 U	22 U	22 U	22 U	22 U	22 U	24 U
SVOC	ISOPHORONE	µg/Kg	5.3 U	13 U	5.6 U	5.5 U	5.9 U	5.5 U	5.6 U	5.5 U	5.5 U	5.4 U	5.9 U
SVOC	ISOSAFROLE	µg/Kg	19 U	45 U	19 U	19 U	20 U	19 U	19 U	19 U	19 U	19 U	21 U
SVOC	METHAPYRILENE	µg/Kg	44 U	110 U	47 UJ	46 U	49 U	46 U	47 U	46 U	46 U	45 U	49 U
SVOC	METHYL METHANESULFONATE	µg/Kg	22 U	52 U	23 U	23 U	24 U	23 U	23 U	22 U	23 U	22 U	24 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	11 U	27 U	12 U	12 U	12 U	12 U	12 U	11 U	12 U	11 U	12 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	8.6 U	21 U	9.1 U	9 U	9.5 U	9 U	9.1 U	8.9 U	9 U	8.7 U	9.6 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	20 U	49 U	21 U	21 U	22 U	21 U	21 UJ	21 UJ	21 UJ	20 UJ	22 UJ
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	46 UJ	110 UJ	48 UJ	48 UJ	51 U	48 U	48 U	47 U	48 U	46 U	51 U
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	13 UJ	30 UJ	13 UJ	13 UJ	14 U	13 U	13 U	13 U	13 U	13 U	14 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	17 UJ	42 UJ	18 UJ	18 UJ	19 U	18 U	18 U	18 U	18 U	17 U	19 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	20 U	49 U	21 U	21 U	22 U	21 U	21 U	21 U	21 U	21 U	23 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	12 U	30 U	13 U	13 U	14 U	13 U	13 U	13 U	13 U	13 U	14 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	NAPHTHALENE	µg/Kg	31 U	**87** J	32 U	32 U	34 U	32 U	32 U	31 U	32 U	**38** J	**230** J
SVOC	NITROBENZENE	µg/Kg	39 U	95 U	41 U	41 U	43 U	41 U	41 U	40 U	41 U	40 U	44 U
SVOC	O-TOLUIDINE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	14 U	33 U	15 U	14 U	15 U	15 U	15 U	14 U	14 U	14 U	15 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	31 U	75 U	33 U	32 U	34 UJ	32 UJ	33 UJ	32 UJ	32 UJ	31 UJ	35 UJ
SVOC	PENTACHLOROBENZENE	µg/Kg	31 U	74 U	32 U	32 U	34 U	32 U	32 U	31 U	32 U	31 U	34 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	21 U	51 U	22 U	22 U	23 U	22 U	22 U	22 U	22 U	21 U	24 U
SVOC	PENTACHLOROPHENOL	µg/Kg	34 UJ	82 UJ	36 UJ	35 UJ	37 UJ	35 UJ	36 UJ	35 UJ	35 UJ	34 UJ	38 UJ
SVOC	PHENACETIN	µg/Kg	13 U	32 U	14 U	14 U	15 U	14 U	14 U	14 U	14 U	14 U	15 U
SVOC	PHENANTHRENE	µg/Kg	**110** J	**420** J	**41** J	**34** J	**78** J	**52** J	**270** J	**210** J	**170** J	**150** J	**52** J
SVOC	PHENOL	µg/Kg	7.9 UJ	19 UJ	8.3 UJ	8.2 UJ	8.7 U	8.2 U	8.3 U	8.1 U	8.2 U	8 U	8.8 U
SVOC	PRONAMIDE	µg/Kg	12 U	29 U	13 U	13 U	13 U	13 U	13 U	12 U	12 U	12 U	13 U
SVOC	PYRENE	µg/Kg	**230** J	**1200**	**100** J	**75** J	**290** J	**180** J	**370** J	**280** J	**240** J	**190** J	**110** J
SVOC	PYRIDINE	µg/Kg	57 UJ	140 UJ	60 UJ	59 UJ	63 U	59 U	60 U	58 U	59 U	57 U	63 U
SVOC	SAFROLE	µg/Kg	16 U	39 U	17 U	17 U	18 U	17 U	17 U	17 U	17 U	16 U	18 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	380 U	920 U	400 U	400 U	420 U	400 U	400 U	390 U	400 U	390 U	420 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	10 U	27 U	11 U	8.4 U	9.8 U	7.9 U	9 U	9.9 U	11 U	15 U	10 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	7.3 U	19 U	7.7 U	5.9 U	6.8 U	5.5 U	6.3 U	6.9 U	7.5 U	11 U	7 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	11 U	27 U	11 U	8.6 U	10 U	8.1 U	9.2 U	10 U	11 U	15 U	10 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	6.8 U	17 U	7.1 U	5.5 U	6.3 U	5.1 U	5.8 U	6.4 U	6.9 U	9.7 U	6.5 U
VOC	1,1-DICHLOROETHANE	µg/Kg	9.4 U	24 U	9.9 U	7.6 U	8.8 U	7.1 U	8.1 U	9 U	9.7 U	14 U	9.1 U
VOC	1,1-DICHLOROETHENE	µg/Kg	21 U	55 U	22 U	17 U	20 U	16 U	18 U	20 U	22 U	31 U	21 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	15 U	37 U	15 U	12 U	14 U	11 U	13 U	14 U	15 U	21 U	14 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	8.9 U	23 U	9.4 U	7.2 U	8.3 U	6.7 U	7.7 U	8.5 U	9.1 U	13 U	8.6 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	57 U	140 U	60 U	60 U	63 U	60 U	60 U	59 U	59 U	58 U	64 U
VOC	1,2-DICHLOROETHANE	µg/Kg	6.8 U	17 U	7.1 U	5.5 U	6.3 U	5.1 U	5.8 U	6.4 U	6.9 U	9.7 U	6.5 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	6.6 U	17 U	7 U	5.4 U	6.2 U	5 U	5.7 U	6.3 U	6.8 U	9.6 U	6.4 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	60 U	140 U	63 U	62 U	66 U	62 U	62 U	61 U	62 U	60 U	66 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	54 UJ	130 UJ	57 UJ	56 UJ	60 U	57 U	57 U	56 U	56 U	55 U	60 U
VOC	2-HEXANONE	µg/Kg	49 U	130 U	52 U	40 U	46 U	37 U	42 U	47 U	50 U	71 U	47 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			4995-1	4995-2	5338-1	5338-2	5583-1	5583-2	5620-1	5620-1-C	5620-2	5620-2-C	5685-1
			MidBlind_4995-1	MidBlind_4995-2	MidBlind_5338-1	MidBlind_5338-2	MidBlind_5583-1	MidBlind_5583-2	MidBlind_5620-1	MidBlind_5620-1-C	MidBlind_5620-2	MidBlind_5620-2-C	MidBlind_5685-1
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	1-6	0-1	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	22 UJ	57 UJ	**160** J	18 UJ	21 UJ	17 U	19 UJ	21 UJ	23 UJ	32 UJ	21 U
VOC	ACETONITRILE	µg/Kg	270 UJ	690 UJ	280 UJ	220 UJ	250 UJ	200 UJ	230 UJ	260 UJ	270 UJ	390 UJ	260 UJ
VOC	ACROLEIN	µg/Kg	140 UJ	360 UJ	150 UJ	110 UJ	130 U	110 U	120 UJ	130 UJ	140 UJ	200 UJ	130 U
VOC	ACRYLONITRILE	µg/Kg	42 U	110 U	45 U	34 U	40 U	32 U	36 U	40 U	43 U	61 U	41 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	59 U	150 U	63 U	48 U	56 U	45 U	51 U	56 U	61 U	85 U	57 U
VOC	BENZENE	µg/Kg	6.2 U	16 U	6.5 U	5 U	5.8 U	4.7 U	5.3 U	5.9 U	6.3 U	8.9 U	5.9 U
VOC	BROMODICHLOROMETHANE	µg/Kg	8 U	21 U	8.4 U	6.5 U	7.5 U	6 U	6.9 U	7.6 U	8.2 U	12 U	7.7 U
VOC	BROMOFORM	µg/Kg	10 U	26 U	11 U	8.1 U	9.4 U	7.6 U	8.7 U	9.5 U	10 U	14 U	9.6 U
VOC	BROMOMETHANE	µg/Kg	89 U	230 U	94 U	72 U	84 U	67 U	77 U	85 U	91 U	130 U	86 U
VOC	CARBON DISULFIDE	µg/Kg	6.5 U	17 U	6.8 U	5.2 U	6.1 U	4.9 U	5.6 U	6.1 U	6.6 U	9.3 U	6.2 U
VOC	CARBON TETRACHLORIDE	µg/Kg	7.1 U	18 U	7.5 U	5.7 U	6.7 U	5.4 U	6.1 U	6.8 U	7.3 U	10 U	6.8 U
VOC	CHLOROBENZENE	µg/Kg	9.8 U	25 U	10 U	7.9 U	9.2 U	7.4 U	8.5 U	9.3 U	10 U	14 U	9.4 U
VOC	CHLOROETHANE	µg/Kg	36 U	92 U	38 U	29 U	34 UJ	27 UJ	31 UJ	34 UJ	37 U	52 UJ	35 UJ
VOC	CHLOROFORM	µg/Kg	8.4 U	22 U	8.8 U	6.8 U	7.8 U	6.3 U	7.2 U	8 U	8.6 U	12 U	8 U
VOC	CHLOROMETHANE	µg/Kg	28 UJ	71 UJ	29 UJ	22 UJ	26 U	21 U	24 U	26 U	28 UJ	40 U	27 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	59 U	150 U	63 U	48 U	56 U	45 U	51 U	56 U	61 U	85 U	57 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	6.8 U	18 U	7.2 U	5.5 U	6.4 U	5.2 U	5.9 U	6.5 U	7 U	9.8 U	6.6 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	5.3 U	14 U	5.6 U	4.3 U	5 U	4 U	4.6 U	5.1 U	5.5 U	7.7 U	5.1 U
VOC	DIBROMOMETHANE	µg/Kg	9.2 U	24 U	9.8 U	7.5 U	8.7 U	7 U	8 U	8.8 U	9.5 U	13 U	8.9 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	22 U	56 U	23 U	17 U	20 UJ	16 U	19 U	21 U	22 U	31 U	21 U
VOC	ETHYL BENZENE	µg/Kg	12 U	32 U	13 U	9.9 U	12 U	9.3 U	11 U	12 U	13 U	18 U	12 U
VOC	ETHYL METHACRYLATE	µg/Kg	59 U	150 U	63 U	48 U	56 U	45 U	51 U	56 U	61 U	85 U	57 U
VOC	ISOBUTANOL	µg/Kg	59 U	150 U	63 U	48 U	56 UJ	45 UJ	51 UJ	56 UJ	61 UJ	85 UJ	57 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	19 U	48 U	20 U	15 U	17 U	14 U	16 U	18 U	19 U	27 U	18 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	54 UJ	140 UJ	57 UJ	43 UJ	50 U	41 U	46 U	51 U	55 U	77 U	52 U
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	10 U	26 U	11 U	8.3 U	9.6 U	7.7 U	8.9 U	9.8 U	11 U	15 U	9.9 U
VOC	METHYL METHACRYLATE	µg/Kg	59 U	150 U	63 U	48 U	56 U	45 U	51 U	56 U	61 U	85 U	57 U
VOC	METHYLACRYLONITRILE	µg/Kg	300 U	760 U	310 U	240 U	280 UJ	220 U	260 U	280 U	300 U	430 U	290 U
VOC	METHYLENE CHLORIDE	µg/Kg	**460**	73 U	30 U	23 U	27 U	21 U	25 U	27 U	29 U	41 U	27 U
VOC	PENTOCHLORETHANE	µg/Kg	13 U	31 U	14 U	14 U	14 U	14 U	14 U	13 U	13 U	13 U	14 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	59 UJ	150 UJ	63 UJ	48 UJ	56 UJ	45 UJ	51 UJ	56 UJ	61 UJ	85 UJ	57 UJ
VOC	STYRENE	µg/Kg	9 U	23 U	9.5 U	7.3 U	8.5 U	6.8 U	7.8 U	8.6 U	9.2 U	13 U	8.7 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	11 U	29 U	12 U	9.2 U	11 U	8.6 U	9.8 U	11 U	12 U	16 U	11 U
VOC	TOLUENE	µg/Kg	**5500** J	**4700** J	34 UJ	26 UJ	31 U	**72**	28 U	31 U	**1400**	**3100**	31 U
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	9.7 U	25 U	10 U	7.9 U	9.1 U	7.3 U	8.4 U	9.2 U	10 U	14 U	9.4 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	8.4 U	22 U	8.8 U	6.8 U	7.8 U	6.3 U	7.2 U	8 U	8.6 U	12 U	8 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	43 U	110 U	45 U	35 U	40 U	32 U	37 U	41 U	44 U	62 U	41 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	11 U	27 U	11 U	8.5 U	9.8 U	7.9 U	9.1 U	10 U	11 U	15 U	10 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	15 U	38 U	16 U	12 U	14 U	11 U	13 U	14 U	15 U	22 U	14 U
VOC	VINYL ACETATE	µg/Kg	58 U	150 U	61 U	47 U	55 U	44 U	50 U	55 U	59 U	84 U	56 U
VOC	VINYL CHLORIDE	µg/Kg	21 U	54 U	22 U	17 U	20 U	16 U	18 U	20 U	21 U	30 U	20 U
VOC	XYLENES, TOTAL	µg/Kg	34 U	87 U	36 U	27 U	32 U	26 U	**34** J	32 U	35 U	**250** J	33 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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			5685-2	574-1	574-2	6676-1	6676-2-D	6676-2-M	6960-1	6960-1-C	6960-2	6960-2-C	706-1
			MidBlind_5685-2	MidBlind_574-1	MidBlind_574-2	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2-M	MidBlind_6960-1	MidBlind_6960-1-C	MidBlind_6960-2	MidBlind_6960-2-C	MidBlind_706-1
			11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	0.036 U	**240**	0.036 U	**130**	**76** J	**41** J	**450**	**480**	**370**	**350**	**250**
GEN	SULFIDE	mg/kg	95 U	97 U	95 U	97 U	93 U	93 U	**270**	100 U	100 U	100 U	86 U
GEN	TOTAL ORGANIC CARBON	mg/kg	**27000**	**30000**	**28000**	**20000**	**15000**	**16000** J	**25000**	**25000**	**32000**	**25000** J	73 U
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2.5 U	2.6 U	2.5 U	2.1 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	**8.4** J	**84**	**72**	2 U	1.9 U	1.9 U	2.2 U	2.1 U	2.1 U	2.1 U	1.8 U
HERB	DINOSEB	µg/Kg	62 UJ	63 U	61 UJ	63 U	60 U	60 U	69 U	66 U	67 U	64 U	55 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2.1 U	2.1 U	2.1 U	2.1 U	2 U	2 U	2.3 U	2.2 U	2.2 U	2.2 U	1.9 U
MET	ANTIMONY	µg/Kg	490 U	**1300** J	980 U	230 U	220 U	220 UJ	**2100** J	1600 U	**1700** J	**2300** J	1000 U
MET	ARSENIC	µg/Kg	**4700**	**7400**	**8500**	**1500**	**3800**	**2800**	**6000**	**3600**	**3400**	**3400**	**3800** J
MET	BARIUM	µg/Kg	**37000**	**38000**	**58000**	**31000**	**38000**	**34000** J	**48000**	**47000**	**48000**	**50000**	**16000**
MET	BERYLLIUM	µg/Kg	**330**	**370**	**340**	**240** J	**260**	**210** J	**480**	**450**	**470**	**480**	49 U
MET	CADMIUM	µg/Kg	**290**	**330**	**300**	**110** J	**88** J	**150** J	320 U	320 U	320 U	350 U	97 U
MET	CHROMIUM, TOTAL	µg/Kg	**6800**	**20000**	**19000**	**8700**	**10000**	**5400** J	**14000**	**15000**	**15000**	**15000**	**8400**
MET	COBALT	µg/Kg	**2600**	**3500**	**4300**	**2200**	**4500**	**2900** J	**4100**	**3900**	**4100**	**4200**	**1500** J
MET	COPPER	µg/Kg	**15000**	**16000**	**15000**	**7400**	**7500**	**7500** J	**18000**	**19000**	**19000**	**20000**	**19000**
MET	LEAD	µg/Kg	**44000**	**34000**	**34000**	**16000**	**16000**	**13000** J	**13000**	**12000**	**13000**	**13000**	**32000**
MET	MERCURY	µg/Kg	**46**	**66**	**68**	**29**	**32**	**29**	**34**	**34**	**31**	**40**	**28**
MET	NICKEL	µg/Kg	**7800**	**10000**	**10000**	**6100**	**6600**	**6800** J	**12000**	**12000**	**12000**	**13000**	**5500**
MET	SELENIUM	µg/Kg	500 U	510 U	500 U	510 U	**540** J	490 U	560 U	530 U	530 U	530 U	**5000**
MET	SILVER	µg/Kg	56 U	57 U	55 U	57 U	55 U	55 U	62 U	59 U	59 U	59 U	**1100** J
MET	THALLIUM	µg/Kg	200 U	210 U	200 U	210 U	200 U	200 U	230 U	210 U	210 U	210 U	900 U
MET	TIN	µg/Kg	530 U	550 U	530 U	540 U	520 U	520 U	590 U	560 U	570 U	560 U	2400 U
MET	VANADIUM	µg/Kg	**10000**	**14000**	**16000**	**8700**	**12000**	**9500** J	**18000**	**17000**	**19000**	**19000**	**6100**
MET	ZINC	µg/Kg	**59000**	**67000**	**58000**	**35000**	**35000**	**26000** J	68 U	64 U	64 U	64 U	270 U
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	6.4 U	6.4 U	6.3 U	6.5 U	6.2 U	6.2 U	7.1 U	6.8 U	6.8 U	6.7 U	57 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	12 U	12 U	11 U	98 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	12 U	12 U	12 U	12 U	12 U	12 U	13 U	13 U	13 U	13 U	110 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	14 U	14 U	14 U	14 U	14 U	14 U	15 U	15 U	15 U	15 U	130 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	9.3 U	9.3 U	**430** J	9.5 U	9 U	9 U	10 U	9.8 U	9.8 U	9.7 U	83 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	7.8 U	7.8 U	7.6 U	7.9 U	7.5 U	7.5 U	8.6 U	8.2 U	8.2 U	8.1 U	69 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	6.5 U	6.5 U	6.4 U	6.6 U	6.3 U	6.3 U	7.1 U	6.8 U	6.8 U	6.7 U	58 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	8.5 U	8.5 U	8.4 U	8.7 U	8.2 U	8.2 U	9.4 U	9 U	9 U	8.9 U	76 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	12 U	12 U	11 U	12 U	11 U	11 U	13 U	12 U	12 U	12 U	100 U
PCB	SUMMED PCB	µg/Kg	**43**	**44**	**470**	**44**	**42**	**42**	**48**	**46**	**46**	**45**	**390**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	39 U	45 U	44 U	50 U	51 U	55 U	58 U	48 U	51 U	53 U	46 U
PEST	4,4'-DDD	µg/Kg	**3** J	0.69 U	0.68 U	0.71 U	**1.5** J	0.67 U	**1.7** J	**1.3** J	**1.5** J	**1.2** J	**79** J
PEST	4,4'-DDE	µg/Kg	0.93 U	**34** J	0.92 U	**6.7** J	**11** J	0.9 U	**1.9** J	**2** J	**2.7** J	**0.99** J	**250**
PEST	4,4'-DDT	µg/Kg	1.1 U	**14** J	1 U	**4.4** J	**4.1** J	**4.9** J	1.2 U	1.1 U	1.1 U	1.1 U	**500**
PEST	ALDRIN	µg/Kg	**1.4** J	**3** J	0.71 U	0.73 U	0.69 U	0.69 U	0.79 U	0.76 U	0.76 U	0.75 U	6.4 U
PEST	ALPHA BHC	µg/Kg	**11** J	0.91 U	0.89 U	0.93 U	0.88 U	0.88 U	1 U	0.96 U	0.96 U	0.94 U	8.1 U
PEST	BETA BHC	µg/Kg	0.98 U	0.98 U	0.96 U	1 U	0.95 U	0.95 U	1.1 U	1 U	1 U	1 U	8.7 U
PEST	CHLORDANE	µg/Kg	0.96 U	0.96 U	0.94 U	0.98 U	0.92 U	0.92 U	1.1 U	1 U	1 U	0.99 U	8.5 U
PEST	DELTA BHC	µg/Kg	0.88 U	**4.1** J	0.87 U	0.9 U	0.85 U	0.85 U	0.97 UJ	0.93 UJ	0.93 UJ	0.92 UJ	7.9 U
PEST	DIELDRIN	µg/Kg	0.72 U	0.72 U	**21** J	0.73 U	0.69 U	0.69 U	**1.3** J	**1.3** J	0.76 U	0.75 U	6.4 U
PEST	DIMETHOATE	µg/Kg	61 U	62 U	60 U	62 U	59 U	59 U	67 U	64 U	65 U	63 U	54 U
PEST	DISULFOTON	µg/Kg	10 U	10 U	10 U	10 U	9.9 U	9.9 U	11 U	11 U	11 U	11 U	9.1 U
PEST	ENDOSULFAN I	µg/Kg	0.55 U	0.55 U	0.54 U	0.56 U	0.53 U	0.53 U	0.61 U	**1.1** J	0.58 U	0.57 U	4.9 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			5685-2	574-1	574-2	6676-1	6676-2-D	6676-2-M	6960-1	6960-1-C	6960-2	6960-2-C	706-1
			MidBlind_5685-2	MidBlind_574-1	MidBlind_574-2	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2-M	MidBlind_6960-1	MidBlind_6960-1-C	MidBlind_6960-2	MidBlind_6960-2-C	MidBlind_706-1
			11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	0.6 U	0.6 U	0.59 U	0.61 U	0.58 U	0.58 U	0.66 U	0.63 U	0.63 U	0.62 U	5.3 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**0.57**	**0.57**	**0.56**	**0.58**	**0.55**	**0.55**	**0.63**	**1.4**	**0.6**	**0.6**	**5.1**
PEST	ENDOSULFAN SULFATE	µg/Kg	0.86 U	0.86 U	0.85 U	0.88 U	0.83 U	0.83 U	0.95 UJ	0.91 UJ	0.91 UJ	0.9 UJ	7.7 U
PEST	ENDRIN	µg/Kg	0.87 U	0.87 U	0.86 U	0.89 U	0.84 U	0.84 U	0.96 U	0.92 U	0.92 U	0.91 U	7.8 U
PEST	ENDRIN ALDEHYDE	µg/Kg	0.9 U	0.9 U	0.88 U	0.91 U	0.87 U	0.87 U	0.99 U	0.94 U	0.95 U	0.93 U	8 U
PEST	FAMPHUR	µg/Kg	33 UJ	34 UJ	33 UJ	33 UJ	32 UJ	32 UJ	37 UJ	35 UJ	36 UJ	34 UJ	30 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	0.69 U	0.69 U	0.68 U	0.71 U	0.67 U	0.67 U	0.76 U	0.73 U	0.73 U	0.72 U	6.2 U
PEST	HEPTACHLOR	µg/Kg	0.72 U	0.72 U	0.71 U	0.73 U	0.69 U	0.69 U	0.79 U	0.76 U	0.76 U	0.75 U	6.4 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	0.99 U	0.99 U	0.98 U	1 U	0.96 U	0.96 U	1.1 U	1 U	1.1 U	1 U	**110** J
PEST	KEPONE	µg/Kg	2000 U	2000 U	1900 U	2000 U	1900 U	1900 U	2200 U	2100 U	2100 U	2000 U	1800 U
PEST	METHOXYCHLOR	µg/Kg	**8.5** J	**8** J	**7.5** J	1.2 U	1.2 U	1.2 U	1.3 U	1.3 U	1.3 U	1.2 U	11 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	12 U	12 U	12 U	9.9 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	20 U	21 U	20 U	21 U	20 U	20 U	22 U	22 U	22 U	21 U	18 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	20 U	20 U	20 U	20 U	19 U	19 U	22 U	21 U	22 U	21 U	18 U
PEST	PARATHION, METHYL	µg/Kg	13 U	14 U	13 U	13 U	13 U	13 U	15 U	14 U	14 U	14 U	12 U
PEST	PHORATE	µg/Kg	10 UJ	11 UJ	10 UJ	10 U	9.9 U	10 U	11 U	11 U	11 U	11 U	9.2 UJ
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	790 U	800 U	770 U	790 U	750 U	760 U	870 U	830 U	840 U	810 U	700 U
PEST	TOXAPHENE	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	12 U	12 U	12 U	100 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	9.5 U	9.6 U	9.3 U	9.5 U	9.1 U	9.1 U	10 U	10 U	10 U	9.8 U	8.4 U
SVOC	1,3-DINITROBENZENE	µg/Kg	8.8 U	8.9 U	8.7 U	8.8 U	8.4 U	8.5 U	9.7 U	9.3 U	9.4 U	9.1 U	7.8 U
SVOC	1,4-DIOXANE	µg/Kg	390 UJ	400 UJ	390 UJ	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 UJ
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	13 UJ	14 U	13 UJ	13 U	13 U	13 U	15 U	14 U	14 U	14 U	12 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	390 U	400 U	390 U	400 UJ	380 UJ	380 U	430 U	410 U	420 U	410 U	350 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	39 U	39 U	38 U	39 U	37 U	37 U	43 U	41 U	41 U	40 U	34 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	16 U	16 U	**16** J	16 U	15 U	16 U	18 U	17 U	17 U	17 U	14 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	8.9 U	9 U	8.8 U	9 U	8.6 U	8.6 U	9.8 U	9.4 U	9.5 U	9.2 U	7.9 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	6.8 U	6.9 U	6.7 U	6.8 U	6.5 U	6.6 U	7.5 UJ	7.2 UJ	7.3 UJ	7 UJ	6 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	30 U	30 U	29 U	30 U	28 U	28 U	33 UJ	31 UJ	32 UJ	30 UJ	26 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	65 U	66 U	64 U	65 U	62 U	62 U	71 U	68 U	69 U	67 U	58 U
SVOC	2,4-DINITROPHENOL	µg/Kg	23 UJ	23 U	22 UJ	23 U	22 U	22 U	25 U	24 U	24 U	23 U	20 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	32 U	33 U	32 U	32 U	31 U	31 U	35 U	34 U	34 U	33 U	29 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	16 U	16 U	16 U	16 U	15 U	15 U	18 U	17 U	17 U	16 U	14 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	6.8 U	6.9 U	6.7 U	6.8 U	6.5 U	6.5 U	7.5 U	7.2 U	7.3 U	7 U	6 U
SVOC	2-Acetylaminofluorene	µg/Kg	15 U	16 U	15 U	16 U	15 U	15 U	17 U	16 U	16 U	16 U	14 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	29 U	29 U	28 U	29 U	28 U	28 U	32 U	30 U	31 U	30 U	26 U
SVOC	2-CHLOROPHENOL	µg/Kg	30 U	30 U	29 U	30 U	28 U	28 U	33 U	31 U	32 U	30 U	26 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	8.5 U	**12** J	**13** J	8.5 U	8.1 U	8.2 U	9.4 U	8.9 U	9.1 U	8.7 U	7.5 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	20 U	20 U	20 U	20 U	19 U	19 U	22 U	21 U	21 U	21 U	18 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	390 U	400 U	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 U
SVOC	2-NITROANILINE	µg/Kg	9 U	9.1 U	8.8 U	9.1 U	8.6 U	8.7 U	9.9 U	9.5 U	9.6 U	9.3 U	8 U
SVOC	2-NITROPHENOL	µg/Kg	11 U	12 U	11 U	12 U	11 U	11 U	13 U	12 U	12 U	12 U	10 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	12 U	12 U	11 U	12 U	11 U	11 U	13 U	12 U	12 U	12 U	10 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	67 U	68 U	66 U	67 U	64 U	64 U	74 U	70 U	71 U	69 U	59 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	390 U	400 U	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	21 U	21 U	21 U	21 U	20 U	20 U	23 U	22 U	22 U	22 U	19 U

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U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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			5685-2	574-1	574-2	6676-1	6676-2-D	6676-2-M	6960-1	6960-1-C	6960-2	6960-2-C	706-1
			MidBlind_5685-2	MidBlind_574-1	MidBlind_574-2	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2-M	MidBlind_6960-1	MidBlind_6960-1-C	MidBlind_6960-2	MidBlind_6960-2-C	MidBlind_706-1
			11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	7.8 U	8 U	7.7 U	7.9 U	7.5 U	7.6 U	8.7 U	8.3 U	8.4 U	8.1 U	7 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	15 U	15 U	15 U	15 U	14 U	14 U	16 U	16 U	16 U	15 U	13 U
SVOC	4-AMINOBIPHENYL	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	12 U	12 U	12 U	10 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	15 U	15 U	14 U	15 U	14 U	14 U	16 U	15 U	16 U	15 U	13 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	12 U	12 U	12 U	12 U	11 U	11 U	13 U	12 U	13 U	12 U	11 U
SVOC	4-CHLOROANILINE	µg/Kg	49 U	49 U	48 U	49 U	47 U	47 U	54 U	51 U	52 U	50 U	43 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	5.5 U	5.6 U	5.5 U	5.6 U	5.3 U	5.3 U	6.1 U	5.8 U	5.9 U	5.7 U	4.9 U
SVOC	4-NITROANILINE	µg/Kg	46 U	47 U	45 U	46 U	44 U	44 U	51 U	48 U	49 U	47 U	41 U
SVOC	4-NITROPHENOL	µg/Kg	9.8 U	10 U	9.7 U	9.9 U	9.4 U	9.5 U	11 U	10 U	11 U	10 U	8.7 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	9.6 U	9.7 UJ	9.4 U	9.6 U	9.2 U	9.2 U	11 UJ	10 UJ	10 UJ	9.9 UJ	8.5 UJ
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	13 U	13 U	12 U	13 U	12 U	12 U	14 U	13 U	13 U	13 U	11 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	15 U	16 U	15 U	16 U	15 U	15 U	17 U	16 U	16 U	16 U	14 U
SVOC	ACENAPHTHENE	µg/Kg	8.5 U	8.6 U	8.3 U	8.5 UJ	8.1 UJ	8.2 UJ	9.4 U	8.9 U	9.1 U	8.7 U	**33** J
SVOC	ACENAPHTHYLENE	µg/Kg	8.6 U	8.7 U	8.4 U	8.6 U	8.2 U	8.3 U	9.5 U	9 U	9.2 U	8.8 U	7.6 U
SVOC	ACETOPHENONE	µg/Kg	9.7 U	**65** J	**66** J	9.8 U	9.4 U	9.4 U	11 U	10 U	10 U	10 U	8.7 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	390 U	400 UJ	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 UJ
SVOC	ANILINE	µg/Kg	51 U	52 U	50 U	51 U	49 U	49 U	56 U	54 U	54 U	52 U	45 U
SVOC	ANTHRACENE	µg/Kg	**16** J	**14** J	5.8 U	5.9 U	5.7 U	5.7 U	6.5 U	6.2 U	6.3 U	6.1 U	5.3 U
SVOC	ARAMITE (TOTAL)	µg/Kg	81 U	83 U	80 U	82 U	78 U	78 U	90 U	86 U	87 U	84 U	72 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	7 U	7.1 U	6.8 U	7 U	6.7 U	6.7 U	7.7 U	7.3 U	7.4 U	7.2 U	**850**
SVOC	BENZO(A)PYRENE	µg/Kg	**49** J	**32** J	**33** J	9.4 UJ	9 UJ	9 UJ	10 UJ	9.9 UJ	10 UJ	9.6 UJ	**1100** J
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**73** J	**58** J	**58** J	**61** J	**49** J	**52** J	**52** J	**58** J	**51** J	**46** J	**1500**
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**74** J	**64** J	**66** J	**160** J	**150** J	31 U	35 U	34 U	34 U	33 U	**1200** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	**22** J	**18** J	**22** J	11 UJ	**49** J	10 U	**48** J	**46** J	**47** J	**44** J	**570** J
SVOC	BENZYL ALCOHOL	µg/Kg	8.6 U	8.7 U	8.5 U	8.7 U	8.3 U	8.3 U	9.5 U	9.1 U	9.2 U	8.9 U	7.7 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	9 U	9.2 U	8.9 U	9.1 U	8.7 U	8.7 U	10 U	9.5 U	9.7 U	9.3 U	8 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	6.1 U	6.2 U	6 U	6.2 U	5.9 U	5.9 U	6.7 U	6.4 U	6.5 U	6.3 U	5.4 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	43 U	43 U	42 U	43 U	41 U	41 U	47 U	45 U	46 U	44 U	38 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	**100** J	**520**	**630**	19 U	18 U	**19** J	21 U	20 U	**35** J	19 U	**50** J
SVOC	CHLOROBENZILATE	µg/Kg	22 U	23 U	22 U	22 U	21 U	21 U	25 U	24 U	24 U	23 U	20 U
SVOC	CHRYSENE	µg/Kg	13 U	13 U	12 U	**35** J	**33** J	**34** J	14 U	13 U	13 U	13 U	**1400**
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	7.9 U	**16** J	**25** J	8 U	7.6 U	7.6 U	8.7 U	8.3 U	8.5 U	8.1 U	7 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8.2 U	8.4 U	8.1 U	8.3 UJ	7.9 UJ	7.9 U	9.1 UJ	8.7 UJ	8.8 UJ	8.5 UJ	7.3 UJ
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	33 U	33 U	32 U	33 U	32 U	32 U	36 U	35 U	35 U	34 U	29 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	37 U	37 U	36 U	37 U	35 U	35 U	40 U	39 U	39 U	38 U	**260** J
SVOC	DIBENZOFURAN	µg/Kg	5 U	5.1 U	5 U	5.1 U	4.9 U	4.9 U	5.6 U	5.3 U	5.4 U	5.2 U	4.5 U
SVOC	DIETHYL PHTHALATE	µg/Kg	6.5 U	6.6 U	6.4 U	6.5 U	6.2 U	6.2 U	7.1 U	6.8 U	6.9 U	6.7 U	5.7 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	23 U	24 U	23 U	24 U	22 U	23 U	26 U	25 U	25 U	24 U	21 U
SVOC	DIPHENYLAMINE	µg/Kg	32 U	33 U	32 U	32 U	31 U	31 U	35 U	34 U	34 U	33 U	29 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	14 U	14 U	14 U	14 U	14 U	14 U	16 UJ	15 UJ	15 UJ	15 UJ	13 U
SVOC	FLUORANTHENE	µg/Kg	**99** J	**64** J	**55** J	**31** J	**25** J	**19** J	12 U	**21** J	**17** J	**12** J	**2400**
SVOC	FLUORENE	µg/Kg	6.6 U	6.7 U	6.5 U	6.7 U	6.3 U	6.4 U	7.3 U	7 U	7.1 U	6.8 U	**40** J
SVOC	HEXACHLOROBENZENE	µg/Kg	11 U	12 U	11 U	12 U	11 U	11 U	13 U	12 U	12 U	12 U	10 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	38 U	39 U	38 U	39 U	37 U	37 U	42 U	40 U	41 U	40 U	34 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	29 U	30 U	29 U	29 U	28 U	28 U	32 U	31 U	31 U	30 U	26 U
SVOC	HEXACHLOROETHANE	µg/Kg	52 U	53 U	52 U	53 U	50 U	51 U	58 U	55 U	56 U	54 U	47 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			5685-2	574-1	574-2	6676-1	6676-2-D	6676-2-M	6960-1	6960-1-C	6960-2	6960-2-C	706-1
			MidBlind_5685-2	MidBlind_574-1	MidBlind_574-2	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2-M	MidBlind_6960-1	MidBlind_6960-1-C	MidBlind_6960-2	MidBlind_6960-2-C	MidBlind_706-1
			11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	790 UJ	800 UJ	770 UJ	790 UJ	750 UJ	760 UJ	870 UJ	830 UJ	840 UJ	810 UJ	700 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	52 U	53 U	51 U	53 U	50 U	50 U	58 U	55 U	56 U	54 U	46 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	**58** J	**41** J	27 UJ	27 U	26 U	26 U	30 U	29 U	29 U	28 U	**1400**
SVOC	ISODRIN	µg/Kg	22 U	22 U	22 U	22 U	21 U	21 U	24 U	23 U	23 U	23 U	20 U
SVOC	ISOPHORONE	µg/Kg	5.5 U	5.6 U	5.4 U	5.5 U	5.3 U	5.3 U	6 U	5.8 U	5.9 U	5.6 U	4.9 U
SVOC	ISOSAFROLE	µg/Kg	19 U	19 U	19 U	19 U	18 U	18 U	21 U	20 U	20 U	20 U	17 U
SVOC	METHAPYRILENE	µg/Kg	46 U	46 U	45 U	46 UJ	44 UJ	44 U	50 U	48 U	49 U	47 U	41 U
SVOC	METHYL METHANESULFONATE	µg/Kg	22 U	23 U	22 U	23 U	22 U	22 U	25 U	24 U	24 U	23 U	20 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	12 U	12 U	11 U	12 U	11 U	11 U	13 U	12 U	12 U	12 U	10 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	8.9 U	9 U	8.8 U	9 U	8.6 U	8.6 U	9.8 U	9.4 U	9.5 U	9.2 U	7.9 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	21 U	21 U	20 U	21 U	20 U	20 U	23 UJ	22 UJ	22 UJ	21 UJ	18 UJ
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	47 U	48 UJ	47 U	48 UJ	45 UJ	46 UJ	52 U	50 U	51 U	49 U	42 U
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	13 U	13 U	13 U	13 UJ	13 UJ	13 U	14 U	14 U	14 U	13 U	12 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	18 U	18 U	18 U	18 UJ	17 UJ	17 U	20 U	19 U	19 U	18 U	16 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	21 U	21 U	21 U	21 U	20 U	20 U	23 U	22 U	22 U	22 U	19 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	13 U	13 U	13 U	13 U	12 U	12 U	14 U	13 U	14 U	13 U	11 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	390 U	400 U	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 U
SVOC	NAPHTHALENE	µg/Kg	**130** J	**78** J	**86** J	32 U	30 U	30 U	35 U	33 U	34 U	32 U	28 U
SVOC	NITROBENZENE	µg/Kg	40 U	41 U	40 U	41 U	39 U	39 U	45 U	43 U	43 U	42 U	36 U
SVOC	O-TOLUIDINE	µg/Kg	390 U	400 U	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	14 U	15 U	14 U	14 U	14 U	14 U	16 U	15 U	15 U	15 U	13 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	32 UJ	33 UJ	32 UJ	32 U	31 U	31 U	35 UJ	34 UJ	34 UJ	33 UJ	29 UJ
SVOC	PENTACHLOROBENZENE	µg/Kg	31 U	32 U	31 U	32 U	30 U	30 U	35 U	33 U	34 U	32 U	28 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	22 U	22 U	21 U	22 U	21 U	21 U	24 U	23 U	23 U	22 U	19 U
SVOC	PENTACHLOROPHENOL	µg/Kg	35 UJ	35 UJ	34 UJ	35 UJ	34 UJ	34 UJ	39 UJ	37 UJ	37 UJ	36 UJ	31 U
SVOC	PHENACETIN	µg/Kg	14 U	14 U	14 U	14 U	13 U	13 U	15 U	15 U	15 U	14 U	12 U
SVOC	PHENANTHRENE	µg/Kg	**55** J	**35** J	**45** J	**14** J	**13** J	**16** J	**10** J	**15** J	**11** J	**8.3** J	**1500**
SVOC	PHENOL	µg/Kg	8.1 U	8.3 U	8 U	8.2 UJ	7.8 UJ	7.8 UJ	9 U	8.6 U	8.7 U	8.4 U	7.2 U
SVOC	PRONAMIDE	µg/Kg	12 U	13 U	12 U	13 U	12 U	12 U	14 U	13 U	13 U	13 U	11 U
SVOC	PYRENE	µg/Kg	**77** J	**56** J	**67** J	19 U	18 U	**21** J	20 U	**20** J	20 U	19 U	**2900** J
SVOC	PYRIDINE	µg/Kg	59 U	59 U	58 U	59 UJ	56 UJ	56 UJ	65 U	62 U	63 U	60 U	52 U
SVOC	SAFROLE	µg/Kg	17 U	17 U	16 U	17 U	16 U	16 U	18 U	18 U	18 U	17 U	15 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	390 U	400 U	390 U	400 U	380 U	380 U	430 U	410 U	420 U	410 U	350 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	8 U	9.1 U	8.9 U	10 U	10 U	11 U	12 U	9.7 U	10 U	11 U	9.4 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	5.6 U	6.4 U	6.2 U	7.2 U	7.2 U	7.9 U	8.2 U	6.8 U	7.2 U	7.5 U	6.6 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	8.2 U	9.3 U	9.1 U	11 U	11 U	12 U	12 U	9.9 U	11 U	11 U	9.7 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	5.2 U	5.9 U	5.7 U	6.6 U	6.7 U	7.3 U	7.6 U	6.3 U	6.7 U	6.9 U	6.1 U
VOC	1,1-DICHLOROETHANE	µg/Kg	7.2 U	8.2 U	8 U	9.3 U	9.4 U	10 U	11 U	8.8 U	9.3 U	9.6 U	8.5 U
VOC	1,1-DICHLOROETHENE	µg/Kg	16 U	19 U	18 U	21 U	21 U	23 U	24 U	20 U	21 U	22 U	19 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	11 U	13 U	12 U	14 U	14 U	16 U	16 U	14 U	14 U	15 U	13 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	6.8 U	7.8 U	7.6 U	8.7 U	8.8 U	9.6 U	10 U	8.3 U	8.8 U	9.1 U	8 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	59 U	60 U	58 U	59 U	57 U	57 U	65 U	62 U	63 U	61 U	52 U
VOC	1,2-DICHLOROETHANE	µg/Kg	5.2 U	5.9 U	5.7 U	6.6 U	6.7 U	7.3 U	7.6 U	6.3 U	6.7 U	6.9 U	6.1 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	5.1 U	5.8 U	5.6 U	6.5 U	6.6 U	7.2 U	7.4 U	6.2 U	6.6 U	6.8 U	6 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	61 U	62 U	60 U	62 U	59 U	59 U	68 U	65 U	66 U	63 U	55 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	56 U	57 U	55 U	56 UJ	54 UJ	54 UJ	62 U	59 U	60 U	58 U	50 U
VOC	2-HEXANONE	µg/Kg	38 U	43 U	42 U	48 U	49 U	53 U	55 U	46 U	48 U	50 U	44 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			5685-2	574-1	574-2	6676-1	6676-2-D	6676-2-M	6960-1	6960-1-C	6960-2	6960-2-C	706-1
			MidBlind_5685-2	MidBlind_574-1	MidBlind_574-2	MidBlind_6676-1	MidBlind_6676-2-D	MidBlind_6676-2-M	MidBlind_6960-1	MidBlind_6960-1-C	MidBlind_6960-2	MidBlind_6960-2-C	MidBlind_706-1
			11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006
		Samp	1-6	0-1	1-6	0-1	1-6	1-6	0-1	0-1	1-6	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	17 UJ	19 UJ	19 UJ	22 UJ	22 UJ	24 U	25 UJ	21 UJ	22 UJ	23 UJ	**350** J
VOC	ACETONITRILE	µg/Kg	210 UJ	230 UJ	230 UJ	260 UJ	270 UJ	290 UJ	300 UJ	250 UJ	270 UJ	270 UJ	240 UJ
VOC	ACROLEIN	µg/Kg	110 U	120 U	120 U	140 UJ	140 UJ	150 UJ	160 UJ	130 UJ	140 UJ	140 UJ	130 UJ
VOC	ACRYLONITRILE	µg/Kg	32 U	**320** J	36 U	41 U	42 U	46 U	47 U	39 U	42 U	43 U	38 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	45 U	52 U	50 U	58 U	59 U	64 U	66 U	55 U	59 U	61 U	54 U
VOC	BENZENE	µg/Kg	4.7 U	5.4 U	5.2 U	6.1 U	6.1 U	6.6 U	6.9 U	5.7 U	6.1 U	6.3 U	5.6 U
VOC	BROMODICHLOROMETHANE	µg/Kg	6.1 U	7 U	6.8 U	7.9 U	7.9 U	8.6 U	9 U	7.4 U	7.9 U	8.2 U	7.2 U
VOC	BROMOFORM	µg/Kg	7.7 U	8.7 U	8.5 U	9.8 U	9.9 U	11 U	11 U	9.3 U	9.9 U	10 U	9.1 U
VOC	BROMOMETHANE	µg/Kg	68 U	78 U	76 U	88 U	89 U	96 U	100 U	83 U	88 U	91 U	81 U
VOC	CARBON DISULFIDE	µg/Kg	5 U	5.6 U	5.5 U	6.3 U	6.4 U	7 U	7.2 U	6 U	6.4 U	6.6 U	5.8 U
VOC	CARBON TETRACHLORIDE	µg/Kg	5.5 U	6.2 U	6 U	7 U	7.1 U	7.7 U	8 U	6.6 U	7 U	7.3 U	6.4 U
VOC	CHLOROBENZENE	µg/Kg	7.5 U	8.5 U	8.3 U	9.6 U	9.7 U	11 U	11 U	9.1 U	9.7 U	10 U	8.8 U
VOC	CHLOROETHANE	µg/Kg	28 UJ	31 UJ	31 UJ	35 U	36 U	39 U	40 UJ	33 UJ	36 UJ	37 UJ	33 UJ
VOC	CHLOROFORM	µg/Kg	6.4 U	7.3 U	**28** J	8.2 U	8.3 U	9 U	9.4 U	7.8 U	8.3 U	8.6 U	7.6 U
VOC	CHLOROMETHANE	µg/Kg	21 U	24 U	23 U	27 UJ	27 UJ	30 U	31 U	26 U	27 U	28 U	25 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	45 U	52 U	50 U	58 U	59 U	64 U	66 U	55 U	59 U	61 U	54 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	5.2 U	5.9 U	5.8 U	6.7 U	6.8 U	7.3 UJ	7.6 U	6.3 U	6.7 U	7 U	6.2 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	4.1 U	4.7 U	4.5 U	5.2 U	5.3 U	5.8 U	6 U	5 U	5.3 U	5.5 U	4.8 U
VOC	DIBROMOMETHANE	µg/Kg	7.1 U	8.1 U	7.9 U	9.1 U	9.2 U	10 U	10 U	8.6 U	9.2 U	9.5 U	8.4 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	17 UJ	19 UJ	18 UJ	21 U	21 U	23 U	24 U	20 U	21 U	22 U	20 U
VOC	ETHYL BENZENE	µg/Kg	9.4 U	11 U	10 U	12 U	12 U	13 UJ	14 U	11 U	12 U	13 U	11 U
VOC	ETHYL METHACRYLATE	µg/Kg	45 U	52 U	50 U	58 U	59 U	64 U	66 U	55 U	59 U	61 U	54 U
VOC	ISOBUTANOL	µg/Kg	45 UJ	52 UJ	50 UJ	58 U	59 U	64 UJ	66 UJ	55 UJ	59 UJ	61 UJ	54 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	14 U	16 U	16 U	18 U	18 U	20 U	21 U	17 U	18 U	19 U	17 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	41 U	47 U	46 U	53 UJ	53 UJ	58 UJ	60 U	50 U	53 U	55 U	49 U
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	7.9 U	8.9 U	8.7 U	10 U	10 U	11 U	12 U	9.5 U	10 U	11 U	9.3 U
VOC	METHYL METHACRYLATE	µg/Kg	45 U	52 U	50 U	58 U	59 U	64 U	66 U	55 U	59 U	61 U	54 U
VOC	METHYLACRYLONITRILE	µg/Kg	230 UJ	260 UJ	250 UJ	290 U	290 U	320 U	330 U	280 U	290 U	300 U	270 U
VOC	METHYLENE CHLORIDE	µg/Kg	22 U	25 U	24 U	28 U	28 U	31 U	32 U	26 U	28 U	29 U	26 U
VOC	PENTOCHLORETHANE	µg/Kg	13 U	14 U	13 U	13 U	13 U	13 U	15 U	14 U	14 U	14 U	12 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	45 UJ	52 UJ	50 UJ	58 UJ	59 UJ	64 UJ	66 UJ	55 UJ	59 UJ	61 UJ	54 UJ
VOC	STYRENE	µg/Kg	6.9 U	7.9 U	7.7 U	8.8 U	8.9 U	9.7 U	10 U	8.4 U	8.9 U	9.2 U	8.2 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	8.7 U	9.9 U	9.7 U	11 U	11 U	12 U	13 U	11 U	11 U	12 U	10 U
VOC	TOLUENE	µg/Kg	**36** J	**90**	**1100**	32 UJ	**1000** J	35 UJ	**290**	30 U	**370**	33 U	**500**
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	7.4 U	8.5 U	8.3 U	9.5 U	9.6 U	11 U	11 U	9 U	9.6 U	9.9 U	8.8 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	6.4 U	7.3 U	7.1 U	8.2 U	8.3 U	9 U	9.4 U	7.8 U	8.3 U	8.6 U	7.6 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	33 U	37 U	36 U	42 U	42 U	46 U	48 U	40 U	42 U	44 U	39 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	8 U	9.1 U	8.9 U	10 U	10 U	11 U	12 U	9.8 U	10 U	11 U	9.5 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	11 U	13 U	13 U	15 U	15 U	16 U	17 U	14 U	15 U	15 U	14 U
VOC	VINYL ACETATE	µg/Kg	44 U	51 U	49 U	57 U	58 U	63 U	65 U	54 U	57 U	59 U	53 U
VOC	VINYL CHLORIDE	µg/Kg	16 U	18 U	18 U	20 U	21 U	22 UJ	23 U	19 U	21 U	21 U	19 U
VOC	XYLENES, TOTAL	µg/Kg	26 U	30 U	29 U	33 U	34 U	37 U	38 U	32 U	34 U	35 U	**34** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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Midland Area Soils

			706-1-C	706-2	706-2-C	7500-1	7500-2	7530-1	7530-1-D	7530-2	7734-1	7734-2	8046-1
			MidBlind_706-1-C	MidBlind_706-2	MidBlind_706-2-C	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-1-D	MidBlind_7530-2	MidBlind_7734-1	MidBlind_7734-2	MidBlind_8046-1
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006
		Samp	0-1	1-6	1-6	0-1	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	SOIL	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	**170** J	**270**	**1400**	**16** J	**210**	**41** J	0.007 U	**18** J	**88** J	**80** J	**51** J
GEN	SULFIDE	mg/kg	93 U	86 U	88 U	130 U	110 U	93 U	94 U	93 U	94 U	91 U	100 UJ
GEN	TOTAL ORGANIC CARBON	mg/kg	**5700**	**4700**	**7800**	**62000**	**51000**	**7700**	**7900**	**7400**	**21000**	**9800**	**16000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.3 U	2.2 U	2.2 U	3.2 U	2.8 U	2.3 U	2.3 U	2.3 U	2.4 U	2.3 U	2.5 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	1.9 U	1.8 U	1.8 U	**29**	**65** J	1.9 U	1.9 U	1.9 U	2 U	1.9 U	2.1 U
HERB	DINOSEB	µg/Kg	180 U	56 UJ	57 U	82 UJ	74 UJ	61 U	61 U	60 U	61 U	59 UJ	67 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2 U	1.9 U	1.9 U	2.7 U	2.5 U	2 U	2 U	2 U	2.1 U	2 U	2.2 U
MET	ANTIMONY	µg/Kg	**1900** J	1000 U	**1900** J	**1800** J	670 U	220 U	230 U	220 U	1000 U	470 U	240 U
MET	ARSENIC	µg/Kg	**2200**	**3400** J	**2900**	**11000**	**13000**	**590** J	**760** J	**720** J	**4300**	**5400**	**4100**
MET	BARIUM	µg/Kg	**20000**	**17000**	**19000**	**53000**	**63000**	**14000**	**16000**	**17000**	**27000**	**31000**	**31000**
MET	BERYLLIUM	µg/Kg	**61** J	**100** J	**86** J	**500**	**580**	**85** J	**99** J	**110** J	**210** J	**240**	**220** J
MET	CADMIUM	µg/Kg	430 U	68 U	330 U	800 U	**860**	**80** J	**90** J	**100** J	380 U	**230**	**130** J
MET	CHROMIUM, TOTAL	µg/Kg	**6800**	**5500**	**6400**	**7900**	**9100**	**2200**	**2600**	**2800**	**5500**	**6700**	**4900**
MET	COBALT	µg/Kg	**1400**	**1700** J	**1400**	**1900**	**2200**	**600**	**730**	**760**	**1800**	**2700**	**1900**
MET	COPPER	µg/Kg	**20000**	**19000**	**20000**	**34000**	**50000**	**3200**	**3800**	**4100**	**14000**	**15000**	**29000**
MET	LEAD	µg/Kg	**47000**	**32000**	**56000**	**88000**	**89000**	**3600**	**4200**	**4400**	**53000**	**44000**	**13000**
MET	MERCURY	µg/Kg	4.1 U	3.9 U	3.9 U	**120**	**68**	**8.6** J	**14**	**15**	**35**	**42**	**27**
MET	NICKEL	µg/Kg	**4800**	**5900**	**5500**	**8000**	**9500**	**1600**	**2000**	**2100**	**5700**	**7900**	**5200**
MET	SELENIUM	µg/Kg	480 U	**6900**	460 U	670 U	**920**	490 U	500 U	490 U	500 U	480 U	540 U
MET	SILVER	µg/Kg	54 U	**810** J	52 U	74 U	67 U	55 U	55 U	54 U	55 U	53 U	60 U
MET	THALLIUM	µg/Kg	200 U	920 U	190 U	270 U	240 U	200 U	200 U	200 U	200 U	190 U	220 U
MET	TIN	µg/Kg	510 U	2400 U	490 U	710 U	630 U	520 U	530 U	520 U	530 U	510 U	570 U
MET	VANADIUM	µg/Kg	**6700**	**8400**	**6700**	**15000**	**17000**	**5300**	**6500**	**6700**	**7300**	**11000**	**11000**
MET	ZINC	µg/Kg	**67000**	280 U	56 U	**83000**	**82000**	**10000**	**12000**	**13000**	60 U	**41000**	65 U
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	310 U	120 U	58 U	8.5 U	7.5 U	31 U	13 U	31 U	6.3 U	6.1 U	6.8 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	530 U	200 U	100 U	15 U	13 U	52 U	22 U	53 U	11 U	10 U	12 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	580 U	220 U	110 U	16 U	14 U	57 U	24 U	58 U	12 U	11 U	13 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	670 U	250 U	130 U	19 U	16 U	67 U	28 U	67 U	14 U	13 U	15 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	450 U	170 U	85 U	12 U	11 U	45 U	18 U	45 U	9.1 U	8.9 U	9.9 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	370 U	140 U	71 U	10 U	9.1 U	37 U	15 U	37 U	7.6 U	7.4 U	8.2 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	310 U	120 U	59 U	8.6 U	7.6 U	31 U	13 U	31 U	6.3 U	6.2 U	6.8 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	410 U	150 U	78 U	11 U	10 U	41 U	17 U	41 U	8.3 U	8.1 U	9 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	550 U	210 U	110 U	15 U	14 U	55 U	23 U	55 U	11 U	**81**	12 U
PCB	SUMMED PCB	µg/Kg	**2100**	**790**	**400**	**57**	**51**	**210**	**85**	**210**	**42**	**120**	**46**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	43 U	48 U	53 U	72 U	57 U	43 U	40 U	64 U	74 U	40 U	46 U
PEST	4,4'-DDD	µg/Kg	**610** J	**130** J	**370** J	**1.9** J	0.81 U	3.3 U	1.4 U	3.3 U	**3.9** J	**2.3** J	0.73 U
PEST	4,4'-DDE	µg/Kg	**1200**	**310** J	**820** J	1.2 U	1.1 U	**41** J	1.8 U	4.5 U	**7.6** J	**14** J	**3.1** J
PEST	4,4'-DDT	µg/Kg	**2500**	**830**	**2700**	1.4 U	**1.8** J	5 U	2.1 U	5.1 U	**3.7** J	**15** J	1.1 U
PEST	ALDRIN	µg/Kg	34 U	13 U	65 U	0.95 U	0.84 U	3.4 U	1.4 U	3.4 U	0.7 U	0.68 U	0.76 U
PEST	ALPHA BHC	µg/Kg	44 U	16 U	83 U	**2.2** J	**3.4** J	4.3 U	1.8 U	4.4 U	0.89 U	0.87 U	0.96 U
PEST	BETA BHC	µg/Kg	47 U	18 U	89 U	1.3 U	1.1 U	4.7 U	1.9 U	4.7 U	0.96 U	0.93 U	1 U
PEST	CHLORDANE	µg/Kg	46 U	17 U	87 U	1.3 U	1.1 U	**310** J	1.9 UJ	**330**	0.93 U	0.91 U	1 U
PEST	DELTA BHC	µg/Kg	42 U	16 U	80 U	1.2 U	**2.4** J	4.2 U	1.7 U	4.3 U	0.86 UJ	0.84 U	0.93 U
PEST	DIELDRIN	µg/Kg	34 U	13 U	65 U	**1.5** J	0.84 U	3.4 U	1.4 U	3.4 U	0.7 U	0.68 U	0.76 U
PEST	DIMETHOATE	µg/Kg	180 U	55 U	56 U	80 U	72 U	60 U	60 U	59 U	60 U	58 U	65 U
PEST	DISULFOTON	µg/Kg	30 U	9.3 U	9.5 U	14 U	12 U	10 U	10 U	9.9 U	10 U	9.7 U	11 U
PEST	ENDOSULFAN I	µg/Kg	26 U	9.9 U	50 U	0.73 U	0.64 U	2.6 U	**22** J	**34** J	0.54 U	0.52 U	0.58 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			706-1-C	706-2	706-2-C	7500-1	7500-2	7530-1	7530-1-D	7530-2	7734-1	7734-2	8046-1
			MidBlind_706-1-C	MidBlind_706-2	MidBlind_706-2-C	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-1-D	MidBlind_7530-2	MidBlind_7734-1	MidBlind_7734-2	MidBlind_8046-1
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006
		Samp	0-1	1-6	1-6	0-1	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	SOIL	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	29 U	11 U	54 U	0.79 U	0.7 U	**6.9** J	1.2 U	**8.2** J	0.58 U	0.57 U	0.63 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**27**	**10**	**52**	**0.76**	**0.67**	**8.2**	**23**	**42**	**0.56**	**0.55**	**0.61**
PEST	ENDOSULFAN SULFATE	µg/Kg	41 U	16 U	78 U	1.1 U	1 U	**31** J	1.7 U	**32** J	0.84 UJ	0.82 U	0.91 U
PEST	ENDRIN	µg/Kg	42 U	16 U	79 U	1.2 U	1 U	4.2 U	1.7 U	4.2 U	0.85 U	0.83 U	0.92 U
PEST	ENDRIN ALDEHYDE	µg/Kg	43 U	16 U	81 U	1.2 U	1.1 U	4.3 U	1.8 U	4.3 U	0.87 U	0.85 U	0.95 U
PEST	FAMPHUR	µg/Kg	96 UJ	30 UJ	31 UJ	44 UJ	39 UJ	32 UJ	33 UJ	32 UJ	33 UJ	31 UJ	35 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	33 U	13 U	63 U	0.92 U	0.81 U	3.3 U	1.4 U	3.3 U	0.68 U	0.66 U	0.73 U
PEST	HEPTACHLOR	µg/Kg	34 U	13 U	65 U	0.95 U	0.84 U	3.4 U	1.4 U	3.4 U	0.7 U	0.68 U	0.76 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	48 U	**27** J	90 U	1.3 U	1.2 U	**6.7** J	**5.9** J	**6.1** J	0.97 U	0.95 U	1.1 U
PEST	KEPONE	µg/Kg	5700 U	1800 U	1800 U	2600 U	2300 U	1900 U	1900 U	1900 U	1900 U	1900 U	2100 U
PEST	METHOXYCHLOR	µg/Kg	57 U	22 U	110 UJ	1.6 U	**5.9** J	5.7 U	2.4 U	5.7 U	1.2 U	**5.3** J	1.3 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	32 U	10 U	10 U	15 U	13 U	11 U	11 U	11 U	11 U	11 U	12 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	59 U	18 U	19 U	27 U	24 U	20 U	20 U	20 U	20 U	19 U	22 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	58 U	18 U	19 U	27 U	24 U	20 U	20 U	19 U	20 U	19 U	22 U
PEST	PARATHION, METHYL	µg/Kg	39 U	12 U	12 U	18 U	16 U	13 U	13 U	13 U	13 U	13 U	14 U
PEST	PHORATE	µg/Kg	30 U	9.4 UJ	9.5 U	14 UJ	12 UJ	10 U	10 U	10 U	10 U	9.8 UJ	11 U
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	2300 U	710 U	720 U	1000 U	930 U	770 U	770 U	760 U	770 U	740 U	840 U
PEST	TOXAPHENE	µg/Kg	540 U	200 U	1000 U	15 U	13 U	54 U	22 U	54 U	11 U	11 U	12 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	27 U	8.6 U	8.7 U	13 U	11 U	9.2 U	9.3 U	9.1 U	9.3 U	8.9 U	10 U
SVOC	1,3-DINITROBENZENE	µg/Kg	25 U	8 U	8.1 U	12 U	10 U	8.6 U	8.6 U	8.5 U	8.6 U	8.3 U	9.4 U
SVOC	1,4-DIOXANE	µg/Kg	1100 U	360 UJ	360 U	520 UJ	460 UJ	380 U	390 U	380 U	380 U	370 UJ	420 U
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	39 U	12 UJ	12 U	18 UJ	16 UJ	13 U	13 U	13 U	13 U	13 UJ	14 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	110 U	35 U	36 U	51 U	46 U	38 U	38 U	37 U	38 U	37 U	41 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	47 U	15 U	15 U	21 U	**30** J	16 U	16 U	16 U	16 U	15 U	17 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	26 U	8.1 U	8.2 U	12 U	11 U	8.7 U	8.7 U	8.6 U	8.7 U	8.4 U	9.5 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	20 UJ	6.2 U	6.3 UJ	9 U	8 U	6.6 U	6.7 U	6.6 U	6.7 UJ	6.4 U	7.3 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	86 UJ	27 U	27 UJ	39 U	35 U	29 U	29 U	29 U	29 UJ	28 U	32 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	190 U	59 U	60 U	85 U	76 U	63 U	64 U	63 U	63 U	61 U	69 U
SVOC	2,4-DINITROPHENOL	µg/Kg	66 U	21 UJ	21 U	30 UJ	27 UJ	22 U	22 U	22 U	22 U	21 UJ	24 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	93 U	29 U	30 U	42 U	38 U	31 U	31 U	31 U	31 U	30 U	34 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	46 U	14 U	15 U	21 U	19 U	15 U	16 U	15 U	16 U	15 U	17 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	20 U	6.1 U	6.3 U	8.9 U	8 U	6.6 U	6.7 U	6.5 U	6.6 U	6.4 U	7.2 U
SVOC	2-Acetylaminofluorene	µg/Kg	45 U	14 U	14 U	20 U	18 U	15 U	15 U	15 U	15 U	15 U	16 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	83 U	26 U	27 U	38 U	34 U	28 U	28 U	28 U	28 U	27 U	31 U
SVOC	2-CHLOROPHENOL	µg/Kg	86 U	27 U	27 U	39 U	35 U	29 U	29 U	29 U	29 U	28 U	32 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	25 U	7.7 U	**8.3** J	11 U	**14** J	8.3 U	8.3 U	8.2 U	8.3 U	**8.6** J	9.1 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	58 U	18 U	18 U	26 U	24 U	20 U	20 U	19 U	20 U	19 U	21 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	2-NITROANILINE	µg/Kg	26 U	8.1 U	8.3 U	12 U	11 U	8.8 U	8.8 U	8.7 U	8.8 U	8.5 U	9.6 U
SVOC	2-NITROPHENOL	µg/Kg	33 U	10 U	11 U	15 U	14 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	33 U	10 U	11 U	15 U	14 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	190 U	60 U	61 U	88 U	79 U	65 U	66 U	64 U	65 U	63 U	71 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	60 U	19 U	19 U	27 U	25 U	20 U	21 U	20 U	20 U	20 U	22 U

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U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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			706-1-C	706-2	706-2-C	7500-1	7500-2	7530-1	7530-1-D	7530-2	7734-1	7734-2	8046-1
			MidBlind_706-1-C	MidBlind_706-2	MidBlind_706-2-C	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-1-D	MidBlind_7530-2	MidBlind_7734-1	MidBlind_7734-2	MidBlind_8046-1
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006
		Samp	0-1	1-6	1-6	0-1	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	SOIL	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	23 U	7.1 U	7.2 U	10 U	9.3 U	7.7 U	7.7 U	7.6 U	7.7 U	7.4 U	8.4 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	43 U	14 U	14 U	20 U	18 U	15 U	15 U	14 U	15 U	14 U	16 U
SVOC	4-AMINOBIPHENYL	µg/Kg	33 U	10 U	10 U	15 U	13 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	42 U	13 U	14 U	19 U	17 U	14 U	14 U	14 U	14 U	14 U	16 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	34 U	11 U	11 U	16 U	14 U	12 U	12 U	11 U	12 U	11 U	13 U
SVOC	4-CHLOROANILINE	µg/Kg	140 U	44 U	45 U	64 U	57 U	47 U	48 U	47 U	48 U	46 U	52 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	16 U	5 U	5.1 U	7.3 U	6.5 U	5.4 U	5.4 U	5.3 U	5.4 U	5.2 U	5.9 U
SVOC	4-NITROANILINE	µg/Kg	130 U	42 U	42 U	61 U	54 U	45 U	45 U	44 U	45 U	43 U	49 U
SVOC	4-NITROPHENOL	µg/Kg	29 U	8.9 U	9.1 U	13 U	12 U	9.6 U	9.7 U	9.5 U	9.6 U	9.3 U	11 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	28 UJ	8.7 U	8.8 UJ	13 U	11 U	9.3 U	9.4 U	9.2 U	9.4 UJ	9 U	10 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	36 U	11 U	12 U	17 U	15 U	12 U	12 U	12 U	12 U	12 U	13 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	45 U	14 U	14 U	20 U	18 U	15 U	15 U	15 U	15 U	15 U	16 U
SVOC	ACENAPHTHENE	µg/Kg	**230** J	**14** J	**49** J	11 U	10 U	8.3 UJ	8.3 UJ	8.2 UJ	8.3 U	8 U	9.1 UJ
SVOC	ACENAPHTHYLENE	µg/Kg	**31** J	7.8 U	7.9 U	11 U	10 U	8.4 U	8.4 U	8.3 U	8.4 U	8.1 U	9.2 U
SVOC	ACETOPHENONE	µg/Kg	28 U	8.8 U	9 U	13 U	12 U	9.5 U	9.6 U	9.4 U	9.5 U	9.2 U	10 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	ANILINE	µg/Kg	150 U	46 U	47 U	67 U	60 U	50 U	50 U	49 U	50 U	48 U	54 U
SVOC	ANTHRACENE	µg/Kg	**810** J	5.3 U	**220** J	7.8 U	7 U	5.8 U	5.8 U	5.7 U	**20** J	**9.2** J	6.3 U
SVOC	ARAMITE (TOTAL)	µg/Kg	240 U	74 U	75 U	110 U	96 U	79 U	80 U	78 U	80 U	77 U	87 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	**5400**	6.3 U	**1500**	9.2 U	8.2 U	6.8 U	6.8 U	6.7 U	6.8 U	6.6 U	7.4 U
SVOC	BENZO(A)PYRENE	µg/Kg	**5900** J	**450** J	**1500** J	**42** J	**63** J	9.1 UJ	9.2 UJ	9 UJ	**160** J	**77** J	**13** J
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**7100**	**620**	**1800**	**81** J	**94** J	7.3 U	7.4 U	7.2 U	**200** J	**110** J	**55** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**3700** J	**510** J	**1300**	**68** J	**100** J	31 U	31 U	31 U	**180** J	**93** J	34 U
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	**2300** J	**210** J	**570**	**20** J	**26** J	10 UJ	10 U	10 UJ	**77** J	**35** J	**53** J
SVOC	BENZYL ALCOHOL	µg/Kg	25 U	7.8 U	7.9 U	11 U	10 U	8.4 U	8.5 U	8.3 U	8.4 U	8.1 U	9.2 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	**630** J	**14** J	**42** J	12 UJ	11 U	8.8 U	8.9 U	8.7 U	8.9 U	8.5 U	9.7 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	18 U	5.5 U	5.6 U	8 U	7.2 U	6 U	6 U	5.9 U	6 U	5.8 U	6.5 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	120 U	39 U	39 U	56 U	50 U	42 U	42 U	41 U	42 U	40 U	46 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	**140** J	**47** J	**110** J	**84** J	**90** J	18 U	18 U	18 U	**1800**	**3100**	20 U
SVOC	CHLOROBENZILATE	µg/Kg	65 U	20 U	21 U	29 U	26 U	22 U	22 U	22 U	22 U	21 U	24 U
SVOC	CHRYSENE	µg/Kg	**6400**	**470**	**1600**	17 U	15 U	12 U	12 U	12 U	**130** J	**36** J	**35** J
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	23 U	7.2 U	7.3 U	10 U	9.3 U	7.7 U	7.8 U	7.6 U	**11** J	**8.3** J	8.4 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	24 UJ	7.5 UJ	7.6 UJ	11 UJ	9.7 U	8 U	8.1 U	7.9 U	8.1 UJ	7.8 U	8.8 UJ
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	95 U	30 U	30 U	43 U	39 U	32 U	32 U	32 U	32 U	31 U	35 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	**1200** J	**120** J	**570**	48 U	43 U	36 U	36 U	35 U	36 U	35 U	39 U
SVOC	DIBENZOFURAN	µg/Kg	**130** J	4.6 U	**26** J	6.7 U	6 U	4.9 U	5 U	4.9 U	4.9 U	4.8 U	5.4 U
SVOC	DIETHYL PHTHALATE	µg/Kg	19 U	5.8 U	5.9 U	8.5 U	7.6 U	6.3 U	6.3 U	6.2 U	6.3 U	6.1 U	6.9 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	68 U	21 U	22 U	31 U	28 U	23 U	23 U	23 U	23 U	22 U	25 U
SVOC	DIPHENYLAMINE	µg/Kg	93 U	29 U	30 U	42 U	38 U	31 U	31 U	31 U	31 U	30 U	34 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	41 UJ	13 U	13 UJ	19 U	17 U	14 U	14 U	14 U	14 UJ	13 U	15 U
SVOC	FLUORANTHENE	µg/Kg	**16000**	**1100**	**4400**	**53** J	**80** J	10 U	10 U	10 U	**250** J	**93** J	11 UJ
SVOC	FLUORENE	µg/Kg	**380** J	**16** J	**75** J	8.7 U	7.8 U	6.5 U	6.5 U	6.4 U	6.5 U	6.2 U	7.1 U
SVOC	HEXACHLOROBENZENE	µg/Kg	33 U	10 U	11 U	15 U	14 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	110 U	35 U	35 U	51 U	45 U	37 U	38 U	37 U	38 U	36 U	41 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	84 U	26 U	27 U	38 U	34 U	28 U	29 U	28 U	28 U	27 U	31 U
SVOC	HEXACHLOROETHANE	µg/Kg	150 U	47 U	48 U	69 U	62 U	51 U	51 U	51 U	51 U	49 U	56 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			706-1-C	706-2	706-2-C	7500-1	7500-2	7530-1	7530-1-D	7530-2	7734-1	7734-2	8046-1
			MidBlind_706-1-C	MidBlind_706-2	MidBlind_706-2-C	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-1-D	MidBlind_7530-2	MidBlind_7734-1	MidBlind_7734-2	MidBlind_8046-1
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006
		Samp	0-1	1-6	1-6	0-1	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	SOIL	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	2300 UJ	710 UJ	720 UJ	1000 UJ	930 UJ	770 UJ	770 UJ	760 UJ	770 UJ	740 UJ	840 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	150 U	47 U	48 U	69 U	62 U	51 U	51 U	50 U	51 U	49 U	56 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	**4800**	**610** J	**2300**	36 UJ	**52** J	27 U	27 U	26 U	**250** J	**47** J	29 U
SVOC	ISODRIN	µg/Kg	63 U	20 U	20 U	29 U	26 U	21 U	22 U	21 U	21 U	21 U	23 U
SVOC	ISOPHORONE	µg/Kg	16 U	5 U	5 U	7.2 U	6.5 U	5.3 U	5.4 U	5.3 U	5.4 U	5.2 U	5.8 U
SVOC	ISOSAFROLE	µg/Kg	55 U	17 U	18 U	25 U	23 U	19 U	19 U	18 U	19 U	18 U	20 U
SVOC	METHAPYRILENE	µg/Kg	130 U	41 U	42 U	60 U	54 U	45 U	45 U	44 U	45 U	43 U	49 U
SVOC	METHYL METHANESULFONATE	µg/Kg	65 U	20 U	21 U	30 U	26 U	22 U	22 U	22 U	22 U	21 U	24 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	33 U	10 U	11 U	15 U	14 U	11 U	11 U	11 U	11 U	11 U	12 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	26 U	8.1 U	8.2 U	12 U	11 U	8.7 U	8.7 U	8.6 U	8.7 U	8.4 U	9.5 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	60 UJ	19 U	19 UJ	27 U	24 U	20 U	20 U	20 U	20 UJ	20 U	22 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	140 U	43 U	44 U	62 U	56 U	46 UJ	46 UJ	46 UJ	46 U	45 U	50 UJ
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	38 U	12 U	12 U	17 U	15 U	13 U	13 U	13 U	13 U	12 U	14 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	51 U	16 U	16 U	23 U	21 U	17 U	17 U	17 U	17 U	17 U	19 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	61 U	19 U	19 U	28 U	25 U	20 U	21 U	20 U	21 U	20 U	22 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	37 U	12 U	12 U	17 U	15 U	12 U	13 U	12 U	13 U	12 U	14 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	NAPHTHALENE	µg/Kg	91 U	28 U	29 U	41 U	**49** J	31 U	31 U	30 U	31 U	30 U	34 U
SVOC	NITROBENZENE	µg/Kg	120 U	37 U	37 U	53 U	48 U	40 U	40 U	39 U	40 U	38 U	43 U
SVOC	O-TOLUIDINE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	41 U	13 U	13 U	19 U	17 U	14 U	14 U	14 U	14 U	14 U	15 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	93 UJ	29 UJ	30 UJ	42 UJ	38 UJ	31 U	31 U	31 U	31 UJ	30 UJ	34 U
SVOC	PENTACHLOROBENZENE	µg/Kg	91 U	28 U	29 U	41 U	37 U	31 U	31 U	30 U	31 U	30 U	34 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	63 U	20 U	20 U	29 U	26 U	21 U	21 U	21 U	21 U	21 U	23 U
SVOC	PENTACHLOROPHENOL	µg/Kg	**120** J	32 U	**55** J	46 U	41 UJ	34 UJ	34 UJ	34 U	34 UJ	33 UJ	37 UJ
SVOC	PHENACETIN	µg/Kg	40 U	13 U	13 U	18 U	16 U	14 U	14 U	13 U	14 U	13 U	15 U
SVOC	PHENANTHRENE	µg/Kg	**9700**	**550**	**2200**	**37** J	**50** J	6 U	6 U	5.9 U	**100** J	**53** J	**11** J
SVOC	PHENOL	µg/Kg	24 U	7.4 U	7.5 U	11 U	9.6 U	7.9 UJ	8 UJ	7.9 UJ	8 U	7.7 U	8.7 UJ
SVOC	PRONAMIDE	µg/Kg	36 U	11 U	11 U	16 U	15 U	12 U	12 U	12 U	12 U	12 U	13 U
SVOC	PYRENE	µg/Kg	**13000** J	**1200** J	**2800**	**80** J	**97** J	18 U	18 U	18 U	**200** J	**140** J	20 U
SVOC	PYRIDINE	µg/Kg	170 U	53 U	54 U	77 U	69 U	57 UJ	58 UJ	57 UJ	57 U	55 U	63 UJ
SVOC	SAFROLE	µg/Kg	48 U	15 U	15 U	22 U	20 U	16 U	16 U	16 U	16 U	16 U	18 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	1100 U	360 U	360 U	520 U	460 U	380 U	390 U	380 U	380 U	370 U	420 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	8.7 U	9.8 U	11 U	15 U	12 U	8.8 U	8.2 U	13 U	15 U	8.1 U	9.3 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	6.1 U	6.8 U	7.6 U	10 U	8 U	6.2 U	5.7 U	9 U	11 U	5.6 U	6.5 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	8.9 U	10 U	11 U	15 U	12 U	9 U	8.4 U	13 U	15 U	8.3 U	9.5 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	5.7 U	6.3 U	7 U	9.4 U	7.5 U	5.7 U	5.3 U	8.4 U	9.7 U	5.2 U	6 U
VOC	1,1-DICHLOROETHANE	µg/Kg	7.9 U	8.8 U	9.8 U	13 U	10 U	8 U	7.4 U	12 U	14 U	7.3 U	8.4 U
VOC	1,1-DICHLOROETHENE	µg/Kg	18 U	20 U	22 U	30 U	24 U	18 U	17 U	26 U	31 U	17 U	19 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	12 U	14 U	15 U	20 U	16 U	12 U	11 U	18 U	21 U	11 U	13 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	7.5 U	8.3 U	9.2 U	12 U	9.8 U	7.5 U	7 U	11 U	13 U	6.9 U	7.9 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	170 U	53 U	54 U	78 U	70 U	58 U	58 U	57 U	58 U	56 U	63 U
VOC	1,2-DICHLOROETHANE	µg/Kg	5.7 U	6.3 U	7 U	9.4 U	7.5 U	5.7 U	5.3 U	8.4 U	9.7 U	5.2 U	6 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	5.6 U	6.2 U	6.9 U	9.2 U	7.3 U	5.6 U	5.2 U	8.2 U	9.5 U	5.1 U	5.9 UJ
VOC	1,3-DICHLOROBENZENE	µg/Kg	180 U	56 U	57 U	81 U	73 U	60 U	60 U	59 U	60 U	58 U	66 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	160 U	51 U	51 U	74 U	66 U	55 UJ	55 UJ	54 UJ	55 U	53 U	60 UJ
VOC	2-HEXANONE	µg/Kg	41 U	46 U	51 U	68 U	54 U	41 U	39 U	61 U	70 U	38 U	44 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			706-1-C	706-2	706-2-C	7500-1	7500-2	7530-1	7530-1-D	7530-2	7734-1	7734-2	8046-1
			MidBlind_706-1-C	MidBlind_706-2	MidBlind_706-2-C	MidBlind_7500-1	MidBlind_7500-2	MidBlind_7530-1	MidBlind_7530-1-D	MidBlind_7530-2	MidBlind_7734-1	MidBlind_7734-2	MidBlind_8046-1
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	10/30/2006
		Samp	0-1	1-6	1-6	0-1	1-6	0-1	0-1	1-6	0-1	1-6	0-1
		:	Soil	Soil	Soil	Soil	Soil	SOIL	Soil	Soil	Soil	SOIL	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	19 UJ	21 UJ	23 UJ	31 UJ	24 UJ	19 U	18 U	28 U	32 UJ	17 U	20 UJ
VOC	ACETONITRILE	µg/Kg	230 UJ	250 UJ	280 UJ	370 UJ	300 UJ	230 UJ	210 UJ	330 UJ	390 UJ	210 UJ	240 UJ
VOC	ACROLEIN	µg/Kg	120 UJ	130 UJ	140 UJ	190 UJ	150 U	120 UJ	110 UJ	170 UJ	200 UJ	110 U	120 UJ
VOC	ACRYLONITRILE	µg/Kg	35 U	40 U	44 U	59 U	47 U	36 U	33 U	52 U	61 U	33 U	38 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	50 U	56 U	61 U	83 U	65 U	50 U	47 U	74 U	85 U	46 U	53 U
VOC	BENZENE	µg/Kg	5.2 U	5.8 U	6.4 U	8.6 U	6.8 U	5.2 U	4.9 U	7.6 U	8.9 U	4.8 U	5.5 U
VOC	BROMODICHLOROMETHANE	µg/Kg	6.7 U	7.5 U	8.3 U	11 U	8.8 U	6.8 U	6.3 U	9.9 U	12 U	6.2 U	7.2 U
VOC	BROMOFORM	µg/Kg	8.4 U	9.4 U	10 U	14 U	11 U	8.5 U	7.9 U	12 U	14 U	7.8 U	9 U
VOC	BROMOMETHANE	µg/Kg	75 U	84 U	92 U	120 U	98 U	75 U	70 U	110 U	130 U	69 U	80 U
VOC	CARBON DISULFIDE	µg/Kg	5.4 U	6.1 U	6.7 U	9 U	7.1 U	5.5 U	5.1 U	8 U	9.3 U	5 U	5.8 U
VOC	CARBON TETRACHLORIDE	µg/Kg	6 U	6.7 U	7.4 U	9.9 U	7.8 U	6 U	5.6 U	8.8 U	10 U	5.5 U	6.4 U
VOC	CHLOROBENZENE	µg/Kg	8.2 U	9.2 U	10 U	14 U	11 U	8.3 U	7.7 U	12 U	14 U	7.6 U	8.7 U
VOC	CHLOROETHANE	µg/Kg	30 UJ	34 UJ	37 UJ	50 UJ	40 UJ	30 U	28 U	45 U	52 UJ	28 UJ	32 U
VOC	CHLOROFORM	µg/Kg	7 U	7.8 U	8.7 U	12 U	9.2 U	7.1 U	6.6 U	10 U	12 U	6.5 U	7.5 U
VOC	CHLOROMETHANE	µg/Kg	23 U	26 U	29 U	38 U	30 U	23 U	22 U	34 U	40 U	21 U	25 UJ
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	50 U	56 U	61 U	83 U	65 U	50 U	47 U	74 U	85 U	46 U	53 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	5.7 U	6.4 U	7.1 U	9.5 U	7.5 U	5.8 U	5.4 U	8.5 U	9.8 U	5.3 U	6.1 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	4.5 U	5 U	5.5 U	7.4 U	5.9 U	4.5 U	4.2 U	6.6 U	7.7 U	4.1 U	4.8 U
VOC	DIBROMOMETHANE	µg/Kg	7.8 U	8.7 U	9.6 U	13 U	10 U	7.8 U	7.3 U	12 U	13 U	7.2 U	8.3 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	18 U	20 U	22 U	30 U	24 UJ	18 U	17 U	27 U	31 U	17 U	19 U
VOC	ETHYL BENZENE	µg/Kg	10 U	12 U	13 U	17 U	14 U	10 UJ	9.7 UJ	15 UJ	18 U	9.5 U	11 UJ
VOC	ETHYL METHACRYLATE	µg/Kg	50 U	56 U	61 U	83 U	65 U	50 U	47 U	74 U	85 U	46 U	53 U
VOC	ISOBUTANOL	µg/Kg	50 UJ	56 UJ	61 UJ	83 UJ	65 UJ	50 UJ	47 UJ	74 UJ	85 UJ	46 UJ	53 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	16 U	17 U	19 U	26 U	20 U	16 U	15 U	23 U	27 U	14 U	17 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	45 U	50 U	56 U	75 U	59 U	45 UJ	42 UJ	67 UJ	77 U	42 U	48 UJ
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	8.6 U	9.6 U	11 U	14 U	11 U	8.7 U	8.1 U	13 U	15 U	7.9 U	9.2 U
VOC	METHYL METHACRYLATE	µg/Kg	50 U	56 U	61 U	83 U	65 U	50 U	47 U	74 U	85 U	46 U	53 U
VOC	METHYLACRYLONITRILE	µg/Kg	250 U	280 U	310 U	410 U	330 UJ	250 U	230 U	370 U	430 U	230 U	270 U
VOC	METHYLENE CHLORIDE	µg/Kg	24 U	27 U	29 U	40 U	31 U	24 U	22 U	**87** J	41 U	22 U	25 U
VOC	PENTOCHLORETHANE	µg/Kg	39 U	12 U	12 U	18 U	16 U	13 U	13 U	13 U	13 U	13 U	14 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	50 UJ	56 UJ	61 UJ	83 UJ	65 UJ	50 UJ	47 UJ	74 UJ	85 UJ	46 UJ	53 UJ
VOC	STYRENE	µg/Kg	7.6 U	8.4 U	9.3 U	13 U	9.9 U	7.6 U	7.1 U	11 U	13 U	7 U	8.1 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	9.5 U	11 U	12 U	16 U	13 U	9.6 U	9 U	14 U	16 U	8.8 U	10 U
VOC	TOLUENE	µg/Kg	**830**	**2700**	**4400**	45 U	**53** J	**160** J	26 UJ	**2100** J	**1700**	**6900**	29 UJ
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	8.2 U	9.1 U	10 U	14 U	11 U	8.2 U	7.7 U	12 U	14 U	7.5 U	8.7 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	7 U	7.8 U	8.7 U	12 U	9.2 U	7.1 U	6.6 U	10 U	12 U	6.5 U	7.5 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	36 U	40 U	44 U	60 U	47 U	36 U	34 U	53 U	61 U	33 U	38 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	8.8 U	9.8 U	11 U	15 U	12 U	8.9 U	8.3 U	13 U	15 U	8.1 U	9.4 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	13 U	14 U	16 U	21 U	17 U	13 U	12 U	19 U	22 U	12 U	13 U
VOC	VINYL ACETATE	µg/Kg	49 U	54 U	60 U	81 U	64 U	49 U	46 U	72 U	83 U	45 U	52 U
VOC	VINYL CHLORIDE	µg/Kg	17 U	20 U	22 U	29 U	23 U	18 U	16 U	26 U	30 U	16 U	19 U
VOC	XYLENES, TOTAL	µg/Kg	28 U	32 U	35 U	47 U	37 U	29 U	27 U	42 U	**55** J	26 U	30 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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Midland Area Soils

			8046-2	8196-1	8196-2	8282-1	8282-2	8314-1	8314-2	876-1	876-2	9386-1	9386-2
			MidBlind_8046-2	MidBlind_8196-1	MidBlind_8196-2	MidBlind_8282-1	MidBlind_8282-2	MidBlind_8314-1	MidBlind_8314-2	MidBlind_876-1	MidBlind_876-2	MidBlind_9386-1	MidBlind_9386-2
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	SOIL	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
GEN	CYANIDE, TOTAL	µg/Kg	**45** J	0.034 U	**89** J	**850**	**98** J	**70** J	**340**	**150** J	**330** J	**540** J	**600**
GEN	SULFIDE	mg/kg	100 UJ	90 UJ	89 UJ	110 U	98 U	94 U	93 U	93 U	89 U	91 U	89 U
GEN	TOTAL ORGANIC CARBON	mg/kg	**22000**	**20000**	73 U	**22000**	**9300**	**12000**	**15000**	**16000**	**8800**	**28000**	**11000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.5 U	2.2 U	2.2 U	2.6 U	2.4 U	2.3 U	2.3 U	2.3 U	2.2 U	2.3 U	2.2 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	2.1 U	**12** J	**28**	2.2 U	2 U	1.9 U	1.9 U	1.9 U	1.8 U	**13** J	**16** J
HERB	DINOSEB	µg/Kg	67 U	59 U	58 U	69 U	64 U	61 UJ	61 UJ	60 U	57 UJ	59 U	58 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2.2 U	2 U	1.9 U	2.3 U	2.1 U	2 U	2 U	2 U	1.9 U	2 U	2 U
MET	ANTIMONY	µg/Kg	240 U	790 UJ	450 U	490 U	310 U	480 U	220 U	**4200** J	**3500** J	**2800** J	**2700** J
MET	ARSENIC	µg/Kg	**5700**	**5800**	**200** J	**1900**	**1100** J	**4000**	**4500**	**7500**	**4800**	370 U	360 U
MET	BARIUM	µg/Kg	**34000**	**32000** J	**27000**	**57000**	**63000**	**27000**	**29000**	**14000** J	**18000**	**24000**	**17000**
MET	BERYLLIUM	µg/Kg	**240** J	**220** J	**210** J	**430**	**480**	**170** J	**180** J	35 U	47 U	**180** J	**78** J
MET	CADMIUM	µg/Kg	**160** J	**110** J	**38** J	**330**	15 U	**190** J	**210** J	73 U	**130** J	**120** J	**58** J
MET	CHROMIUM, TOTAL	µg/Kg	**4200**	**11000** J	**6600**	**15000**	**17000**	**5800**	**5200**	**5500** J	**7900**	**47000**	**39000**
MET	COBALT	µg/Kg	**2300**	**3000** J	**2800**	**6800**	**7400**	**2200**	**1700**	**1700** J	**2000**	**2900**	**1900**
MET	COPPER	µg/Kg	**29000**	**16000** J	**11000**	**24000**	**21000**	**13000**	**18000**	**9900** J	**13000**	**43000**	**55000**
MET	LEAD	µg/Kg	**15000**	**16000** J	**9900**	**13000**	**9600**	**40000**	**34000**	**21000** J	**37000**	**15000**	**15000**
MET	MERCURY	µg/Kg	**26**	**36**	**43**	**42**	**22**	**33**	**36**	4.2 U	**37**	**96**	**170**
MET	NICKEL	µg/Kg	**5600**	**9000** J	**7700**	**18000**	**19000**	**6400**	**5600**	**6300**	**7300**	**6900**	**5600**
MET	SELENIUM	µg/Kg	530 U	480 U	460 U	550 U	520 U	490 U	490 U	**5700**	930 U	960 U	940 U
MET	SILVER	µg/Kg	59 U	53 U	52 U	61 U	58 U	55 U	54 U	**1700** J	**270** J	110 U	110 U
MET	THALLIUM	µg/Kg	210 U	190 U	190 U	220 U	210 U	200 U	200 U	990 U	370 U	390 U	380 U
MET	TIN	µg/Kg	570 U	**2200** J	490 U	580 U	550 U	530 U	520 U	2600 U	990 U	1000 U	1000 U
MET	VANADIUM	µg/Kg	**15000**	**12000** J	**10000**	**21000**	**24000**	**10000**	**8400**	**6300** J	**8300**	**7200**	**6500**
MET	ZINC	µg/Kg	64 U	58 UJ	56 U	**71000**	**45000**	**43000**	**37000**	**81000** J	**110000**	**190000**	**180000**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	6.7 U	6 U	5.9 UJ	7.1 U	6.6 U	6.3 U	6.2 U	6.3 U	30 U	6.1 U	6 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	12 U	10 U	10 UJ	12 U	11 U	11 U	11 U	11 U	51 U	11 U	10 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	13 U	11 U	11 UJ	13 U	12 U	12 U	12 U	12 U	56 U	12 U	11 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	15 U	13 U	13 UJ	15 U	14 U	14 U	14 U	14 U	65 U	13 U	13 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	9.8 U	8.7 U	8.5 UJ	10 U	9.5 U	9.1 U	9.1 U	9.1 U	43 U	8.9 U	8.7 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	8.1 U	7.2 U	7.1 UJ	8.5 U	7.9 U	7.6 U	7.5 U	7.6 U	36 U	7.4 U	7.2 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	6.8 U	6 U	5.9 UJ	7.1 U	6.6 U	6.3 U	6.3 U	6.3 U	30 U	6.2 U	6 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	8.9 U	8 U	7.8 UJ	9.4 U	8.7 U	8.3 U	8.3 U	**370**	**970** J	8.1 U	7.9 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	12 U	11 U	11 UJ	13 U	12 U	11 U	11 U	11 U	54 U	11 U	11 U
PCB	SUMMED PCB	µg/Kg	**46**	**41**	**40**	**48**	**44**	**42**	**42**	**410**	**1200**	**42**	**40**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	53 U	41 U	43 U	56 U	45 U	71 U	47 U	40 U	38 U	45 U	38 U
PEST	4,4'-DDD	µg/Kg	0.73 U	**3.8** J	**6.8** J	0.76 U	0.71 U	0.68 U	**1.7** J	0.68 U	3.2 U	**2.7** J	0.64 U
PEST	4,4'-DDE	µg/Kg	**1.9** J	**4.6** J	0.85 U	1 U	0.95 U	**5.6** J	**6.5** J	**4** J	4.3 U	0.89 U	**7.3** J
PEST	4,4'-DDT	µg/Kg	1.1 U	**1** J	**5.5** J	1.2 U	1.1 U	**9.3** J	**4.4** J	1 U	4.9 U	**21** J	**26** J
PEST	ALDRIN	µg/Kg	0.75 U	0.67 U	0.66 U	0.79 U	0.73 U	0.7 U	0.7 U	0.7 U	3.3 U	0.68 U	0.67 U
PEST	ALPHA BHC	µg/Kg	0.95 U	0.85 U	**0.91** J	**4.8** J	0.93 U	0.88 U	0.88 U	0.88 U	4.2 U	0.87 U	**1** J
PEST	BETA BHC	µg/Kg	1 U	0.91 U	0.9 U	1.1 U	1 U	0.95 U	0.95 U	0.95 U	4.6 U	**30** J	**8.5** J
PEST	CHLORDANE	µg/Kg	1 U	**12** J	**15** J	1.1 U	0.98 U	0.93 U	0.93 U	0.93 U	4.4 U	0.91 U	0.89 U
PEST	DELTA BHC	µg/Kg	0.93 U	0.83 U	0.81 U	**3** J	0.9 U	0.86 U	0.86 U	0.86 U	4.1 U	0.84 U	0.82 U
PEST	DIELDRIN	µg/Kg	0.75 U	0.67 U	0.66 U	**5.5** J	**1.1** J	0.7 U	0.7 U	0.7 U	3.3 U	**2.7** J	**3.8** J
PEST	DIMETHOATE	µg/Kg	65 U	58 U	57 U	67 U	63 U	60 U	60 U	59 U	56 U	58 U	57 U
PEST	DISULFOTON	µg/Kg	11 U	9.7 U	9.5 U	11 U	11 U	10 U	10 U	9.9 U	9.5 U	9.7 U	9.6 U
PEST	ENDOSULFAN I	µg/Kg	0.58 U	0.51 U	0.5 U	0.6 U	0.56 U	0.54 U	0.53 U	0.54 U	2.6 U	**2.1** J	**1.3** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			8046-2	8196-1	8196-2	8282-1	8282-2	8314-1	8314-2	876-1	876-2	9386-1	9386-2
			MidBlind_8046-2	MidBlind_8196-1	MidBlind_8196-2	MidBlind_8282-1	MidBlind_8282-2	MidBlind_8314-1	MidBlind_8314-2	MidBlind_876-1	MidBlind_876-2	MidBlind_9386-1	MidBlind_9386-2
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	SOIL	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
PEST	ENDOSULFAN II	µg/Kg	0.63 U	0.56 U	0.55 U	0.66 U	0.61 U	0.58 U	**1.4** J	0.58 U	2.8 U	0.57 U	0.56 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**0.6**	**0.54**	**0.52**	**0.63**	**0.59**	**0.56**	**1.6**	**0.56**	**2.7**	**2.3**	**1.6**
PEST	ENDOSULFAN SULFATE	µg/Kg	0.9 U	0.8 U	0.79 U	0.95 U	0.88 U	0.84 U	0.84 U	0.84 U	4 U	0.82 U	0.8 U
PEST	ENDRIN	µg/Kg	0.91 U	22	0.8 U	**12** J	0.89 U	**9.4** J	0.85 U	0.85 U	4.1 U	0.83 U	0.81 U
PEST	ENDRIN ALDEHYDE	µg/Kg	0.94 U	0.84 U	0.82 U	0.98 U	0.91 U	0.87 U	0.87 U	0.87 U	4.2 U	0.86 U	0.83 U
PEST	FAMPHUR	µg/Kg	35 UJ	31 UJ	31 UJ	37 UJ	34 UJ	33 UJ	32 UJ	32 UJ	31 UJ	31 UJ	31 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	0.73 U	0.65 U	0.63 U	0.76 U	0.71 U	0.68 U	0.67 U	0.68 U	3.2 U	0.66 U	0.64 U
PEST	HEPTACHLOR	µg/Kg	0.75 U	0.67 U	0.66 U	0.79 U	0.73 U	0.7 U	0.7 U	0.7 U	3.3 U	0.68 U	0.67 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	1 U	**1.1** J	0.91 U	**1.6** J	**1** J	**3.5** J	0.96 U	0.97 U	4.6 U	0.95 U	0.92 U
PEST	KEPONE	µg/Kg	2100 U	1900 U	1800 U	2200 U	2000 U	1900 U	1900 U	1900 U	1800 U	1900 U	1800 U
PEST	METHOXYCHLOR	µg/Kg	1.3 U	**12** J	1.1 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	5.6 U	**6.8** J	**9.1** J
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	12 U	11 U	10 U	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	22 U	19 U	19 U	22 U	21 U	20 U	20 U	20 U	19 U	19 U	19 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	22 U	19 U	19 U	22 U	21 U	20 U	20 U	19 U	19 U	19 U	19 U
PEST	PARATHION, METHYL	µg/Kg	14 U	13 U	12 U	15 U	14 U	13 U	13 U	13 U	12 U	13 U	12 U
PEST	PHORATE	µg/Kg	11 U	9.8 U	9.6 U	11 U	11 U	10 UJ	10 UJ	10 UJ	9.5 UJ	9.8 U	9.6 U
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	840 U	740 U	730 U	860 U	810 U	770 U	770 U	760 U	720 U	740 U	730 U
PEST	TOXAPHENE	µg/Kg	12 U	10 U	10 U	12 U	11 U	11 U	11 U	11 U	52 U	11 U	10 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	10 U	9 U	8.8 U	10 U	9.7 U	9.3 U	9.2 U	9.1 U	8.7 U	8.9 U	8.8 U
SVOC	1,3-DINITROBENZENE	µg/Kg	9.4 U	8.3 U	8.1 U	9.7 U	9 U	8.6 U	8.6 U	8.5 U	8.1 U	8.3 U	8.2 U
SVOC	1,4-DIOXANE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 UJ	380 UJ	380 UJ	360 UJ	370 U	370 U
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	14 U	13 U	12 U	15 U	14 U	13 UJ	13 UJ	13 U	12 UJ	13 U	12 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 UJ
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	41 U	37 U	36 U	43 U	40 U	38 U	38 U	37 U	36 U	37 U	36 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	17 U	**450**	**440**	18 U	17 U	16 U	16 U	**23** J	**42** J	15 U	15 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	9.5 U	8.4 U	8.2 U	9.8 U	9.2 U	8.8 U	8.7 U	8.6 U	8.2 U	8.4 U	8.3 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	7.3 U	**25** J	**29** J	7.5 U	7 U	6.7 U	6.6 U	6.6 U	6.3 U	6.4 U	6.3 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	32 U	28 U	27 U	32 U	30 U	29 U	29 U	29 U	27 U	28 U	28 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	69 U	61 U	60 U	71 U	67 U	64 U	63 U	63 U	60 U	61 U	60 U
SVOC	2,4-DINITROPHENOL	µg/Kg	24 U	21 U	21 U	25 U	23 U	22 UJ	22 UJ	22 U	21 UJ	21 U	21 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	34 U	30 U	30 U	35 U	33 U	32 U	31 U	31 U	30 U	30 U	30 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	17 U	15 U	15 U	17 U	16 U	16 U	15 U	15 U	15 U	15 U	15 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	7.2 U	6.4 U	6.3 U	7.5 U	7 U	6.7 U	6.6 U	6.5 U	6.3 U	6.4 U	6.3 U
SVOC	2-Acetylaminofluorene	µg/Kg	16 U	15 U	14 U	17 U	16 U	15 U	15 U	15 U	14 U	15 U	14 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	31 U	27 U	27 U	32 U	30 U	28 U	28 U	28 U	27 U	27 U	27 U
SVOC	2-CHLOROPHENOL	µg/Kg	32 U	28 U	27 U	32 U	30 U	29 U	29 U	29 U	27 U	28 U	28 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	9.1 U	**11** J	7.8 U	9.3 U	8.7 U	8.3 U	8.3 U	8.2 U	7.8 U	8 U	7.9 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	21 U	19 U	19 U	22 U	21 U	20 U	20 U	19 U	18 U	19 U	19 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 U
SVOC	2-NITROANILINE	µg/Kg	9.6 U	8.5 U	8.3 U	9.9 U	9.2 U	8.8 U	8.8 U	8.7 U	8.3 U	8.5 U	8.4 U
SVOC	2-NITROPHENOL	µg/Kg	12 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	12 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	71 U	63 U	62 U	73 U	69 U	66 U	65 U	64 U	61 U	63 U	62 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	22 U	20 U	19 U	23 U	21 U	21 U	20 U	20 U	19 U	20 U	19 U

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			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	SOIL	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	3-NITROANILINE	µg/Kg	8.4 U	7.4 U	7.3 U	8.6 U	8.1 U	7.7 U	7.6 U	7.6 U	7.2 U	7.4 U	7.3 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	16 U	14 U	14 U	16 U	15 U	15 U	15 U	14 U	14 U	14 U	14 U
SVOC	4-AMINOBIPHENYL	µg/Kg	12 U	11 U	10 U	12 U	12 U	11 U	11 U	11 U	10 U	11 U	11 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	16 U	14 U	14 U	16 U	15 U	14 U	14 U	14 U	14 U	14 U	14 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	13 U	11 U	11 U	13 U	12 U	12 U	12 U	11 U	11 U	11 U	11 U
SVOC	4-CHLOROANILINE	µg/Kg	52 U	46 U	45 U	53 U	50 U	48 U	47 U	47 U	45 U	46 U	45 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	5.9 U	5.2 U	5.1 U	6.1 U	5.7 U	5.5 U	5.4 U	5.3 U	5.1 U	5.2 U	5.2 U
SVOC	4-NITROANILINE	µg/Kg	49 U	44 U	43 U	51 U	47 U	45 U	45 U	44 U	42 U	43 U	43 U
SVOC	4-NITROPHENOL	µg/Kg	11 U	9.3 U	9.1 U	11 U	10 U	9.7 U	9.6 U	9.5 U	9.1 U	9.3 U	9.2 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	10 U	9 U	8.9 U	11 U	9.8 U	9.4 U	9.3 U	9.2 UJ	8.8 U	9 U	8.9 U
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	13 U	12 U	12 U	14 U	13 U	12 U	12 U	12 U	12 U	12 U	12 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	16 U	15 U	14 U	17 U	16 U	15 U	15 U	15 U	14 U	15 U	14 U
SVOC	ACENAPHTHENE	µg/Kg	9.1 UJ	8 UJ	7.8 UJ	9.3 UJ	8.7 UJ	8.3 U	8.3 U	8.2 U	7.8 U	8 UJ	7.9 UJ
SVOC	ACENAPHTHYLENE	µg/Kg	9.2 U	8.1 U	**64** J	9.4 U	8.8 U	8.4 U	8.4 U	8.3 U	7.9 U	8.1 U	8 U
SVOC	ACETOPHENONE	µg/Kg	10 U	9.2 U	9 U	11 U	10 U	9.6 U	9.5 U	9.4 U	9 U	9.2 U	9.1 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 UJ	360 U	370 U	370 U
SVOC	ANILINE	µg/Kg	54 U	48 U	47 U	56 U	52 U	50 U	50 U	49 U	47 U	48 U	47 U
SVOC	ANTHRACENE	µg/Kg	6.3 U	**71** J	**29** J	6.5 U	6.1 U	**74** J	**11** J	**17** J	**26** J	**11** J	**13** J
SVOC	ARAMITE (TOTAL)	µg/Kg	87 U	77 U	75 U	89 U	84 U	80 U	79 U	78 U	75 U	77 U	76 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	7.4 U	**190** J	6.4 U	7.6 U	7.1 U	**400**	6.8 U	6.7 U	6.4 U	6.6 U	6.5 U
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**49** J	**220** J	**87** J	**47** J	**44** J	**560**	**92** J	**190** J	**180** J	**64** J	7 U
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**160** J	**200** J	**160** J	**170** J	**160** J	**620** J	**150** J	**200** J	**160** J	**160** J	**150** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	**52** J	**86** J	**62** J	12 U	11 U	**200** J	**91** J	**68** J	**66** J	10 U	**56** J
SVOC	BENZYL ALCOHOL	µg/Kg	9.2 U	8.2 U	8 U	9.5 U	8.9 U	8.5 U	8.4 U	8.3 U	7.9 U	8.1 U	8 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	9.7 U	8.6 U	8.4 U	9.9 U	9.3 U	8.9 U	8.8 U	8.7 U	8.3 U	8.6 U	8.4 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	6.5 U	5.8 U	5.7 U	6.7 U	6.3 U	6 U	6 U	5.9 U	5.6 U	5.8 U	5.7 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	46 U	40 U	40 U	47 U	44 U	42 U	42 U	41 U	39 U	40 U	40 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	20 U	18 U	17 U	21 U	19 U	18 U	18 U	**33** J	**35** J	18 U	17 U
SVOC	CHLOROBENZILATE	µg/Kg	24 U	21 U	21 U	25 U	23 U	22 U	22 U	22 U	21 U	21 U	21 U
SVOC	CHRYSENE	µg/Kg	**33** J	**190** J	**84** J	**28** J	13 U	**490**	**54** J	**120** J	**130** J	**51** J	12 U
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	8.4 U	7.5 U	7.3 U	8.7 U	8.1 U	7.8 U	7.7 U	7.6 U	7.3 U	7.5 U	**59** J
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8.8 UJ	7.8 UJ	7.6 UJ	9.1 UJ	8.5 UJ	8.1 U	8 U	7.9 U	7.6 U	7.8 UJ	7.7 UJ
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	35 U	31 U	30 U	36 U	34 U	32 U	32 U	32 U	30 U	31 U	31 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	39 U	**43** J	34 U	40 U	38 U	**120** J	36 U	35 U	**39** J	**64** J	**66** J
SVOC	DIBENZOFURAN	µg/Kg	5.4 U	**12** J	4.7 U	5.5 U	5.2 U	5 U	4.9 U	4.9 U	4.7 U	4.8 U	4.7 U
SVOC	DIETHYL PHTHALATE	µg/Kg	6.9 U	6.1 U	6 U	7.1 U	6.6 U	6.4 U	6.3 U	6.2 U	5.9 U	6.1 U	**13** J
SVOC	DIMETHYL PHTHALATE	µg/Kg	25 U	22 U	22 U	26 U	24 U	23 U	23 U	23 U	22 U	22 U	22 U
SVOC	DIPHENYLAMINE	µg/Kg	34 U	30 U	30 U	35 U	33 U	32 U	31 U	31 U	30 U	30 U	30 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	15 U	13 U	13 U	16 U	15 U	14 U	14 U	14 U	13 U	13 U	13 U
SVOC	FLUORANTHENE	µg/Kg	11 UJ	**410** J	**90** J	12 UJ	11 UJ	**950**	**160** J	**200** J	**270** J	**37** J	9.7 UJ
SVOC	FLUORENE	µg/Kg	7.1 U	**22** J	**15** J	7.3 U	6.8 U	**18** J	6.4 U	6.4 U	6.1 U	6.2 U	6.2 U
SVOC	HEXACHLOROBENZENE	µg/Kg	12 U	**190** J	11 U	13 U	12 U	11 U	11 U	**13** J	11 U	11 U	11 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	41 U	36 U	36 U	42 U	39 U	38 U	37 U	37 U	35 U	36 U	36 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	31 U	28 U	27 U	32 U	30 U	29 U	28 U	28 U	27 U	27 U	27 U
SVOC	HEXACHLOROETHANE	µg/Kg	56 U	50 U	49 U	58 U	54 U	52 U	51 U	51 U	48 U	50 U	49 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			8046-2	8196-1	8196-2	8282-1	8282-2	8314-1	8314-2	876-1	876-2	9386-1	9386-2
			MidBlind_8046-2	MidBlind_8196-1	MidBlind_8196-2	MidBlind_8282-1	MidBlind_8282-2	MidBlind_8314-1	MidBlind_8314-2	MidBlind_876-1	MidBlind_876-2	MidBlind_9386-1	MidBlind_9386-2
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	SOIL	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
SVOC	HEXACHLOROPHENE	µg/Kg	840 UJ	740 UJ	730 UJ	860 UJ	810 UJ	770 UJ	770 UJ	760 UJ	720 UJ	740 UJ	730 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	56 U	49 U	48 U	57 U	54 U	51 U	51 U	50 U	48 U	49 U	49 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	29 U	**120** J	**57** J	30 U	28 U	**770** J	**120** J	**210** J	**190** J	**32** J	25 U
SVOC	ISODRIN	µg/Kg	23 U	21 U	20 U	24 U	23 U	22 U	21 U	21 U	20 U	21 U	20 U
SVOC	ISOPHORONE	µg/Kg	5.8 U	5.2 U	5.1 U	6 U	5.6 U	5.4 U	5.3 U	5.3 U	5 U	5.2 U	5.1 U
SVOC	ISOSAFROLE	µg/Kg	20 U	18 U	18 U	21 U	20 U	19 U	19 U	18 U	18 U	18 U	18 U
SVOC	METHAPYRILENE	µg/Kg	49 U	43 U	42 U	50 U	47 U	45 U	45 U	44 U	42 U	43 U	43 UJ
SVOC	METHYL METHANESULFONATE	µg/Kg	24 U	21 U	21 U	25 U	23 U	22 U	22 U	22 U	21 U	21 U	21 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	12 U	11 U	11 U	13 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	9.5 U	8.4 U	8.2 U	9.8 U	9.2 U	8.8 U	8.7 U	8.6 U	8.2 U	8.4 U	8.3 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	22 U	20 U	19 U	23 U	21 U	20 U	20 U	20 U	19 U	20 U	19 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	50 UJ	45 UJ	44 UJ	52 UJ	49 UJ	47 U	46 U	46 UJ	44 U	45 UJ	44 UJ
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	14 U	12 U	12 U	14 UJ	13 UJ	13 U	13 U	13 U	12 U	12 UJ	12 UJ
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	19 U	17 U	16 U	20 UJ	18 UJ	18 U	17 U	17 U	16 U	17 UJ	17 UJ
SVOC	N-NITROSOMORPHOLINE	µg/Kg	22 U	20 U	19 U	23 U	22 U	21 U	20 U	20 U	19 U	20 U	20 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	14 U	12 U	12 U	14 U	13 U	13 U	12 U	12 U	12 U	12 U	12 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 U
SVOC	NAPHTHALENE	µg/Kg	34 U	**68** J	**49** J	35 U	32 U	31 U	31 U	30 U	29 U	**510**	**430**
SVOC	NITROBENZENE	µg/Kg	43 U	38 U	38 U	45 U	42 U	40 U	39 U	39 U	37 U	38 U	38 U
SVOC	O-TOLUIDINE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	15 U	14 U	13 U	16 U	15 U	14 U	14 U	14 U	13 U	14 U	13 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	34 U	30 U	30 U	35 U	33 U	32 UJ	31 UJ	31 UJ	30 UJ	30 U	30 U
SVOC	PENTACHLOROBENZENE	µg/Kg	34 U	30 U	29 U	35 U	32 U	31 U	31 U	30 U	29 U	30 U	29 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	23 U	21 U	20 U	24 U	22 U	21 U	21 U	21 U	20 U	21 U	20 U
SVOC	PENTACHLOROPHENOL	µg/Kg	37 UJ	**360** J	**400** J	38 UJ	36 UJ	34 UJ	34 UJ	34 UJ	**37** J	33 UJ	32 UJ
SVOC	PHENACETIN	µg/Kg	15 U	13 U	13 U	15 U	14 U	14 U	14 U	13 U	13 U	13 U	13 U
SVOC	PHENANTHRENE	µg/Kg	**13** J	**240** J	**37** J	6.8 U	6.3 U	**420**	**62** J	**93** J	**110** J	**71** J	**85** J
SVOC	PHENOL	µg/Kg	8.7 UJ	7.7 UJ	7.5 UJ	8.9 UJ	8.4 UJ	8 U	7.9 U	7.9 U	7.5 U	7.7 UJ	7.6 UJ
SVOC	PRONAMIDE	µg/Kg	13 U	12 U	12 U	14 U	13 U	12 U	12 U	12 U	11 U	12 U	12 U
SVOC	PYRENE	µg/Kg	20 U	**260** J	**63** J	20 U	19 U	**840** J	**130** J	**230** J	**220** J	**41** J	**32** J
SVOC	PYRIDINE	µg/Kg	63 UJ	55 UJ	54 UJ	64 UJ	60 UJ	58 U	57 U	57 U	54 U	55 UJ	55 UJ
SVOC	SAFROLE	µg/Kg	18 U	16 U	15 U	18 U	17 U	16 U	16 U	16 U	15 U	16 U	16 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	420 U	370 U	360 U	430 U	400 U	390 U	380 U	380 U	360 U	370 U	370 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	11 U	8.2 U	8.6 U	11 U	9.2 U	14 U	9.6 U	8.2 U	7.8 U	9.2 U	7.7 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	7.5 U	5.8 U	6 U	7.9 U	6.4 U	10 U	6.7 U	5.7 U	5.4 U	6.4 U	5.4 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	11 U	8.4 U	8.8 U	12 U	9.4 U	15 U	9.8 U	8.4 U	7.9 U	9.4 U	7.9 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	6.9 U	5.3 U	5.6 U	7.3 U	5.9 U	9.4 U	6.2 U	5.3 U	5 U	6 U	5 U
VOC	1,1-DICHLOROETHANE	µg/Kg	9.7 U	7.5 U	7.8 U	10 U	8.3 U	13 U	8.7 U	7.4 U	7 U	8.3 U	6.9 U
VOC	1,1-DICHLOROETHENE	µg/Kg	22 U	17 U	18 U	23 U	19 U	29 U	20 U	17 U	16 U	19 U	16 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	15 U	12 U	12 U	16 U	13 U	20 U	13 U	11 U	11 U	13 U	11 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	9.1 U	7 U	7.4 U	9.7 U	7.8 U	12 U	8.2 U	7 U	6.6 U	7.9 U	6.6 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	63 U	56 U	55 U	65 U	61 U	58 U	57 U	57 U	54 U	56 U	55 U
VOC	1,2-DICHLOROETHANE	µg/Kg	6.9 U	5.3 U	5.6 U	7.3 U	5.9 U	9.4 U	6.2 U	5.3 U	5 U	6 U	5 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	6.8 UJ	5.3 UJ	5.5 UJ	7.2 U	5.8 U	9.2 U	6.1 U	5.2 U	4.9 U	5.9 U	4.9 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	66 U	58 U	57 U	68 U	63 U	60 U	60 U	59 U	57 U	58 U	57 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	60 UJ	53 UJ	52 UJ	61 UJ	57 UJ	55 U	54 U	54 U	51 U	53 UJ	52 UJ
VOC	2-HEXANONE	µg/Kg	50 U	39 U	41 U	53 U	43 U	68 U	45 U	39 U	36 U	43 U	36 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			8046-2	8196-1	8196-2	8282-1	8282-2	8314-1	8314-2	876-1	876-2	9386-1	9386-2
			MidBlind_8046-2	MidBlind_8196-1	MidBlind_8196-2	MidBlind_8282-1	MidBlind_8282-2	MidBlind_8314-1	MidBlind_8314-2	MidBlind_876-1	MidBlind_876-2	MidBlind_9386-1	MidBlind_9386-2
			10/30/2006	10/30/2006	10/30/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006
		Samp	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6	0-1	1-6
		:	Soil	SOIL	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**											
VOC	ACETONE	µg/Kg	23 UJ	18 UJ	18 UJ	24 UJ	19 UJ	31 UJ	20 U	18 UJ	17 UJ	20 UJ	16 UJ
VOC	ACETONITRILE	µg/Kg	270 UJ	210 UJ	220 UJ	290 UJ	240 UJ	370 UJ	250 UJ	210 UJ	200 UJ	240 UJ	200 UJ
VOC	ACROLEIN	µg/Kg	140 UJ	110 UJ	120 UJ	150 UJ	120 UJ	190 U	130 U	110 U	100 U	120 UJ	100 UJ
VOC	ACRYLONITRILE	µg/Kg	43 U	33 U	35 U	46 U	37 U	**260** J	39 U	33 U	31 U	37 U	31 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	61 U	47 U	49 U	64 U	52 U	82 U	54 U	47 U	44 U	52 U	44 U
VOC	BENZENE	µg/Kg	6.3 U	4.9 U	5.1 U	6.7 U	5.4 U	8.5 U	5.7 U	4.9 U	4.6 U	5.4 U	4.5 U
VOC	BROMODICHLOROMETHANE	µg/Kg	8.2 U	6.3 U	6.6 U	8.7 U	7 U	11 U	7.3 U	6.3 U	6 U	7.1 U	5.9 U
VOC	BROMOFORM	µg/Kg	10 U	7.9 U	8.3 U	11 U	8.8 U	14 U	9.2 U	7.9 U	7.5 U	8.8 U	7.4 U
VOC	BROMOMETHANE	µg/Kg	91 U	71 U	74 U	97 U	78 U	120 U	82 U	70 U	66 U	79 U	66 U
VOC	CARBON DISULFIDE	µg/Kg	6.6 U	5.1 U	5.4 U	7 U	5.7 U	8.9 U	5.9 U	5.1 U	4.8 U	5.7 U	4.8 U
VOC	CARBON TETRACHLORIDE	µg/Kg	7.3 U	5.6 U	5.9 U	7.7 U	6.2 U	9.8 U	6.5 U	5.6 U	5.3 U	6.3 U	5.2 U
VOC	CHLOROBENZENE	µg/Kg	10 U	7.7 U	8.1 U	11 U	8.6 U	14 U	9 U	7.7 U	7.3 U	8.6 U	7.2 U
VOC	CHLOROETHANE	µg/Kg	37 U	28 U	30 UJ	39 U	32 U	50 UJ	33 UJ	28 U	27 UJ	32 U	26 U
VOC	CHLOROFORM	µg/Kg	8.6 U	6.6 U	6.9 U	9.1 U	7.3 U	12 U	7.7 U	6.6 UJ	6.2 U	7.4 U	6.2 U
VOC	CHLOROMETHANE	µg/Kg	28 UJ	22 UJ	23 U	30 UJ	24 UJ	**87**	25 U	22 U	21 U	24 UJ	20 UJ
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	61 U	47 U	49 U	64 U	52 U	82 U	54 U	47 U	44 U	52 U	44 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	7 U	5.4 U	5.7 U	7.4 U	6 U	9.4 U	6.3 U	5.4 U	5.1 U	6 U	5 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	5.5 U	4.2 U	4.4 U	5.8 U	4.7 U	7.4 U	4.9 U	4.2 U	4 U	4.7 U	3.9 U
VOC	DIBROMOMETHANE	µg/Kg	9.5 U	7.3 U	7.7 U	10 U	8.1 U	13 U	8.5 U	7.3 U	6.9 U	8.2 U	6.8 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	22 U	17 U	18 U	23 U	19 U	30 UJ	20 U	17 UJ	16 UJ	19 U	16 U
VOC	ETHYL BENZENE	µg/Kg	13 UJ	9.7 UJ	10 UJ	13 U	11 U	17 U	11 U	9.7 U	**67**	**69**	**150**
VOC	ETHYL METHACRYLATE	µg/Kg	61 U	47 U	49 U	64 U	52 U	82 U	54 U	47 U	44 U	52 U	44 U
VOC	ISOBUTANOL	µg/Kg	61 UJ	47 UJ	49 UJ	64 U	52 U	82 UJ	54 UJ	47 UJ	44 UJ	52 U	44 U
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	19 U	15 U	15 U	20 U	16 U	26 U	17 U	15 U	14 U	16 U	14 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	55 UJ	42 UJ	45 UJ	58 UJ	47 UJ	74 U	49 U	42 U	40 U	47 UJ	40 UJ
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	11 U	8.1 U	8.5 U	11 U	9 U	14 U	9.4 U	8.1 U	7.6 U	9.1 U	7.6 U
VOC	METHYL METHACRYLATE	µg/Kg	61 U	47 U	49 U	64 U	52 U	82 U	54 U	47 U	44 U	52 U	44 U
VOC	METHYLACRYLONITRILE	µg/Kg	300 U	230 U	250 U	320 U	260 U	410 UJ	270 U	230 UJ	220 UJ	260 U	220 U
VOC	METHYLENE CHLORIDE	µg/Kg	29 U	22 U	24 U	31 U	25 U	39 U	26 U	22 U	21 U	25 U	21 U
VOC	PENTOCHLORETHANE	µg/Kg	14 U	13 U	12 U	15 U	14 U	13 U	13 U	13 U	12 U	13 U	12 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	61 UJ	47 UJ	49 UJ	64 UJ	52 UJ	82 UJ	54 UJ	47 UJ	44 UJ	52 UJ	44 UJ
VOC	STYRENE	µg/Kg	9.2 U	7.1 U	7.5 U	9.8 U	7.9 U	13 U	8.3 U	7.1 U	6.7 U	**160**	**140**
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	12 U	9 U	9.4 U	12 U	10 U	16 U	10 U	9 U	8.5 U	10 U	8.4 U
VOC	TOLUENE	µg/Kg	**1300** J	**3500**	**110**	35 UJ	29 UJ	**770**	**3400**	**3900**	**1400**	29 UJ	**440** J
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	10 U	7.7 U	8.1 U	11 U	8.5 U	14 U	8.9 U	7.7 U	7.2 U	8.6 U	7.2 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	8.6 U	6.6 U	6.9 U	9.1 U	7.3 U	12 U	7.7 U	6.6 U	6.2 U	7.4 U	6.2 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	44 U	34 U	35 U	46 U	38 U	59 U	39 U	34 U	32 U	38 U	32 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	11 U	8.3 U	8.7 U	11 U	9.2 U	15 U	9.6 U	8.3 U	7.8 U	9.3 U	7.7 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	15 U	12 U	12 U	16 U	13 U	21 U	14 U	12 U	11 U	13 U	11 U
VOC	VINYL ACETATE	µg/Kg	59 U	46 U	48 U	63 U	51 U	80 U	53 U	46 U	43 U	51 U	43 U
VOC	VINYL CHLORIDE	µg/Kg	21 U	16 U	17 U	23 U	18 U	29 U	19 U	16 U	16 U	18 U	15 U
VOC	XYLENES, TOTAL	µg/Kg	35 U	27 U	28 U	37 U	30 U	47 U	31 U	27 U	**140**	**280**	**250**

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
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Midland Area Soils

			9496-1	9496-2	9645-1	9645-1-C	9645-2	9645-2-C	9672-1	9672-2	9712-1	9712-2
			MidBlind_9496-1	MidBlind_9496-2	MidBlind_9645-1	MidBlind_9645-1-C	MidBlind_9645-2	MidBlind_9645-2-C	MidBlind_9672-1	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**										
GEN	CYANIDE, TOTAL	µg/Kg	**260**	0.034 U	0.0071 U	**18** J	0.0069 U	0.0069 U	0.0076 U	**75** J	**51** J	**12** J
GEN	SULFIDE	mg/kg	96 U	90 U	94 U	94 U	92 U	92 U	100 UJ	92 UJ	100 U	97 U
GEN	TOTAL ORGANIC CARBON	mg/kg	**15000**	73 U	**16000**	**13000**	**10000**	**11000**	**38000**	73 U	**27000**	**31000**
HERB	2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	µg/Kg	2.4 U	2.2 U	2.3 U	2.4 U	2.3 U	2.3 U	2.5 U	2.3 U	2.5 U	2.4 U
HERB	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/Kg	2 U	1.9 U	**14** J	2 U	1.9 U	1.9 U	2.1 U	1.9 U	2.1 U	2 U
HERB	DINOSEB	µg/Kg	62 U	58 UJ	61 U	61 U	60 U	60 U	66 U	59 U	66 UJ	64 U
HERB	SILVEX (2,4,5-TP)	µg/Kg	2.1 U	2 U	2 U	2.1 U	2 U	2 U	2.2 U	2 U	2.2 U	2.1 U
MET	ANTIMONY	µg/Kg	460 U	220 U	1100 U	1200 U	1400 U	740 UJ	250 U	230 U	1400 U	430 U
MET	ARSENIC	µg/Kg	**3100**	**5500**	**2200**	**2000**	**2600**	**2500**	**9200**	**2000**	**5200**	**3600**
MET	BARIUM	µg/Kg	**81000**	**70000**	**26000**	**25000**	**28000**	**27000**	**24000**	**7800**	**38000**	**37000**
MET	BERYLLIUM	µg/Kg	**1100**	**720**	**190** J	**180** J	**210** J	**200** J	**310**	**92** J	**290**	**280**
MET	CADMIUM	µg/Kg	**170** J	**300**	160 U	160 U	180 U	170 U	**350**	**33** J	330 U	**240** J
MET	CHROMIUM, TOTAL	µg/Kg	**11000**	**6400**	**4100**	**3900**	**4300**	**4200** J	**8300**	**2200**	**6600**	**7100**
MET	COBALT	µg/Kg	**6000**	**5100**	**1600**	**1500**	**1800**	**1600**	**2600**	**910**	**2500**	**2600**
MET	COPPER	µg/Kg	**18000**	**19000**	**5800**	**5500**	**6100**	**6300**	**39000**	**5500**	**13000**	**13000**
MET	LEAD	µg/Kg	**11000**	**12000**	**10000**	**9900**	**11000**	**12000**	**31000**	**3400**	**20000**	**18000**
MET	MERCURY	µg/Kg	**31**	**35**	4.2 U	4.2 U	**30**	4.1 U	**67**	4.1 U	**39**	**36**
MET	NICKEL	µg/Kg	**15000**	**14000**	**4300**	**4100**	**5000**	**4600**	**8500**	**2600**	**6700**	**6900**
MET	SELENIUM	µg/Kg	1000 U	470 U	490 U	490 U	490 U	480 U	530 U	480 U	540 U	510 U
MET	SILVER	µg/Kg	110 U	53 U	55 U	55 U	54 U	54 U	59 U	54 U	60 U	57 U
MET	THALLIUM	µg/Kg	410 U	190 U	200 U	200 U	200 U	200 U	210 U	190 U	220 U	210 U
MET	TIN	µg/Kg	1100 U	500 U	520 U	520 U	520 U	510 U	570 U	510 U	570 U	550 U
MET	VANADIUM	µg/Kg	**25000**	**20000**	**8100**	**7600**	**8700**	**8400**	**12000**	**5300**	**15000**	**11000**
MET	ZINC	µg/Kg	**38000**	**49000**	60 U	60 U	59 U	59 U	64 U	59 U	65 U	**40000**
PCB	PCB-1016 (AROCLOR 1016)	µg/Kg	6.4 U	5.9 U	6.2 U	6.3 U	6.1 U	6.2 U	6.8 U	6.1 U	6.8 U	6.5 U
PCB	PCB-1221 (AROCLOR 1221)	µg/Kg	11 U	10 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	11 U
PCB	PCB-1232 (AROCLOR 1232)	µg/Kg	12 U	11 U	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
PCB	PCB-1242 (AROCLOR 1242)	µg/Kg	14 U	13 U	14 U	14 U	13 U	14 U	15 U	13 U	15 U	14 U
PCB	PCB-1248 (AROCLOR 1248)	µg/Kg	9.3 U	8.6 U	9 U	9.2 U	8.9 U	9 U	9.8 U	8.9 U	9.9 U	9.5 U
PCB	PCB-1254 (AROCLOR 1254)	µg/Kg	7.7 U	7.1 U	7.5 U	7.6 U	7.4 U	7.5 U	8.2 U	7.4 U	8.2 U	7.9 U
PCB	PCB-1260 (AROCLOR 1260)	µg/Kg	**77**	**60**	6.3 U	6.4 U	6.2 U	6.2 U	6.8 U	6.2 U	6.9 U	6.6 U
PCB	PCB-1262 (AROCLOR 1262)	µg/Kg	**99**	7.9 U	8.3 U	8.4 U	8.2 U	8.2 U	9 U	8.2 U	9 U	8.7 U
PCB	PCB-1268 (AROCLOR 1268)	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
PCB	SUMMED PCB	µg/Kg	**210**	**98**	**42**	**43**	**42**	**42**	**46**	**42**	**46**	**44**
PEST	1,2-DIBROMO-3-CHLOROPROPANE	µg/Kg	48 U	40 U	43 U	48 U	40 U	41 U	60 U	41 U	57 U	43 U
PEST	4,4'-DDD	µg/Kg	0.69 U	0.64 U	0.67 U	0.68 U	0.66 U	0.67 U	0.73 U	0.66 U	0.73 U	0.71 U
PEST	4,4'-DDE	µg/Kg	0.93 U	0.86 U	**1.1** J	**1.2** J	**1.2** J	**2** J	**4.1** J	0.89 U	0.99 U	0.95 U
PEST	4,4'-DDT	µg/Kg	1.1 U	0.97 U	1 U	1 U	1 U	1 U	**2** J	1 U	1.1 U	**4.3** J
PEST	ALDRIN	µg/Kg	0.72 U	0.66 U	0.69 U	0.71 U	0.69 U	0.69 U	0.76 U	0.69 U	0.76 U	0.73 U
PEST	ALPHA BHC	µg/Kg	0.91 U	0.84 U	0.88 U	0.9 U	0.87 U	0.87 U	0.96 U	0.87 U	0.96 U	0.92 U
PEST	BETA BHC	µg/Kg	0.98 U	0.9 U	0.95 U	0.97 U	0.94 U	0.94 U	1 U	0.94 U	1 U	1 U
PEST	CHLORDANE	µg/Kg	0.95 U	0.88 U	0.93 U	0.94 U	0.91 U	0.92 U	1 U	0.91 U	1 U	0.97 U
PEST	DELTA BHC	µg/Kg	0.88 U	0.82 U	0.86 U	0.87 U	0.85 U	0.85 U	0.93 U	0.85 U	0.94 U	0.9 U
PEST	DIELDRIN	µg/Kg	0.72 U	0.66 U	0.69 U	0.71 U	0.69 U	0.69 U	0.76 U	0.69 U	**1** J	0.73 U
PEST	DIMETHOATE	µg/Kg	61 U	57 U	60 U	60 U	58 U	59 U	65 U	58 U	65 U	62 U
PEST	DISULFOTON	µg/Kg	10 U	9.6 U	10 U	10 U	9.8 U	9.8 U	11 U	9.8 U	11 U	11 U
PEST	ENDOSULFAN I	µg/Kg	0.55 U	0.51 U	0.53 U	0.54 U	0.53 UJ	0.53 U	0.58 U	0.53 U	0.58 U	0.56 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			9496-1	9496-2	9645-1	9645-1-C	9645-2	9645-2-C	9672-1	9672-2	9712-1	9712-2
			MidBlind_9496-1	MidBlind_9496-2	MidBlind_9645-1	MidBlind_9645-1-C	MidBlind_9645-2	MidBlind_9645-2-C	MidBlind_9672-1	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
		Sam	0-1	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**										
PEST	ENDOSULFAN II	µg/Kg	0.6 U	0.55 U	0.58 U	0.59 U	0.57 U	0.57 U	0.63 U	0.57 U	0.63 U	0.61 U
PEST	SUMMED Endosulfan (I and II)	µg/Kg	**0.57**	**0.53**	**0.56**	**0.57**	**0.55**	**0.55**	**0.6**	**0.55**	**0.61**	**0.58**
PEST	ENDOSULFAN SULFATE	µg/Kg	0.86 U	0.79 U	0.83 U	0.85 U	0.82 U	0.83 U	0.91 U	0.82 U	0.91 U	0.88 U
PEST	ENDRIN	µg/Kg	0.87 U	0.8 U	0.85 U	0.86 U	0.83 U	0.84 U	0.92 U	0.83 U	0.92 U	0.89 U
PEST	ENDRIN ALDEHYDE	µg/Kg	0.89 U	0.83 U	0.87 U	0.88 U	0.86 U	0.86 U	0.94 U	0.86 U	0.95 U	0.91 U
PEST	FAMPHUR	µg/Kg	33 UJ	31 UJ	33 UJ	33 UJ	32 UJ	32 UJ	35 UJ	32 UJ	35 UJ	34 UJ
PEST	GAMMA BHC (LINDANE)	µg/Kg	0.69 U	0.64 U	0.67 U	0.68 U	0.66 U	0.67 U	0.73 U	0.66 U	0.73 U	0.71 U
PEST	HEPTACHLOR	µg/Kg	0.72 U	0.66 U	0.69 U	0.71 U	0.69 U	0.69 U	0.76 U	0.69 U	0.76 U	0.73 U
PEST	HEPTACHLOR EPOXIDE	µg/Kg	0.99 U	0.91 U	0.96 U	0.98 U	0.95 U	0.95 U	1 U	0.95 U	1.1 U	1 U
PEST	KEPONE	µg/Kg	2000 U	1800 U	1900 U	1900 U	1900 U	1900 U	2100 U	1900 U	2100 U	2000 U
PEST	METHOXYCHLOR	µg/Kg	1.2 U	1.1 U	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	1.1 U	1.3 U	1.2 U
PEST	O,O,O-TRIETHYL PHOSPHOROTHIOATE	µg/Kg	11 U	10 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	11 U
PEST	O,O-DIETHYL O-2-PYRAZINYL PHOSPHOROTHIOATE (THIONAZIN)	µg/Kg	20 U	19 U	20 U	20 U	19 U	20 U	22 U	19 U	22 U	21 U
PEST	PARATHION, ETHYL (PARATHION)	µg/Kg	20 U	19 U	20 U	20 U	19 U	19 U	21 U	19 U	21 U	21 U
PEST	PARATHION, METHYL	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U	14 U	13 U	14 U	14 U
PEST	PHORATE	µg/Kg	10 UJ	9.7 UJ	10 UJ	10 UJ	9.9 UJ	9.9 UJ	11 U	9.8 U	11 UJ	11 UJ
PEST	TETRAETHYL DITHIOPYROPHOSPHATE (SULFOTEPP)	µg/Kg	780 U	730 U	770 U	770 U	750 U	750 U	830 U	750 U	840 U	800 U
PEST	TOXAPHENE	µg/Kg	11 U	10 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	11 U
SVOC	1,2,4,5-TETRACHLOROBENZENE	µg/Kg	9.4 U	8.8 U	9.3 U	9.3 U	9 U	9.1 U	10 U	9 U	10 U	9.6 U
SVOC	1,3-DINITROBENZENE	µg/Kg	8.8 U	8.2 U	8.6 U	8.6 U	8.4 U	8.4 U	9.3 U	8.4 U	9.3 U	8.9 U
SVOC	1,4-DIOXANE	µg/Kg	390 UJ	370 UJ	380 UJ	390 UJ	370 UJ	380 UJ	420 U	370 U	420 UJ	400 UJ
SVOC	1,4-NAPHTHOQUINONE	µg/Kg	13 U	13 UJ	13 U	13 U	13 U	13 U	14 U	13 U	14 UJ	14 U
SVOC	1-NAPHTHYLAMINE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
SVOC	2,2'-OXYBIS(1-CHLOROPROPANE)	µg/Kg	39 U	36 U	38 U	38 U	37 U	37 U	41 U	37 U	41 U	39 U
SVOC	2,3,4,6-TETRACHLOROPHENOL	µg/Kg	16 U	15 U	16 U	16 U	15 U	15 U	17 U	15 U	17 U	16 U
SVOC	2,4,5-TRICHLOROPHENOL	µg/Kg	8.9 U	8.3 U	8.7 U	8.7 U	8.5 U	8.5 U	9.4 U	8.5 U	9.5 U	9.1 U
SVOC	2,4,6-TRICHLOROPHENOL	µg/Kg	6.8 U	6.4 U	6.7 U	6.7 U	6.5 U	6.5 U	7.2 U	6.5 U	7.2 U	6.9 U
SVOC	2,4-DICHLOROPHENOL	µg/Kg	30 U	28 U	29 U	29 U	28 U	28 U	31 U	28 U	31 U	30 U
SVOC	2,4-DIMETHYLPHENOL	µg/Kg	65 U	61 U	63 U	63 U	62 U	62 U	69 U	62 U	69 U	66 U
SVOC	2,4-DINITROPHENOL	µg/Kg	23 U	21 UJ	22 U	22 U	22 U	22 U	24 U	22 U	24 UJ	23 U
SVOC	2,4-DINITROTOLUENE	µg/Kg	32 U	30 U	31 U	31 U	31 U	31 U	34 U	30 U	34 U	33 U
SVOC	2,6-DICHLOROPHENOL	µg/Kg	16 U	15 U	16 U	16 U	15 U	15 U	17 U	15 U	17 U	16 U
SVOC	2,6-DINITROTOLUENE	µg/Kg	6.8 U	6.3 U	6.6 U	6.6 U	6.5 U	6.5 U	7.2 U	6.5 U	7.2 U	6.9 U
SVOC	2-Acetylaminofluorene	µg/Kg	15 U	14 U	15 U	15 U	15 U	15 U	16 U	15 U	16 U	16 U
SVOC	2-CHLORONAPHTHALENE	µg/Kg	29 U	27 U	28 U	28 U	28 U	28 U	31 U	27 U	31 U	29 U
SVOC	2-CHLOROPHENOL	µg/Kg	30 U	28 U	29 U	29 U	28 U	28 U	31 U	28 U	31 U	30 U
SVOC	2-METHYLNAPHTHALENE	µg/Kg	**21** J	**23** J	8.3 U	8.3 U	8.1 U	8.1 U	**260** J	**11** J	9 U	8.6 U
SVOC	2-METHYLPHENOL (O-CRESOL)	µg/Kg	20 U	19 U	20 U	20 U	19 U	19 U	21 U	19 U	21 U	20 U
SVOC	2-NAPHTHYLAMINE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
SVOC	2-NITROANILINE	µg/Kg	9 U	8.4 U	8.8 U	8.8 U	8.6 U	8.6 U	9.5 U	8.5 U	9.6 U	9.2 U
SVOC	2-NITROPHENOL	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
SVOC	3 & 4-METHYLPHENOL (M,P-CRESOL)	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
SVOC	3,3'-DICHLOROBENZIDINE	µg/Kg	67 U	62 U	65 U	65 U	64 U	64 U	71 U	63 U	71 U	68 U
SVOC	3,3'-DIMETHYLBENZIDINE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
SVOC	3-METHYLCHOLANTHRENE	µg/Kg	21 U	20 U	20 U	20 U	20 U	20 U	22 U	20 U	22 U	21 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

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			MidBlind_9496-1	MidBlind_9496-2	MidBlind_9645-1	MidBlind_9645-1-C	MidBlind_9645-2	MidBlind_9645-2-C	MidBlind_9672-1	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**										
SVOC	3-NITROANILINE	µg/Kg	7.8 U	7.3 U	7.7 U	7.7 U	7.5 U	7.5 U	8.3 U	7.5 U	8.3 U	8 U
SVOC	4,6-DINITRO-2-METHYLPHENOL	µg/Kg	15 U	14 U	15 U	15 U	14 U	14 U	16 U	14 U	16 U	15 U
SVOC	4-AMINOBIPHENYL	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
SVOC	4-BROMOPHENYL PHENYL ETHER	µg/Kg	15 U	14 U	14 U	14 U	14 U	14 U	16 U	14 U	16 U	15 U
SVOC	4-CHLORO-3-METHYLPHENOL	µg/Kg	12 U	11 U	12 U	12 U	11 U	11 U	13 U	11 U	13 U	12 U
SVOC	4-CHLOROANILINE	µg/Kg	49 U	45 U	48 U	48 U	46 U	47 U	51 U	46 U	52 U	49 U
SVOC	4-CHLOROPHENYL PHENYL ETHER	µg/Kg	5.5 U	5.2 U	5.4 U	5.4 U	5.3 U	5.3 U	5.9 U	5.3 U	5.9 U	5.6 U
SVOC	4-NITROANILINE	µg/Kg	46 U	43 U	45 U	45 U	44 U	44 U	49 U	44 U	49 U	47 U
SVOC	4-NITROPHENOL	µg/Kg	9.8 U	9.2 U	9.6 U	9.6 U	9.4 U	9.4 U	10 U	9.4 U	10 U	10 U
SVOC	4-NITROQUINOLINE-1-OXIDE	µg/Kg	9.5 UJ	8.9 U	9.4 U	9.4 U	9.1 UJ	9.2 U	10 U	9.1 U	10 U	9.7 UJ
SVOC	5-NITRO-O-TOLUIDINE	µg/Kg	13 U	12 U	12 U	12 U	12 U	12 U	13 U	12 U	13 U	13 U
SVOC	7,12-DIMETHYLBENZ(A)ANTHRACENE	µg/Kg	15 U	14 U	15 U	15 U	15 U	15 U	16 U	15 U	16 U	16 U
SVOC	ACENAPHTHENE	µg/Kg	8.5 U	7.9 U	8.3 U	8.3 U	8.1 U	8.1 U	9 UJ	8.1 UJ	9 U	8.6 U
SVOC	ACENAPHTHYLENE	µg/Kg	8.6 U	8 U	8.4 U	8.4 U	8.2 U	8.2 U	9.1 U	8.2 U	9.1 U	8.7 U
SVOC	ACETOPHENONE	µg/Kg	9.7 U	9.1 U	9.5 U	9.5 U	9.3 U	9.3 U	10 U	9.3 U	10 U	9.9 U
SVOC	ALPHA, ALPHA DIMETHYLPHENETHYLAMINE	µg/Kg	390 UJ	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 UJ
SVOC	ANILINE	µg/Kg	51 U	48 U	50 U	50 U	49 U	49 U	54 U	48 U	54 U	52 U
SVOC	ANTHRACENE	µg/Kg	5.9 U	5.5 U	5.8 U	5.8 U	5.6 U	5.7 U	**12** J	5.6 U	6.3 U	**9.9** J
SVOC	ARAMITE (TOTAL)	µg/Kg	81 U	76 U	80 U	80 U	78 U	78 U	86 U	77 U	86 U	83 U
SVOC	BENZO(A)ANTHRACENE	µg/Kg	6.9 U	6.5 U	6.8 U	6.8 U	6.6 U	6.7 U	7.4 U	6.6 U	7.4 U	7.1 U
SVOC	BENZO(A)PYRENE	µg/Kg	9.3 U	8.7 U	**17** J	**15** J	**17** J	**9.2** J	**25** J	8.9 UJ	**34** J	**26** J
SVOC	BENZO(B)FLUORANTHENE	µg/Kg	**29** J	7 U	**37** J	**44** J	**38** J	**30** J	**70** J	**41** J	**66** J	**53** J
SVOC	BENZO(G,H,I)PERYLENE	µg/Kg	**34** J	30 U	**37** J	**39** J	30 U	30 U	**170** J	**150** J	**51** J	**56** J
SVOC	BENZO(K)FLUORANTHENE	µg/Kg	11 U	9.9 U	10 U	**12** J	**15** J	10 U	**58** J	10 U	**15** J	**14** J
SVOC	BENZYL ALCOHOL	µg/Kg	8.6 U	8.1 U	8.4 U	8.4 U	8.2 U	8.3 U	9.1 U	8.2 U	9.2 U	8.8 U
SVOC	BENZYL BUTYL PHTHALATE	µg/Kg	9 U	8.5 U	8.9 U	8.9 U	8.6 U	8.7 U	9.6 U	8.6 U	**15** J	9.2 U
SVOC	BIS(2-CHLOROETHOXY) METHANE	µg/Kg	6.1 U	5.7 U	6 U	6 U	5.8 U	5.9 U	6.5 U	5.8 U	6.5 U	6.2 U
SVOC	BIS(2-CHLOROETHYL) ETHER	µg/Kg	43 U	40 U	42 U	42 U	41 U	41 U	45 U	41 U	45 U	44 U
SVOC	BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	**24** J	18 U	**56** J	18 U	18 U	18 U	20 U	18 UJ	**90** J	**70** J
SVOC	CHLOROBENZILATE	µg/Kg	22 U	21 U	22 U	22 U	21 U	21 U	24 U	21 U	24 U	23 U
SVOC	CHRYSENE	µg/Kg	13 U	12 U	12 U	12 U	12 U	12 U	**59** J	**25** J	13 U	13 U
SVOC	DI-N-BUTYL PHTHALATE	µg/Kg	7.9 U	7.4 U	7.7 U	7.7 U	7.5 U	7.6 U	8.4 U	7.5 U	**47** J	8.1 U
SVOC	DI-N-OCTYLPHTHALATE	µg/Kg	8.2 U	7.7 U	8.1 UJ	8.1 UJ	7.9 UJ	7.9 UJ	8.7 UJ	7.8 UJ	8.8 UJ	8.4 U
SVOC	DIALLATE (TOTAL OF CIS AND TRANS ISOMERS)	µg/Kg	33 U	31 U	32 UJ	32 UJ	31 UJ	32 UJ	35 U	31 U	35 U	33 U
SVOC	DIBENZ(A,H)ANTHRACENE	µg/Kg	37 U	34 U	36 U	36 U	35 U	35 U	39 U	35 U	39 U	37 U
SVOC	DIBENZOFURAN	µg/Kg	5 U	4.7 U	4.9 U	4.9 U	4.8 U	4.8 U	**56** J	4.8 U	5.4 U	5.1 U
SVOC	DIETHYL PHTHALATE	µg/Kg	6.4 U	6 U	6.3 U	6.3 U	6.2 U	6.2 U	6.8 U	6.1 U	6.9 U	6.6 U
SVOC	DIMETHYL PHTHALATE	µg/Kg	23 U	22 U	23 U	23 U	22 U	22 U	25 U	22 U	25 U	24 U
SVOC	DIPHENYLAMINE	µg/Kg	32 U	30 U	31 U	31 U	31 U	31 U	34 U	30 U	34 U	33 U
SVOC	ETHYL METHANESULFONATE	µg/Kg	14 U	13 U	14 UJ	14 UJ	14 UJ	14 UJ	15 U	14 U	15 U	14 U
SVOC	FLUORANTHENE	µg/Kg	10 U	9.8 U	10 U	**31** J	**26** J	**15** J	11 UJ	9.9 UJ	**51** J	**40** J
SVOC	FLUORENE	µg/Kg	6.6 U	6.2 U	6.5 U	6.5 U	6.3 U	6.3 U	7 U	6.3 U	7 U	6.7 U
SVOC	HEXACHLOROBENZENE	µg/Kg	11 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
SVOC	HEXACHLOROBUTADIENE	µg/Kg	38 U	36 U	38 U	38 U	37 U	37 U	41 U	36 U	41 U	39 U
SVOC	HEXACHLOROCYCLOPENTADIENE	µg/Kg	29 U	27 U	28 U	28 U	28 U	28 U	31 U	28 U	31 U	30 U
SVOC	HEXACHLOROETHANE	µg/Kg	52 U	49 U	51 U	51 U	50 U	50 U	55 U	50 U	56 U	53 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			9496-1	9496-2	9645-1	9645-1-C	9645-2	9645-2-C	9672-1	9672-2	9712-1	9712-2
			MidBlind_9496-1	MidBlind_9496-2	MidBlind_9645-1	MidBlind_9645-1-C	MidBlind_9645-2	MidBlind_9645-2-C	MidBlind_9672-1	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**										
SVOC	HEXACHLOROPHENE	µg/Kg	780 UJ	730 UJ	770 UJ	770 UJ	750 UJ	750 UJ	830 UJ	750 UJ	840 UJ	800 UJ
SVOC	HEXACHLOROPROPENE	µg/Kg	52 U	49 U	51 U	51 U	50 U	50 U	55 U	50 U	56 U	53 U
SVOC	INDENO(1,2,3-C,D)PYRENE	µg/Kg	27 U	25 UJ	27 U	27 U	26 U	26 U	**37** J	26 U	29 UJ	28 U
SVOC	ISODRIN	µg/Kg	22 U	21 U	21 U	21 U	21 U	21 U	23 U	21 U	23 U	22 U
SVOC	ISOPHORONE	µg/Kg	5.5 U	5.1 U	5.4 U	5.4 U	5.2 U	5.2 U	5.8 U	5.2 U	5.8 U	5.6 U
SVOC	ISOSAFROLE	µg/Kg	19 U	18 U	19 U	19 U	18 U	18 U	20 U	18 U	20 U	19 U
SVOC	METHAPYRILENE	µg/Kg	46 U	43 U	45 U	45 U	44 U	44 U	48 U	43 U	49 U	47 U
SVOC	METHYL METHANESULFONATE	µg/Kg	22 U	21 U	22 U	22 U	21 U	21 U	24 U	21 U	24 U	23 U
SVOC	N-NITROSO-DI-N-BUTYLAMINE	µg/Kg	12 U	11 U	11 U	11 U	11 U	11 U	12 U	11 U	12 U	12 U
SVOC	N-NITROSODI-N-PROPYLAMINE	µg/Kg	8.9 U	8.3 U	8.7 U	8.7 U	8.5 U	8.5 U	9.4 U	8.5 U	9.5 U	9.1 U
SVOC	N-NITROSODIETHYLAMINE	µg/Kg	21 U	19 U	20 UJ	20 UJ	20 UJ	20 UJ	22 U	20 U	22 U	21 U
SVOC	N-NITROSODIMETHYLAMINE	µg/Kg	47 UJ	44 U	46 U	46 U	45 U	45 U	50 UJ	45 UJ	50 U	48 UJ
SVOC	N-NITROSODIPHENYLAMINE	µg/Kg	13 U	12 U	13 U	13 U	12 U	12 U	14 U	12 U	14 U	13 U
SVOC	N-NITROSOMETHYLETHYLAMINE	µg/Kg	18 U	17 U	17 U	17 U	17 U	17 U	19 U	17 U	19 U	18 U
SVOC	N-NITROSOMORPHOLINE	µg/Kg	21 U	20 U	21 U	21 U	20 U	20 U	22 U	20 U	22 U	21 U
SVOC	N-NITROSOPIPERIDINE	µg/Kg	13 U	12 U	13 U	13 U	12 U	12 U	14 U	12 U	14 U	13 U
SVOC	N-NITROSOPYRROLIDINE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
SVOC	NAPHTHALENE	µg/Kg	31 U	29 U	31 U	31 U	30 U	30 U	**210** J	30 U	33 U	32 U
SVOC	NITROBENZENE	µg/Kg	40 U	38 U	40 U	40 U	39 U	39 U	43 U	39 U	43 U	41 U
SVOC	O-TOLUIDINE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
SVOC	P-DIMETHYLAMINOAZOBENZENE	µg/Kg	14 U	13 U	14 U	14 U	14 U	14 U	15 U	14 U	15 U	15 U
SVOC	P-PHENYLENEDIAMINE	µg/Kg	32 UJ	30 UJ	31 UJ	31 UJ	31 UJ	31 UJ	34 U	30 U	34 UJ	33 UJ
SVOC	PENTACHLOROBENZENE	µg/Kg	31 U	29 U	31 U	31 U	30 U	30 U	33 U	30 U	33 U	32 U
SVOC	PENTACHLORONITROBENZENE	µg/Kg	22 U	20 U	21 U	21 U	21 U	21 U	23 U	21 U	23 U	22 U
SVOC	PENTACHLOROPHENOL	µg/Kg	35 UJ	33 UJ	34 U	34 U	33 U	33 U	37 UJ	33 UJ	37 U	36 UJ
SVOC	PHENACETIN	µg/Kg	14 U	13 U	14 U	14 U	13 U	13 U	15 U	13 U	15 U	14 U
SVOC	PHENANTHRENE	µg/Kg	**42** J	**11** J	**10** J	**12** J	**10** J	**7.8** J	**110** J	**9.7** J	**40** J	**36** J
SVOC	PHENOL	µg/Kg	8.1 U	7.6 U	8 U	8 U	7.8 U	7.8 U	8.6 UJ	7.7 UJ	8.7 U	8.3 U
SVOC	PRONAMIDE	µg/Kg	12 U	12 U	12 U	12 U	12 U	12 U	13 U	12 U	13 U	13 U
SVOC	PYRENE	µg/Kg	**28** J	17 U	**27** J	**36** J	**30** J	**18** J	**35** J	17 U	**88** J	**62** J
SVOC	PYRIDINE	µg/Kg	58 U	55 U	57 U	57 U	56 U	56 U	62 UJ	56 UJ	62 U	60 U
SVOC	SAFROLE	µg/Kg	17 U	16 U	16 U	16 U	16 U	16 U	18 U	16 U	18 U	17 U
SVOC	SYM-TRINITROBENZENE	µg/Kg	390 U	370 U	380 U	390 U	370 U	380 U	420 U	370 U	420 U	400 U
VOC	1,1,1,2-TETRACHLOROETHANE	µg/Kg	9.8 U	8 U	8.8 U	9.7 U	8.1 U	8.3 U	12 U	8.3 U	12 U	8.7 U
VOC	1,1,1-TRICHLOROETHANE	µg/Kg	6.9 U	5.6 U	6.1 U	6.8 U	5.6 U	5.8 U	8.5 U	5.8 U	8.1 U	6.1 U
VOC	1,1,2,2-TETRACHLOROETHANE	µg/Kg	10 U	8.2 U	9 U	10 U	8.2 U	8.5 U	12 U	8.5 U	12 U	8.9 U
VOC	1,1,2-TRICHLOROETHANE	µg/Kg	6.4 U	5.2 U	5.7 U	6.3 U	5.2 U	5.4 U	7.9 U	5.4 U	7.5 U	5.6 U
VOC	1,1-DICHLOROETHANE	µg/Kg	8.9 U	7.3 U	7.9 U	8.8 U	7.3 U	7.5 U	11 U	7.5 U	11 U	7.8 U
VOC	1,1-DICHLOROETHENE	µg/Kg	20 U	16 U	18 U	20 U	16 U	17 U	25 U	17 U	24 U	18 U
VOC	1,2,3-TRICHLOROPROPANE	µg/Kg	14 U	11 U	12 U	14 U	11 U	12 U	17 U	12 U	16 U	12 U
VOC	1,2-DIBROMOETHANE (EDB)	µg/Kg	8.4 U	6.9 U	7.5 U	8.3 U	6.9 U	7 U	10 U	7.1 U	9.9 U	7.4 U
VOC	1,2-DICHLOROBENZENE	µg/Kg	59 U	55 U	58 U	58 U	56 U	56 U	62 U	56 U	63 U	60 U
VOC	1,2-DICHLOROETHANE	µg/Kg	6.4 U	5.2 U	5.7 U	6.3 U	5.2 U	5.4 U	7.9 U	5.4 U	7.5 U	5.6 U
VOC	1,2-DICHLOROPROPANE	µg/Kg	6.2 U	5.1 U	5.6 U	6.2 U	5.1 U	5.3 U	7.7 UJ	5.3 UJ	7.4 U	5.5 U
VOC	1,3-DICHLOROBENZENE	µg/Kg	61 U	57 U	60 U	60 U	59 U	59 U	65 U	58 U	65 U	63 U
VOC	1,4-DICHLOROBENZENE	µg/Kg	56 U	52 U	55 U	55 U	53 U	54 U	59 UJ	53 UJ	59 U	57 U
VOC	2-HEXANONE	µg/Kg	46 U	38 U	41 U	46 U	38 U	39 U	57 U	39 U	55 U	41 U

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

TABLE D-2
Additional Chemicals Soil Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

			9496-1	9496-2	9645-1	9645-1-C	9645-2	9645-2-C	9672-1	9672-2	9712-1	9712-2
			MidBlind_9496-1	MidBlind_9496-2	MidBlind_9645-1	MidBlind_9645-1-C	MidBlind_9645-2	MidBlind_9645-2-C	MidBlind_9672-1	MidBlind_9672-2	MidBlind_9712-1	MidBlind_9712-2
			11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	11/13/2006	10/30/2006	10/30/2006	11/13/2006	11/13/2006
		Samp	0-1	1-6	0-1	0-1	1-6	1-6	0-1	1-6	0-1	1-6
		:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Group	**Analyte**	**Units**										
VOC	ACETONE	µg/Kg	21 UJ	17 UJ	19 U	21 U	17 U	18 U	26 UJ	18 UJ	25 UJ	18 UJ
VOC	ACETONITRILE	µg/Kg	250 UJ	210 UJ	230 UJ	250 UJ	210 UJ	210 UJ	310 UJ	210 UJ	300 UJ	220 UJ
VOC	ACROLEIN	µg/Kg	130 U	110 U	120 UJ	130 UJ	110 UJ	110 UJ	160 UJ	110 UJ	160 UJ	120 U
VOC	ACRYLONITRILE	µg/Kg	40 U	33 U	36 U	39 U	**190** J	33 U	49 U	34 U	**560** J	35 U
VOC	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/Kg	56 U	46 U	50 U	55 U	46 U	47 U	69 U	47 U	66 U	49 U
VOC	BENZENE	µg/Kg	5.8 U	4.8 U	5.2 U	5.8 U	4.8 U	4.9 U	**67** J	4.9 U	6.9 U	5.1 U
VOC	BROMODICHLOROMETHANE	µg/Kg	7.5 U	6.2 U	6.7 U	7.5 U	6.2 U	6.3 U	9.3 U	6.4 U	8.9 U	6.6 U
VOC	BROMOFORM	µg/Kg	9.4 U	7.7 U	8.4 U	9.4 U	7.7 U	7.9 U	12 U	8 U	11 U	8.3 U
VOC	BROMOMETHANE	µg/Kg	84 U	69 U	75 U	83 U	69 U	71 U	100 U	71 U	100 U	74 U
VOC	CARBON DISULFIDE	µg/Kg	6.1 U	5 U	5.4 U	6 U	5 U	5.1 U	7.5 U	5.2 U	7.2 U	5.4 U
VOC	CARBON TETRACHLORIDE	µg/Kg	6.7 U	5.5 U	6 U	6.6 U	5.5 U	5.6 U	8.3 U	5.7 U	7.9 U	5.9 U
VOC	CHLOROBENZENE	µg/Kg	9.2 U	7.5 U	8.2 U	9.1 U	7.6 U	7.8 U	11 U	7.8 U	11 U	8.1 U
VOC	CHLOROETHANE	µg/Kg	34 UJ	28 UJ	30 UJ	34 UJ	28 U	29 UJ	42 U	29 U	40 UJ	30 UJ
VOC	CHLOROFORM	µg/Kg	**29** J	6.4 U	7 U	**35** J	6.5 U	6.6 U	9.7 U	6.7 U	9.3 U	6.9 U
VOC	CHLOROMETHANE	µg/Kg	26 U	21 U	23 U	26 U	21 U	22 U	32 UJ	22 UJ	31 U	23 U
VOC	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	µg/Kg	56 U	46 U	50 U	55 U	46 U	47 U	69 U	47 U	66 U	49 U
VOC	CIS-1,3-DICHLOROPROPENE	µg/Kg	6.4 U	5.3 U	5.7 U	6.4 U	5.3 U	5.4 U	7.9 U	5.5 U	7.6 U	5.7 U
VOC	DIBROMOCHLOROMETHANE	µg/Kg	5 U	4.1 U	4.5 U	5 U	4.1 U	4.2 U	6.2 U	4.3 U	6 U	4.4 U
VOC	DIBROMOMETHANE	µg/Kg	8.7 U	7.1 U	7.8 U	8.6 U	7.1 U	7.3 U	11 U	7.4 U	10 U	7.7 U
VOC	DICHLORODIFLUOROMETHANE	µg/Kg	20 UJ	17 UJ	18 U	20 U	17 U	17 U	25 U	17 U	24 U	18 UJ
VOC	ETHYL BENZENE	µg/Kg	12 U	**26** J	10 U	12 U	9.5 U	9.7 U	**230** J	9.8 UJ	14 U	10 U
VOC	ETHYL METHACRYLATE	µg/Kg	56 U	46 U	50 U	55 U	46 U	47 U	69 U	47 U	66 U	49 U
VOC	ISOBUTANOL	µg/Kg	56 UJ	46 UJ	50 UJ	55 UJ	46 UJ	47 UJ	69 UJ	47 UJ	66 UJ	49 UJ
VOC	METHYL ETHYL KETONE (2-BUTANONE)	µg/Kg	17 U	14 U	16 U	17 U	14 U	15 U	22 U	15 U	21 U	15 U
VOC	METHYL IODIDE (IODOMETHANE)	µg/Kg	50 U	41 U	45 U	50 U	41 U	43 U	62 UJ	43 UJ	60 U	45 U
VOC	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/Kg	9.6 U	7.9 U	8.6 U	9.6 U	7.9 U	8.1 U	12 U	8.2 U	11 U	8.5 U
VOC	METHYL METHACRYLATE	µg/Kg	56 U	46 U	50 U	55 U	46 U	47 U	69 U	47 U	66 U	49 U
VOC	METHYLACRYLONITRILE	µg/Kg	280 UJ	230 UJ	250 U	280 U	230 U	240 U	340 U	240 U	330 U	250 UJ
VOC	METHYLENE CHLORIDE	µg/Kg	27 U	22 U	24 U	27 U	22 U	23 U	33 U	23 U	32 U	24 U
VOC	PENTOCHLORETHANE	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U	14 U	13 U	14 U	14 U
VOC	PROPIONITRILE, ETHYL CYANIDE	µg/Kg	56 UJ	46 UJ	50 UJ	55 UJ	46 UJ	47 UJ	69 UJ	47 UJ	66 UJ	49 UJ
VOC	STYRENE	µg/Kg	8.5 U	6.9 U	7.6 U	8.4 U	7 U	7.1 U	11 U	7.2 U	10 U	7.5 U
VOC	TETRACHLOROETHENE (PCE)	µg/Kg	11 U	8.8 U	9.6 U	11 U	8.8 U	9 U	13 U	9.1 U	13 U	9.4 U
VOC	TOLUENE	µg/Kg	31 U	**2000**	27 U	**62**	25 U	26 U	**510**	**68**	**4400**	**1300**
VOC	TRANS-1,2-DICHLOROETHENE	µg/Kg	9.1 U	7.5 U	8.2 U	9.1 U	7.5 U	7.7 U	11 U	7.8 U	11 U	8.1 U
VOC	TRANS-1,3-DICHLOROPROPENE	µg/Kg	7.9 U	6.4 U	7 U	7.8 U	6.5 U	6.6 U	9.7 U	6.7 U	9.3 U	6.9 U
VOC	TRANS-1,4-DICHLORO-2-BUTENE	µg/Kg	40 U	33 U	36 U	40 U	33 U	34 U	50 U	34 U	48 U	36 U
VOC	TRICHLOROETHENE (TCE)	µg/Kg	9.9 U	8.1 U	8.8 U	9.8 U	8.1 U	8.3 U	12 U	8.4 U	12 U	8.7 U
VOC	TRICHLOROFLUOROMETHANE	µg/Kg	14 UJ	12 U	13 U	14 U	12 U	12 U	17 U	12 U	17 U	12 U
VOC	VINYL ACETATE	µg/Kg	55 U	45 U	49 U	54 U	45 U	46 U	67 U	46 U	65 U	48 U
VOC	VINYL CHLORIDE	µg/Kg	20 U	16 U	18 U	19 U	16 U	17 U	24 U	17 U	23 U	17 U
VOC	XYLENES, TOTAL	µg/Kg	32 U	**100** J	29 U	32 U	26 U	27 U	**1500**	**260**	38 U	**32** J

J = Estimated value
U = Undetected
UJ = Undetected; Estimated detection limit
SL = Selected MDEQ Screening Level
Bold = analyte detected; Shaded = analyte exceeds SL

Appendix E

Tentatively Identified Compound Analytical Results

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
1139-1	N	SVOC	10/30/2006	1-Docosene,	155	µg/kg
1139-1	N	SVOC	10/30/2006	Benzeneacetic acid,	227	µg/kg
1139-1	N	SVOC	10/30/2006	Heptadecane, 9-octyl-,	338	µg/kg
1139-1	N	SVOC	10/30/2006	Hexadecanoic acid,	940	µg/kg
1139-1	N	SVOC	10/30/2006	Pentadecanoic acid,	441	µg/kg
1139-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	328	µg/kg
1139-1	N	SVOC	10/30/2006	Unknown, RRT 2.694	276	µg/kg
1139-1	N	SVOC	10/30/2006	Unknown, RRT 7.802	808	µg/kg
1139-1	N	SVOC	10/30/2006	Unknown, RRT 7.903	238	µg/kg
1139-1	N	SVOC	10/30/2006	Unknown, RRT 8.021	218	µg/kg
1139-2	N	SVOC	10/30/2006	1-Hentetracontanol,	163	µg/kg
1139-2	N	SVOC	10/30/2006	Cholesterol,	182	µg/kg
1139-2	N	SVOC	10/30/2006	Pentadecanoic acid,	325	µg/kg
1139-2	N	SVOC	10/30/2006	Unknown, RRT 7.807	588	µg/kg
1139-2	N	SVOC	10/30/2006	Unknown, RRT 8.128	207	µg/kg
1251-1	N	SVOC	11/13/2006	9-Tricosene, (Z)-,	170	µg/kg
1251-1	N	SVOC	11/13/2006	Heptacosane,	697	µg/kg
1251-1	N	SVOC	11/13/2006	Octadecanoic acid,	484	µg/kg
1251-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	1,180	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 3.842	261	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 4.356	314	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 5.244	162	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 7.64	3,210	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 7.848	1,000	µg/kg
1251-1	N	SVOC	11/13/2006	Unknown, RRT 8.116	263	µg/kg
1251-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	449	µg/kg
1251-2	N	SVOC	11/13/2006	Cholesterol,	412	µg/kg
1251-2	N	SVOC	11/13/2006	Heptadecane,	190	µg/kg
1251-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	238	µg/kg
1251-2	N	SVOC	11/13/2006	Unknown, RRT 2.607	180	µg/kg
1251-2	N	SVOC	11/13/2006	Unknown, RRT 5.549	221	µg/kg
1251-2	N	SVOC	11/13/2006	Unknown, RRT 7.859	658	µg/kg
1438-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	934	µg/kg
1438-1	N	SVOC	11/13/2006	1,4-Naphthalenedione, 5-hydroxy-,	141	µg/kg
1438-1	N	SVOC	11/13/2006	Cholesterol,	583	µg/kg
1438-1	N	SVOC	11/13/2006	Docosane,	190	µg/kg
1438-1	N	SVOC	11/13/2006	Pentadecanoic acid,	273	µg/kg
1438-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	447	µg/kg
1438-1	N	SVOC	11/13/2006	Unknown, RRT 5.554	137	µg/kg
1438-1	N	SVOC	11/13/2006	Unknown, RRT 7.87	464	µg/kg
1438-2	N	SVOC	11/13/2006	Benzene, 1-methoxy-3-methyl-,	227	µg/kg
1438-2	N	SVOC	11/13/2006	Benzeneacetic acid,	209	µg/kg
1438-2	N	SVOC	11/13/2006	Cyclohexadecane,	138	µg/kg
1438-2	N	SVOC	11/13/2006	Heneicosane, 11-pentyl-,	644	µg/kg
1438-2	N	SVOC	11/13/2006	Phytol,	311	µg/kg
1438-2	N	SVOC	11/13/2006	Pregnane-3,11,20,21-tetrol, cyclic 20,21,	1,090	µg/kg
1438-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	478	µg/kg
1438-2	N	SVOC	11/13/2006	Unknown, RRT 3.944	413	µg/kg
1438-2	N	SVOC	11/13/2006	Unknown, RRT 4.11	210	µg/kg
1438-2	N	SVOC	11/13/2006	Unknown, RRT 8.127	363	µg/kg
1517-1	N	SVOC	11/13/2006	Heneicosane,	636	µg/kg
1517-1	N	SVOC	11/13/2006	Octadecanoic acid,	156	µg/kg
1517-1	N	SVOC	11/13/2006	Octadecanoic acid, butyl ester,	393	µg/kg
1517-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	893	µg/kg
1517-1	N	SVOC	11/13/2006	Unknown, RRT 7.041	206	µg/kg
1517-1	N	SVOC	11/13/2006	Unknown, RRT 7.843	880	µg/kg
1517-1	N	SVOC	11/13/2006	Unknown, RRT 8.036	1,590	µg/kg
1517-1-C	N	SVOC	11/13/2006	1-Heneicosyl formate,	291	µg/kg
1517-1-C	N	SVOC	11/13/2006	Docosanoic acid,	168	µg/kg
1517-1-C	N	SVOC	11/13/2006	Hexadecanoic acid,	544	µg/kg
1517-1-C	N	SVOC	11/13/2006	Octadecane,	273	µg/kg
1517-1-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	420	µg/kg
1517-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.319	218	µg/kg
1517-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.891	387	µg/kg
1517-1-C	N	SVOC	11/13/2006	Vitamin E,	199	µg/kg
1517-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	762	µg/kg
1517-2	N	SVOC	11/13/2006	2-Pentene, 2,4-dimethyl-,	145	µg/kg
1517-2	N	SVOC	11/13/2006	3-Butenoic acid, 4-phenyl-,	183	µg/kg
1517-2	N	SVOC	11/13/2006	Cyclotetracosane,	237	µg/kg
1517-2	N	SVOC	11/13/2006	Heptadecane, 9-octyl-,	255	µg/kg
1517-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	361	µg/kg
1517-2	N	SVOC	11/13/2006	Unknown, RRT 5.329	164	µg/kg
1517-2	N	SVOC	11/13/2006	Unknown, RRT 7.212	269	µg/kg
1517-2	N	SVOC	11/13/2006	Unknown, RRT 7.891	362	µg/kg
1517-2	N	SVOC	11/13/2006	Unknown, RRT 8.084	563	µg/kg
1517-2-C	N	SVOC	11/13/2006	4,8,12,16-Tetramethylheptadecan-4-olide,	135	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
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Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
1517-2-C	N	SVOC	11/13/2006	Cyclopentadecane,	345	µg/kg
1517-2-C	N	SVOC	11/13/2006	Hexadecanoic acid,	285	µg/kg
1517-2-C	N	SVOC	11/13/2006	Pentacosane,	243	µg/kg
1517-2-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	274	µg/kg
1517-2-C	N	SVOC	11/13/2006	Unknown, RRT 6.035	263	µg/kg
1517-2-C	N	SVOC	11/13/2006	Unknown, RRT 7.886	472	µg/kg
1517-2-C	N	SVOC	11/13/2006	Unknown, RRT 8.078	163	µg/kg
1517-2-C	N	SVOC	11/13/2006	Vitamin E,	270	µg/kg
1582-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,230	µg/kg
1582-1	N	SVOC	10/30/2006	1-Hexacosanal,	154	µg/kg
1582-1	N	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	219	µg/kg
1582-1	N	SVOC	10/30/2006	Benzeneacetic acid,	152	µg/kg
1582-1	N	SVOC	10/30/2006	Ergost-5-en-3-ol, (3.beta.)-,	361	µg/kg
1582-1	N	SVOC	10/30/2006	Heneicosane,	900	µg/kg
1582-1	N	SVOC	10/30/2006	Heneicosanoic acid,	212	µg/kg
1582-1	N	SVOC	10/30/2006	Heptadecanoic acid,	364	µg/kg
1582-1	N	SVOC	10/30/2006	Oleic Acid,	157	µg/kg
1582-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	731	µg/kg
1582-1-D	FD	SVOC	10/30/2006	12-Octadecenal,	149	µg/kg
1582-1-D	FD	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	226	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Ethanol, 2-(hexadecyloxy)-,	475	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Heneicosane,	985	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Heneicosanoic acid,	197	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Hexadecanoic acid,	345	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Pregnane-3,11,20,21-tetrol, cyclic 20,21,	1,460	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Stigmast-4-en-3-one,	652	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Unknown, RRT 7.454	401	µg/kg
1582-1-D	FD	SVOC	10/30/2006	Vitamin E,	334	µg/kg
1582-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	779	µg/kg
1582-2	N	SVOC	10/30/2006	3-Butenoic acid, 4-phenyl-,	172	µg/kg
1582-2	N	SVOC	10/30/2006	9-Tricosene, (Z)-,	219	µg/kg
1582-2	N	SVOC	10/30/2006	Docosanoic acid,	153	µg/kg
1582-2	N	SVOC	10/30/2006	Ergost-5-en-3-ol, (3.beta.)-,	219	µg/kg
1582-2	N	SVOC	10/30/2006	Ethyl trans-2 decenoate,	141	µg/kg
1582-2	N	SVOC	10/30/2006	Octadecanoic acid,	148	µg/kg
1582-2	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	268	µg/kg
1582-2	N	SVOC	10/30/2006	Tetratriacontane,	459	µg/kg
1582-2	N	SVOC	10/30/2006	Unknown, RRT 7.342	285	µg/kg
2147-1	N	SVOC	10/30/2006	1-Docosene,	491	µg/kg
2147-1	N	SVOC	10/30/2006	Oleic Acid,	367	µg/kg
2147-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	677	µg/kg
2147-1	N	SVOC	10/30/2006	Tetracosane,	313	µg/kg
2147-1	N	SVOC	10/30/2006	Unknown, RRT 3.18	149	µg/kg
2147-1	N	SVOC	10/30/2006	Unknown, RRT 4.865	169	µg/kg
2147-1	N	SVOC	10/30/2006	Unknown, RRT 5.454	299	µg/kg
2147-1	N	SVOC	10/30/2006	Unknown, RRT 7.909	802	µg/kg
2147-1	N	SVOC	10/30/2006	Unknown, RRT 8.032	772	µg/kg
2147-2-D	FD	SVOC	10/30/2006	1-Hentetracontanol,	360	µg/kg
2147-2-D	FD	SVOC	10/30/2006	1-Hentetracontanol,	363	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Cyclotetracosane,	707	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Hexadecanoic acid,	1,030	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Hop-22(29)-en-3.beta.-ol,	767	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Oleic Acid,	633	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Unknown, RRT 3.55	187	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Unknown, RRT 4.213	188	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Unknown, RRT 6.192	224	µg/kg
2147-2-D	FD	SVOC	10/30/2006	Vitamin E,	219	µg/kg
2147-2-M	N	SVOC	10/30/2006	1-Heneicosyl formate,	697	µg/kg
2147-2-M	N	SVOC	10/30/2006	1-Nonadecene,	438	µg/kg
2147-2-M	N	SVOC	10/30/2006	D:C-Friedoolean-8-en-3-one,	526	µg/kg
2147-2-M	N	SVOC	10/30/2006	Ethanol, 2-(hexadecyloxy)-,	366	µg/kg
2147-2-M	N	SVOC	10/30/2006	Heneicosanoic acid,	353	µg/kg
2147-2-M	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	595	µg/kg
2147-2-M	N	SVOC	10/30/2006	Unknown, RRT 4.213	217	µg/kg
2147-2-M	N	SVOC	10/30/2006	Unknown, RRT 7.807	2,160	µg/kg
2147-2-M	N	SVOC	10/30/2006	Unknown, RRT 8.026	815	µg/kg
2147-2-M	N	SVOC	10/30/2006	Vitamin E,	257	µg/kg
2753-1-D	FD	SVOC	10/30/2006	.gamma.-Sitosterol,	1,010	µg/kg
2753-1-D	FD	SVOC	10/30/2006	1-Hexacosanol,	182	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Heneicosane, 11-decyl-,	449	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Oleic Acid,	348	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Stigmast-4-en-3-one,	676	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Unknown, RRT 2.694	196	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Unknown, RRT 7.903	536	µg/kg
2753-1-D	FD	SVOC	10/30/2006	Unknown, RRT 8.021	164	µg/kg
2753-1-M	N	SVOC	10/30/2006	Cholesterol,	235	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
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Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
2753-1-M	N	SVOC	10/30/2006	Cyclohexadecane,	296	µg/kg
2753-1-M	N	SVOC	10/30/2006	Heneicosanoic acid,	201	µg/kg
2753-1-M	N	SVOC	10/30/2006	Heptadecane, 9-octyl-,	606	µg/kg
2753-1-M	N	SVOC	10/30/2006	Octadecanoic acid,	138	µg/kg
2753-1-M	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	927	µg/kg
2753-1-M	N	SVOC	10/30/2006	Tetradecanoic acid,	154	µg/kg
2753-1-M	N	SVOC	10/30/2006	Unknown, RRT 7.593	825	µg/kg
2753-1-M	N	SVOC	10/30/2006	Unknown, RRT 7.919	684	µg/kg
2753-1-M	N	SVOC	10/30/2006	Unknown, RRT 8.026	210	µg/kg
2753-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,630	µg/kg
2753-2	N	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	191	µg/kg
2753-2	N	SVOC	10/30/2006	Hexadecanoic acid,	771	µg/kg
2753-2	N	SVOC	10/30/2006	Oleic Acid,	270	µg/kg
2753-2	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	1,150	µg/kg
2753-2	N	SVOC	10/30/2006	Tetracosane,	898	µg/kg
2753-2	N	SVOC	10/30/2006	Unknown, RRT 6.266	361	µg/kg
2753-2	N	SVOC	10/30/2006	Unknown, RRT 6.443	291	µg/kg
2753-2	N	SVOC	10/30/2006	Unknown, RRT 7.925	937	µg/kg
2753-2	N	SVOC	10/30/2006	Unknown, RRT 8.026	431	µg/kg
2808-1	N	SVOC	10/30/2006	.alpha.-Amyrin,	760	µg/kg
2808-1	N	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	132	µg/kg
2808-1	N	SVOC	10/30/2006	Ethanol, 2-(tetradecyloxy)-,	249	µg/kg
2808-1	N	SVOC	10/30/2006	Heneicosanoic acid,	183	µg/kg
2808-1	N	SVOC	10/30/2006	Octadecanoic acid,	221	µg/kg
2808-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	473	µg/kg
2808-1	N	SVOC	10/30/2006	Unknown, RRT 3.951	133	µg/kg
2808-1	N	SVOC	10/30/2006	Unknown, RRT 7.807	1,350	µg/kg
2808-1	N	SVOC	10/30/2006	Unknown, RRT 7.919	802	µg/kg
2808-1	N	SVOC	10/30/2006	Vitamin E,	198	µg/kg
2808-2	N	SVOC	10/30/2006	.beta.-Sitosterol,	1,550	µg/kg
2808-2	N	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	148	µg/kg
2808-2	N	SVOC	10/30/2006	Octadecanoic acid,	175	µg/kg
2808-2	N	SVOC	10/30/2006	Testosterone,	430	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 3.116	140	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 3.175	132	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 7.272	186	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 7.336	159	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 7.919	454	µg/kg
2808-2	N	SVOC	10/30/2006	Unknown, RRT 8.021	367	µg/kg
2823-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	509	µg/kg
2823-1	N	SVOC	11/13/2006	Eicosane, 9-octyl-,	544	µg/kg
2823-1	N	SVOC	11/13/2006	Nonadecane,	234	µg/kg
2823-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	195	µg/kg
2823-1	N	SVOC	11/13/2006	Unknown, RRT 7.87	578	µg/kg
2823-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	307	µg/kg
2823-2	N	SVOC	11/13/2006	Heneicosane,	182	µg/kg
2823-2	N	SVOC	11/13/2006	Unknown, RRT 5.554	173	µg/kg
2823-2	N	SVOC	11/13/2006	Unknown, RRT 6.137	133	µg/kg
2823-2	N	SVOC	11/13/2006	Unknown, RRT 7.865	287	µg/kg
3374-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,450	µg/kg
3374-1	N	SVOC	10/30/2006	16-Octadecenal,	142	µg/kg
3374-1	N	SVOC	10/30/2006	1-Octadecanethiol,	263	µg/kg
3374-1	N	SVOC	10/30/2006	Docosanoic acid,	137	µg/kg
3374-1	N	SVOC	10/30/2006	Heneicosanoic acid,	315	µg/kg
3374-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	783	µg/kg
3374-1	N	SVOC	10/30/2006	Unknown, RRT 7.347	522	µg/kg
3374-1	N	SVOC	10/30/2006	Unknown, RRT 7.925	387	µg/kg
3374-1	N	SVOC	10/30/2006	Unknown, RRT 8.032	464	µg/kg
3374-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	634	µg/kg
3374-2	N	SVOC	10/30/2006	1-Heptadecanol,	232	µg/kg
3374-2	N	SVOC	10/30/2006	Unknown, RRT 5.689	152	µg/kg
3374-2	N	SVOC	10/30/2006	Unknown, RRT 6.454	172	µg/kg
3374-2	N	SVOC	10/30/2006	Unknown, RRT 7.347	248	µg/kg
3374-2	N	SVOC	10/30/2006	Unknown, RRT 7.909	242	µg/kg
3374-2	N	SVOC	10/30/2006	Unknown, RRT 8.032	165	µg/kg
3672-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	618	µg/kg
3672-1	N	SVOC	11/13/2006	9-Hexadecenoic acid,	440	µg/kg
3672-1	N	SVOC	11/13/2006	Docosanoic acid,	153	µg/kg
3672-1	N	SVOC	11/13/2006	Phosphonic acid, dioctadecyl ester,	277	µg/kg
3672-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	543	µg/kg
3672-1	N	SVOC	11/13/2006	Unknown, RRT 3.955	275	µg/kg
3672-1	N	SVOC	11/13/2006	Unknown, RRT 4.105	184	µg/kg
3672-1	N	SVOC	11/13/2006	Unknown, RRT 5.554	206	µg/kg
3672-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	559	µg/kg
3672-2	N	SVOC	11/13/2006	Docosanoic acid,	145	µg/kg
3672-2	N	SVOC	11/13/2006	Ethanol, 2-(tetradecyloxy)-,	273	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
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Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
3672-2	N	SVOC	11/13/2006	Octadecane,	222	µg/kg
3672-2	N	SVOC	11/13/2006	Pentadecanoic acid,	178	µg/kg
3672-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	319	µg/kg
3672-2	N	SVOC	11/13/2006	Unknown, RRT 4.522	181	µg/kg
3672-2	N	SVOC	11/13/2006	Unknown, RRT 5.238	214	µg/kg
3672-2	N	SVOC	11/13/2006	Unknown, RRT 5.559	304	µg/kg
3672-2	N	SVOC	11/13/2006	Unknown, RRT 7.87	350	µg/kg
4460-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,740	µg/kg
4460-1	N	SVOC	10/30/2006	1-Docosene,	342	µg/kg
4460-1	N	SVOC	10/30/2006	2-Pentadecanone, 6,10,14-trimethyl-,	137	µg/kg
4460-1	N	SVOC	10/30/2006	Docosane, 9-butyl-,	1,470	µg/kg
4460-1	N	SVOC	10/30/2006	Docosanoic acid,	352	µg/kg
4460-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	885	µg/kg
4460-1	N	SVOC	10/30/2006	Unknown, RRT 5.368	231	µg/kg
4460-1	N	SVOC	10/30/2006	Unknown, RRT 6.956	151	µg/kg
4460-1	N	SVOC	10/30/2006	Unknown, RRT 7.935	1,170	µg/kg
4460-1	N	SVOC	10/30/2006	Vitamin E,	302	µg/kg
4460-2	N	SVOC	10/30/2006	1-Docosene,	490	µg/kg
4460-2	N	SVOC	10/30/2006	Octadecanoic acid,	152	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 4.491	156	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 5.373	303	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 7.347	326	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 7.818	1,380	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 7.876	332	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 7.935	837	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 8.037	431	µg/kg
4460-2	N	SVOC	10/30/2006	Unknown, RRT 8.123	606	µg/kg
4507-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	953	µg/kg
4507-1	N	SVOC	11/13/2006	Ergost-7-en-3-ol, (3.beta.)-,	258	µg/kg
4507-1	N	SVOC	11/13/2006	Ethanol, 2-(hexadecyloxy)-,	185	µg/kg
4507-1	N	SVOC	11/13/2006	Heptadecane, 9-octyl-,	341	µg/kg
4507-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	521	µg/kg
4507-1	N	SVOC	11/13/2006	Unknown, RRT 7.191	208	µg/kg
4507-1	N	SVOC	11/13/2006	Unknown, RRT 7.811	169	µg/kg
4507-1	N	SVOC	11/13/2006	Unknown, RRT 7.87	246	µg/kg
4507-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	608	µg/kg
4507-2	N	SVOC	11/13/2006	2-Hexyl-1-decanol,	142	µg/kg
4507-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	310	µg/kg
4507-2	N	SVOC	11/13/2006	Unknown, RRT 7.965	309	µg/kg
4507-2	N	SVOC	11/13/2006	Vitamin E,	168	µg/kg
4528-1	N	SVOC	11/13/2006	.beta.-Sitosterol,	1,940	µg/kg
4528-1	N	SVOC	11/13/2006	1-Pentadecene,	411	µg/kg
4528-1	N	SVOC	11/13/2006	Eicosane,	344	µg/kg
4528-1	N	SVOC	11/13/2006	Hexadecanoic acid,	310	µg/kg
4528-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	684	µg/kg
4528-1	N	SVOC	11/13/2006	Unknown, RRT 4.8	152	µg/kg
4528-1	N	SVOC	11/13/2006	Unknown, RRT 5.559	188	µg/kg
4528-1	N	SVOC	11/13/2006	Unknown, RRT 7.768	1,070	µg/kg
4528-1	N	SVOC	11/13/2006	Unknown, RRT 7.848	1,690	µg/kg
4528-1	N	SVOC	11/13/2006	Unknown, RRT 8.068	2,110	µg/kg
4528-2	N	SVOC	11/13/2006	.beta.-Sitosterol,	679	µg/kg
4528-2	N	SVOC	11/13/2006	Heneicosane,	160	µg/kg
4528-2	N	SVOC	11/13/2006	Unknown, RRT 5.319	322	µg/kg
4528-2	N	SVOC	11/13/2006	Unknown, RRT 5.554	448	µg/kg
4528-2	N	SVOC	11/13/2006	Unknown, RRT 7.843	601	µg/kg
4528-2	N	SVOC	11/13/2006	Unknown, RRT 7.956	269	µg/kg
4528-2	N	SVOC	11/13/2006	Unknown, RRT 8.057	499	µg/kg
4995-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,170	µg/kg
4995-1	N	SVOC	10/30/2006	Anthracene, 2-methyl-,	549	µg/kg
4995-1	N	SVOC	10/30/2006	Docosanoic acid,	194	µg/kg
4995-1	N	SVOC	10/30/2006	Heneicosane,	338	µg/kg
4995-1	N	SVOC	10/30/2006	Hexadecanoic acid,	261	µg/kg
4995-1	N	SVOC	10/30/2006	Phenanthrene, 2,5-dimethyl-,	146	µg/kg
4995-1	N	SVOC	10/30/2006	Pyrene, 2-methyl-,	257	µg/kg
4995-1	N	SVOC	10/30/2006	Unknown, RRT 7.347	232	µg/kg
4995-1	N	SVOC	10/30/2006	Unknown, RRT 7.93	475	µg/kg
4995-1	N	SVOC	10/30/2006	Unknown, RRT 8.123	464	µg/kg
4995-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	939	µg/kg
4995-2	N	SVOC	10/30/2006	Benzo[k]fluoranthene,	171	µg/kg
4995-2	N	SVOC	10/30/2006	Stigmasterol,	197	µg/kg
4995-2	N	SVOC	10/30/2006	Unknown, RRT 2.945	216	µg/kg
4995-2	N	SVOC	10/30/2006	Unknown, RRT 4.443	208	µg/kg
4995-2	N	SVOC	10/30/2006	Unknown, RRT 7.352	242	µg/kg
4995-2	N	SVOC	10/30/2006	Unknown, RRT 7.935	591	µg/kg
5338-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,300	µg/kg
5338-1	N	SVOC	10/30/2006	Heptadecane, 9-octyl-,	643	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
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Midland Area Soils

Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
5338-1	N	SVOC	10/30/2006	Hexadecanoic acid,	299	µg/kg
5338-1	N	SVOC	10/30/2006	Pentadecanoic acid,	140	µg/kg
5338-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	615	µg/kg
5338-1	N	SVOC	10/30/2006	Unknown, RRT 6.277	134	µg/kg
5338-1	N	SVOC	10/30/2006	Unknown, RRT 6.454	172	µg/kg
5338-2	N	SVOC	10/30/2006	1-Docosanol, acetate,	183	µg/kg
5338-2	N	SVOC	10/30/2006	Oleic Acid,	639	µg/kg
5338-2	N	SVOC	10/30/2006	Unknown, RRT 6.454	136	µg/kg
5338-2	N	SVOC	10/30/2006	Unknown, RRT 7.818	628	µg/kg
5338-2	N	SVOC	10/30/2006	Unknown, RRT 8.032	142	µg/kg
5583-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	794	µg/kg
5583-1	N	SVOC	11/13/2006	Hexatriacontane,	326	µg/kg
5583-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	426	µg/kg
5583-1	N	SVOC	11/13/2006	Unknown, RRT 3.955	140	µg/kg
5583-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	554	µg/kg
5620-1	N	SVOC	11/13/2006	1-Heptadecene,	385	µg/kg
5620-1	N	SVOC	11/13/2006	9,10-Anthracenedione,	167	µg/kg
5620-1	N	SVOC	11/13/2006	Benzene, 1-ethyl-2-methyl-,	255	µg/kg
5620-1	N	SVOC	11/13/2006	Octadecanoic acid,	304	µg/kg
5620-1	N	SVOC	11/13/2006	Octadecanoic acid, butyl ester,	2,820	µg/kg
5620-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	1,250	µg/kg
5620-1	N	SVOC	11/13/2006	Tetratriacontane,	527	µg/kg
5620-1	N	SVOC	11/13/2006	Unknown, RRT 4.083	350	µg/kg
5620-1	N	SVOC	11/13/2006	Unknown, RRT 7.635	3,340	µg/kg
5620-1	N	SVOC	11/13/2006	Unknown, RRT 7.848	1,080	µg/kg
5620-1-C	N	SVOC	11/13/2006	.gamma.-Sitosterol,	2,800	µg/kg
5620-1-C	N	SVOC	11/13/2006	Octadecanoic acid, butyl ester,	185	µg/kg
5620-1-C	N	SVOC	11/13/2006	Testosterone,	978	µg/kg
5620-1-C	N	SVOC	11/13/2006	Unknown, RRT 2.832	133	µg/kg
5620-1-C	N	SVOC	11/13/2006	Unknown, RRT 6.79	187	µg/kg
5620-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.046	329	µg/kg
5620-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.849	1,050	µg/kg
5620-1-C	N	SVOC	11/13/2006	Unknown, RRT 8.036	241	µg/kg
5620-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	2,170	µg/kg
5620-2	N	SVOC	11/13/2006	Docosanoic acid,	218	µg/kg
5620-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	580	µg/kg
5620-2	N	SVOC	11/13/2006	Unknown, RRT 4.083	166	µg/kg
5620-2	N	SVOC	11/13/2006	Unknown, RRT 5.869	178	µg/kg
5620-2	N	SVOC	11/13/2006	Unknown, RRT 6.292	323	µg/kg
5620-2	N	SVOC	11/13/2006	Unknown, RRT 7.041	351	µg/kg
5620-2	N	SVOC	11/13/2006	Unknown, RRT 7.843	630	µg/kg
5620-2-C	N	SVOC	11/13/2006	Cyclopentane, (4-octyldodecyl)-,	404	µg/kg
5620-2-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	741	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 2.832	185	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 3.179	149	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 5.238	165	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 5.8	181	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 5.87	574	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 6.939	500	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 7.843	747	µg/kg
5620-2-C	N	SVOC	11/13/2006	Unknown, RRT 8.036	387	µg/kg
5685-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	543	µg/kg
5685-1	N	SVOC	11/13/2006	Benzene, 1,3-diethyl-,	224	µg/kg
5685-1	N	SVOC	11/13/2006	Benzene, 1,4-diethyl-,	193	µg/kg
5685-1	N	SVOC	11/13/2006	Docosane,	183	µg/kg
5685-1	N	SVOC	11/13/2006	Hexadecanoic acid,	245	µg/kg
5685-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	291	µg/kg
5685-1	N	SVOC	11/13/2006	Unknown, RRT 5.565	204	µg/kg
5685-1	N	SVOC	11/13/2006	Unknown, RRT 5.821	324	µg/kg
5685-1	N	SVOC	11/13/2006	Unknown, RRT 7.207	158	µg/kg
5685-2	N	SVOC	11/13/2006	1,3,5,7-Cyclooctatetraene,	147	µg/kg
5685-2	N	SVOC	11/13/2006	Benzene, 1,2-diethyl-,	153	µg/kg
5685-2	N	SVOC	11/13/2006	Benzene, 1,3-diethyl-,	147	µg/kg
5685-2	N	SVOC	11/13/2006	Testosterone,	322	µg/kg
5685-2	N	SVOC	11/13/2006	Unknown, RRT 5.554	208	µg/kg
5685-2	N	SVOC	11/13/2006	Unknown, RRT 5.811	336	µg/kg
574-1	N	SVOC	11/13/2006	1,3,5,7-Cyclooctatetraene,	236	µg/kg
574-1	N	SVOC	11/13/2006	7-Heptadecene, 17-chloro-,	279	µg/kg
574-1	N	SVOC	11/13/2006	Ethylbenzene,	163	µg/kg
574-1	N	SVOC	11/13/2006	Heneicosane, 11-decyl-,	461	µg/kg
574-1	N	SVOC	11/13/2006	Hexadecanoic acid, methyl ester,	212	µg/kg
574-1	N	SVOC	11/13/2006	Octadecane, 1-[2-(hexadecyloxy)ethoxy]-,	164	µg/kg
574-1	N	SVOC	11/13/2006	Octadecanoic acid, methyl ester,	805	µg/kg
574-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	900	µg/kg
574-1	N	SVOC	11/13/2006	Unknown, RRT 7.18	255	µg/kg
574-1	N	SVOC	11/13/2006	Unknown, RRT 7.645	1,000	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
574-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	487	µg/kg
574-2	N	SVOC	11/13/2006	1,3,5,7-Cyclooctatetraene,	279	µg/kg
574-2	N	SVOC	11/13/2006	Docosane, 9-butyl-,	192	µg/kg
574-2	N	SVOC	11/13/2006	Hexadecanoic acid, methyl ester,	189	µg/kg
574-2	N	SVOC	11/13/2006	Octadecanoic acid, methyl ester,	189	µg/kg
574-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	410	µg/kg
574-2	N	SVOC	11/13/2006	Unknown, RRT 3.222	139	µg/kg
6676-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,040	µg/kg
6676-1	N	SVOC	10/30/2006	Docosanoic acid,	269	µg/kg
6676-1	N	SVOC	10/30/2006	Ethanol, 2-(hexadecyloxy)-,	360	µg/kg
6676-1	N	SVOC	10/30/2006	Heneicosane, 11-decyl-,	442	µg/kg
6676-1	N	SVOC	10/30/2006	Hexadecanoic acid,	565	µg/kg
6676-1	N	SVOC	10/30/2006	Octadecanoic acid,	232	µg/kg
6676-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	354	µg/kg
6676-1	N	SVOC	10/30/2006	Unknown, RRT 4.94	292	µg/kg
6676-1	N	SVOC	10/30/2006	Unknown, RRT 6.192	135	µg/kg
6676-1	N	SVOC	10/30/2006	Unknown, RRT 7.925	318	µg/kg
6676-2-D	FD	SVOC	10/30/2006	17-Pentatriacontene,	191	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Eicosane, 10-methyl-,	254	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Pentadecanoic acid,	135	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Stigmast-4-en-3-one,	164	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Unknown, RRT 4.945	176	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Unknown, RRT 7.919	177	µg/kg
6676-2-D	FD	SVOC	10/30/2006	Unknown, RRT 8.026	184	µg/kg
6676-2-M	N	SVOC	10/30/2006	.gamma.-Sitosterol,	834	µg/kg
6676-2-M	N	SVOC	10/30/2006	1-Hentetracontanol,	233	µg/kg
6676-2-M	N	SVOC	10/30/2006	Hexadecanoic acid,	142	µg/kg
6676-2-M	N	SVOC	10/30/2006	Undecane 5-cyclohexyl-, 5-cyclohexyl-,	693	µg/kg
6676-2-M	N	SVOC	10/30/2006	Unknown, RRT 7.93	228	µg/kg
6676-2-M	N	SVOC	10/30/2006	Unknown, RRT 8.026	304	µg/kg
6960-1	N	SVOC	11/13/2006	Ethanol, 2-(hexadecyloxy)-,	217	µg/kg
6960-1	N	SVOC	11/13/2006	Octadecanoic acid,	171	µg/kg
6960-1	N	SVOC	11/13/2006	Pentadecanoic acid,	259	µg/kg
6960-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	934	µg/kg
6960-1	N	SVOC	11/13/2006	Unknown, RRT 5.196	360	µg/kg
6960-1	N	SVOC	11/13/2006	Unknown, RRT 5.292	197	µg/kg
6960-1	N	SVOC	11/13/2006	Unknown, RRT 7.164	963	µg/kg
6960-1	N	SVOC	11/13/2006	Unknown, RRT 8.073	391	µg/kg
6960-1-C	N	SVOC	11/13/2006	17-Octadecenal,	159	µg/kg
6960-1-C	N	SVOC	11/13/2006	1-Eicosanol,	267	µg/kg
6960-1-C	N	SVOC	11/13/2006	Docosane,	978	µg/kg
6960-1-C	N	SVOC	11/13/2006	Octadecanoic acid,	225	µg/kg
6960-1-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	1,870	µg/kg
6960-1-C	N	SVOC	11/13/2006	Unknown, RRT 6.292	248	µg/kg
6960-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.635	3,200	µg/kg
6960-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.848	620	µg/kg
6960-1-C	N	SVOC	11/13/2006	Vitamin E,	743	µg/kg
6960-2	N	SVOC	11/13/2006	4,8,12,16-Tetramethylheptadecan-4-olide,	134	µg/kg
6960-2	N	SVOC	11/13/2006	Docosane,	533	µg/kg
6960-2	N	SVOC	11/13/2006	Docosanoic acid,	189	µg/kg
6960-2	N	SVOC	11/13/2006	Octadecanoic acid,	157	µg/kg
6960-2	N	SVOC	11/13/2006	Octadecanoic acid,	211	µg/kg
6960-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	634	µg/kg
6960-2	N	SVOC	11/13/2006	Unknown, RRT 2.596	242	µg/kg
6960-2	N	SVOC	11/13/2006	Unknown, RRT 7.169	488	µg/kg
6960-2	N	SVOC	11/13/2006	Unknown, RRT 8.1	485	µg/kg
6960-2-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	198	µg/kg
706-1	N	SVOC	11/13/2006	a'-Neogammacer-22(29)-en-3-ol, (3.beta.,,	747	µg/kg
706-1	N	SVOC	11/13/2006	Benzo[e]pyrene,	134	µg/kg
706-1	N	SVOC	11/13/2006	Unknown, RRT 7.645	945	µg/kg
706-1	N	SVOC	11/13/2006	Unknown, RRT 7.79	415	µg/kg
706-1	N	SVOC	11/13/2006	Unknown, RRT 7.865	550	µg/kg
706-1	N	SVOC	11/13/2006	Unknown, RRT 8.02	214	µg/kg
706-1-C	N	SVOC	11/13/2006	9,10-Anthracenedione,	562	µg/kg
706-1-C	N	SVOC	11/13/2006	Perylene,	592	µg/kg
706-1-C	N	SVOC	11/13/2006	Unknown, RRT 4.297	2,150	µg/kg
706-1-C	N	SVOC	11/13/2006	Unknown, RRT 5.549	523	µg/kg
706-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.485	842	µg/kg
706-2-C	N	SVOC	11/13/2006	Benzo[e]pyrene,	201	µg/kg
706-2-C	N	SVOC	11/13/2006	Unknown, RRT 3.008	390	µg/kg
706-2-C	N	SVOC	11/13/2006	Unknown, RRT 4.297	1,010	µg/kg
706-2-C	N	SVOC	11/13/2006	Unknown, RRT 5.244	304	µg/kg
706-2-C	N	SVOC	11/13/2006	Unknown, RRT 5.549	250	µg/kg
7500-1	N	SVOC	11/13/2006	3-Eicosene, (E)-,	180	µg/kg
7500-1	N	SVOC	11/13/2006	Tetratriacontane,	284	µg/kg
7500-1	N	SVOC	11/13/2006	Unknown, RRT 3.179	328	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
7500-1	N	SVOC	11/13/2006	Unknown, RRT 5.319	225	µg/kg
7500-1	N	SVOC	11/13/2006	Unknown, RRT 5.554	417	µg/kg
7500-1	N	SVOC	11/13/2006	Unknown, RRT 7.87	170	µg/kg
7500-1	N	SVOC	11/13/2006	Vitamin E,	140	µg/kg
7500-2	N	SVOC	11/13/2006	Hexadecanoic acid,	464	µg/kg
7500-2	N	SVOC	11/13/2006	Pentadecane,	200	µg/kg
7500-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	226	µg/kg
7500-2	N	SVOC	11/13/2006	Unknown, RRT 4.522	276	µg/kg
7500-2	N	SVOC	11/13/2006	Unknown, RRT 5.319	189	µg/kg
7500-2	N	SVOC	11/13/2006	Unknown, RRT 7.87	222	µg/kg
7500-2	N	SVOC	11/13/2006	Vitamin E,	268	µg/kg
7530-1	N	SVOC	10/30/2006	17-Pentatriacontene,	185	µg/kg
7530-1	N	SVOC	10/30/2006	Unknown, RRT 3.18	174	µg/kg
7530-1	N	SVOC	10/30/2006	Unknown, RRT 4.213	148	µg/kg
7530-1	N	SVOC	10/30/2006	Unknown, RRT 7.272	162	µg/kg
7530-1-D	N	SVOC	10/30/2006	17-Pentatriacontene,	241	µg/kg
7530-1-D	N	SVOC	10/30/2006	1-Hentetracontanol,	190	µg/kg
7530-1-D	N	SVOC	10/30/2006	Hexadecanoic acid,	181	µg/kg
7530-1-D	N	SVOC	10/30/2006	Octadecane, 1-chloro-,	197	µg/kg
7530-1-D	N	SVOC	10/30/2006	Octadecanoic acid,	291	µg/kg
7530-1-D	N	SVOC	10/30/2006	Unknown, RRT 4.491	156	µg/kg
7530-1-D	N	SVOC	10/30/2006	Unknown, RRT 6.454	233	µg/kg
7530-1-D	N	SVOC	10/30/2006	Unknown, RRT 8.026	326	µg/kg
7530-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	450	µg/kg
7530-2	N	SVOC	10/30/2006	Cyclooctacosane,	286	µg/kg
7530-2	N	SVOC	10/30/2006	Cyclotetracosane,	171	µg/kg
7530-2	N	SVOC	10/30/2006	Stigmasterol,	196	µg/kg
7530-2	N	SVOC	10/30/2006	Unknown, RRT 3.18	140	µg/kg
7530-2	N	SVOC	10/30/2006	Unknown, RRT 4.945	137	µg/kg
7530-2	N	SVOC	10/30/2006	Unknown, RRT 8.106	137	µg/kg
7734-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	1,230	µg/kg
7734-1	N	SVOC	11/13/2006	Heneicosane, 11-(1-ethylpropyl)-,	484	µg/kg
7734-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	791	µg/kg
7734-1	N	SVOC	11/13/2006	Unknown, RRT 6.292	178	µg/kg
7734-1	N	SVOC	11/13/2006	Unknown, RRT 6.795	252	µg/kg
7734-1	N	SVOC	11/13/2006	Unknown, RRT 7.843	264	µg/kg
7734-2	N	SVOC	11/13/2006	Docosane,	207	µg/kg
7734-2	N	SVOC	11/13/2006	Heneicosane,	207	µg/kg
8046-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	776	µg/kg
8046-1	N	SVOC	10/30/2006	14-Pentadecenoic acid,	226	µg/kg
8046-1	N	SVOC	10/30/2006	Ethanol, 2-(tetradecyloxy)-,	134	µg/kg
8046-1	N	SVOC	10/30/2006	Hexadecanoic acid,	319	µg/kg
8046-1	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	134	µg/kg
8046-1	N	SVOC	10/30/2006	Unknown, RRT 1.442	146	µg/kg
8046-1	N	SVOC	10/30/2006	Unknown, RRT 5.94	138	µg/kg
8046-1	N	SVOC	10/30/2006	Unknown, RRT 7.919	315	µg/kg
8046-2	N	SVOC	10/30/2006	Pentadecanoic acid,	204	µg/kg
8046-2	N	SVOC	10/30/2006	Tetratriacontane,	175	µg/kg
8196-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,590	µg/kg
8196-1	N	SVOC	10/30/2006	Ergost-5-en-3-ol, (3.beta.)-,	559	µg/kg
8196-1	N	SVOC	10/30/2006	Testosterone,	527	µg/kg
8196-1	N	SVOC	10/30/2006	Unknown, RRT 4.94	477	µg/kg
8196-1	N	SVOC	10/30/2006	Unknown, RRT 5.94	846	µg/kg
8196-1	N	SVOC	10/30/2006	Unknown, RRT 6.272	194	µg/kg
8196-1	N	SVOC	10/30/2006	Unknown, RRT 7.342	386	µg/kg
8196-1	N	SVOC	10/30/2006	Unknown, RRT 7.908	516	µg/kg
8196-2	N	SVOC	10/30/2006	1,3,5,7-Cyclooctatetraene,	159	µg/kg
8196-2	N	SVOC	10/30/2006	Hexadecanoic acid,	460	µg/kg
8196-2	N	SVOC	10/30/2006	Unknown, RRT 4.94	169	µg/kg
8196-2	N	SVOC	10/30/2006	Unknown, RRT 5.94	410	µg/kg
8196-2	N	SVOC	10/30/2006	Unknown, RRT 7.903	143	µg/kg
8282-1	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,580	µg/kg
8282-1	N	SVOC	10/30/2006	Cyclooctacosane,	395	µg/kg
8282-1	N	SVOC	10/30/2006	Hexadecanoic acid,	213	µg/kg
8282-1	N	SVOC	10/30/2006	Oleic Acid,	256	µg/kg
8282-1	N	SVOC	10/30/2006	Tritetracontane,	218	µg/kg
8282-1	N	SVOC	10/30/2006	Unknown, RRT 7.347	1,280	µg/kg
8282-1	N	SVOC	10/30/2006	Unknown, RRT 7.614	214	µg/kg
8282-1	N	SVOC	10/30/2006	Unknown, RRT 7.93	210	µg/kg
8282-1	N	SVOC	10/30/2006	Unknown, RRT 8.117	779	µg/kg
8282-2	N	SVOC	10/30/2006	.gamma.-Sitosterol,	1,410	µg/kg
8282-2	N	SVOC	10/30/2006	1-Heneicosyl formate,	253	µg/kg
8282-2	N	SVOC	10/30/2006	Cholesterol,	955	µg/kg
8282-2	N	SVOC	10/30/2006	Cyclohexadecane,	395	µg/kg
8282-2	N	SVOC	10/30/2006	Hexadecanoic acid,	280	µg/kg
8282-2	N	SVOC	10/30/2006	Oleic Acid,	350	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
Data Evaluation Report in Support of Bioavailability Study
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Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
8282-2	N	SVOC	10/30/2006	Stigmast-4-en-3-one,	525	µg/kg
8282-2	N	SVOC	10/30/2006	Unknown, RRT 4.469	289	µg/kg
8282-2	N	SVOC	10/30/2006	Unknown, RRT 7.925	271	µg/kg
8282-2	N	SVOC	10/30/2006	Urs-12-en-24-oic acid, 3-oxo-, methyl es,	140	µg/kg
8314-1	N	SVOC	11/13/2006	Heptadecane,	223	µg/kg
8314-1	N	SVOC	11/13/2006	Testosterone,	493	µg/kg
8314-1	N	SVOC	11/13/2006	Unknown, RRT 4.104	159	µg/kg
8314-1	N	SVOC	11/13/2006	Unknown, RRT 4.329	141	µg/kg
8314-1	N	SVOC	11/13/2006	Unknown, RRT 4.372	340	µg/kg
8314-1	N	SVOC	11/13/2006	Unknown, RRT 4.778	328	µg/kg
8314-2	N	SVOC	11/13/2006	Unknown, RRT 2.928	134	µg/kg
8314-2	N	SVOC	11/13/2006	Unknown, RRT 4.377	388	µg/kg
876-1	N	SVOC	11/13/2006	1,1'-Biphenyl, 2-phenoxy-,	199	µg/kg
876-1	N	SVOC	11/13/2006	Docosane,	132	µg/kg
876-1	N	SVOC	11/13/2006	Unknown, RRT 4.361	168	µg/kg
876-1	N	SVOC	11/13/2006	Unknown, RRT 7.458	161	µg/kg
876-1	N	SVOC	11/13/2006	Unknown, RRT 7.945	209	µg/kg
876-2	N	SVOC	11/13/2006	1,1'-Biphenyl, 2-phenoxy-,	312	µg/kg
876-2	N	SVOC	11/13/2006	3-Penten-2-one, 4-methyl-,	138	µg/kg
876-2	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	158	µg/kg
876-2	N	SVOC	11/13/2006	Styrene,	208	µg/kg
876-2	N	SVOC	11/13/2006	Tetracosane,	137	µg/kg
876-2	N	SVOC	11/13/2006	Unknown, RRT 5.554	156	µg/kg
876-2	N	SVOC	11/13/2006	Unknown, RRT 5.811	204	µg/kg
9386-1	N	SVOC	10/30/2006	2,4-Diphenyl-4-methyl-2(E)-pentene,	244	µg/kg
9386-1	N	SVOC	10/30/2006	Benzene, (1-methylethyl)-,	277	µg/kg
9386-1	N	SVOC	10/30/2006	Benzene, 1,3-diethyl-,	473	µg/kg
9386-1	N	SVOC	10/30/2006	Benzene, propyl-,	160	µg/kg
9386-1	N	SVOC	10/30/2006	Heneicosane,	654	µg/kg
9386-1	N	SVOC	10/30/2006	Unknown, RRT 3.806	142	µg/kg
9386-1	N	SVOC	10/30/2006	Unknown, RRT 4.491	312	µg/kg
9386-1	N	SVOC	10/30/2006	Unknown, RRT 7.347	459	µg/kg
9386-1	N	SVOC	10/30/2006	Unknown, RRT 7.812	1,300	µg/kg
9386-1	N	SVOC	10/30/2006	Unknown, RRT 7.925	300	µg/kg
9386-2	N	SVOC	10/30/2006	Benzene, (1-methylethyl)-,	208	µg/kg
9386-2	N	SVOC	10/30/2006	Benzene, 1,2-diethyl-,	467	µg/kg
9386-2	N	SVOC	10/30/2006	Benzene, 1-ethyl-2-methyl-,	411	µg/kg
9386-2	N	SVOC	10/30/2006	Butylated Hydroxytoluene,	369	µg/kg
9386-2	N	SVOC	10/30/2006	Octadecanoic acid,	187	µg/kg
9386-2	N	SVOC	10/30/2006	Styrene,	389	µg/kg
9386-2	N	SVOC	10/30/2006	Unknown, RRT 2.464	141	µg/kg
9386-2	N	SVOC	10/30/2006	Unknown, RRT 3.346	276	µg/kg
9386-2	N	SVOC	10/30/2006	Unknown, RRT 5.94	3,730	µg/kg
9496-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	274	µg/kg
9496-1	N	SVOC	11/13/2006	Unknown, RRT 7.64	535	µg/kg
9496-2	N	SVOC	11/13/2006	Ergost-5-en-3-ol, (3.beta.)-,	310	µg/kg
9496-2	N	SVOC	11/13/2006	Oleic Acid,	347	µg/kg
9496-2	N	SVOC	11/13/2006	Unknown, RRT 7.121	142	µg/kg
9496-2	N	SVOC	11/13/2006	Unknown, RRT 7.961	303	µg/kg
9645-1	N	SVOC	11/13/2006	.gamma.-Sitosterol,	786	µg/kg
9645-1	N	SVOC	11/13/2006	1-Octadecanol,	400	µg/kg
9645-1	N	SVOC	11/13/2006	Cholesterol,	202	µg/kg
9645-1	N	SVOC	11/13/2006	Hexadecanoic acid,	328	µg/kg
9645-1	N	SVOC	11/13/2006	Octadecane,	251	µg/kg
9645-1	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	432	µg/kg
9645-1	N	SVOC	11/13/2006	Unknown, RRT 7.314	150	µg/kg
9645-1	N	SVOC	11/13/2006	Unknown, RRT 7.886	274	µg/kg
9645-1-C	N	SVOC	11/13/2006	.gamma.-Sitosterol,	861	µg/kg
9645-1-C	N	SVOC	11/13/2006	Heneicosane, 11-(1-ethylpropyl)-,	174	µg/kg
9645-1-C	N	SVOC	11/13/2006	Hexadecanoic acid,	163	µg/kg
9645-1-C	N	SVOC	11/13/2006	Octadecanoic acid, butyl ester,	172	µg/kg
9645-1-C	N	SVOC	11/13/2006	Stigmast-4-en-3-one,	418	µg/kg
9645-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.212	169	µg/kg
9645-1-C	N	SVOC	11/13/2006	Unknown, RRT 7.886	194	µg/kg
9645-2	N	SVOC	11/13/2006	1-Dotriacontanol,	141	µg/kg
9645-2	N	SVOC	11/13/2006	Unknown, RRT 7.201	136	µg/kg
9645-2	N	SVOC	11/13/2006	Unknown, RRT 7.667	752	µg/kg
9645-2	N	SVOC	11/13/2006	Unknown, RRT 7.881	226	µg/kg
9645-2	N	SVOC	11/13/2006	Unknown, RRT 7.966	184	µg/kg
9672-1	N	SVOC	10/30/2006	Benzene, 1,2,3-trimethyl-,	177	µg/kg
9672-1	N	SVOC	10/30/2006	Hexadecanoic acid,	390	µg/kg
9672-1	N	SVOC	10/30/2006	Naphthalene, 1,4,5-trimethyl-,	153	µg/kg
9672-1	N	SVOC	10/30/2006	Naphthalene, 2,3-dimethyl-,	245	µg/kg
9672-1	N	SVOC	10/30/2006	Taraxerol,	168	µg/kg
9672-1	N	SVOC	10/30/2006	Unknown, RRT 4.935	141	µg/kg
9672-1	N	SVOC	10/30/2006	Unknown, RRT 5.175	187	µg/kg

TABLE E-1
Tentatively Identified Compounds (TICs) Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

Sample ID	Sample Type	Chemical Group[a]	SampleDate	Analyte	Result[b]	Units
9672-2	N	SVOC	10/30/2006	Hexadecanoic acid,	193	µg/kg
9672-2	N	SVOC	10/30/2006	Unknown, RRT 2.694	187	µg/kg
9712-1	N	SVOC	11/13/2006	Heneicosane,	227	µg/kg
9712-1	N	SVOC	11/13/2006	Unknown, RRT 3.179	134	µg/kg
9712-1	N	SVOC	11/13/2006	Unknown, RRT 7.191	133	µg/kg
9712-1	N	SVOC	11/13/2006	Unknown, RRT 7.651	360	µg/kg
9712-1	N	SVOC	11/13/2006	Unknown, RRT 7.87	161	µg/kg
9712-1	N	SVOC	11/13/2006	Unknown, RRT 7.955	166	µg/kg
9712-2	N	SVOC	11/13/2006	.gamma.-Sitosterol,	460	µg/kg
9712-2	N	SVOC	11/13/2006	Cyclopentadecanone, 2-hydroxy-,	183	µg/kg
9712-2	N	SVOC	11/13/2006	Cyclotetracosane,	133	µg/kg
9712-2	N	SVOC	11/13/2006	Dotriacontane,	164	µg/kg
9712-2	N	SVOC	11/13/2006	Testosterone,	292	µg/kg
9712-2	N	SVOC	11/13/2006	Unknown, RRT 0.606	147	µg/kg
9712-2	N	SVOC	11/13/2006	Unknown, RRT 7.18	158	µg/kg
EB-10-30-06-1	EB	SVOC	10/30/2006	1-Hexanol, 2-ethyl-,	4.76	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Ethanol, 2-phenoxy-,	3.53	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Hexanoic acid,	6.51	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Octadecanoic acid,	7.19	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 3.019	2.22	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 3.077	2.27	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 4.142	2.37	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 4.923	3.01	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 5.019	3.12	µg/L
EB-10-30-06-1	EB	SVOC	10/30/2006	Unknown, RRT 5.495	6.17	µg/L
EB-10-30-06-2	EB	SVOC	10/30/2006	Octadecanoic acid,	3.35	µg/L
EB-10-30-06-2	EB	SVOC	10/30/2006	Unknown, RRT 4.94	3.7	µg/L
EB-10-30-06-2	EB	SVOC	10/30/2006	Unknown, RRT 5.555	10.1	µg/L
EB-10-30-06-2	EB	SVOC	10/30/2006	Unknown, RRT 6.186	6.78	µg/L
EB-10-30-06-3	EB	SVOC	10/30/2006	Octadecanoic acid,	2.24	µg/L
EB-10-30-06-3	EB	SVOC	10/30/2006	Unknown, RRT 4.946	4.82	µg/L
EB-10-30-06-3	EB	SVOC	10/30/2006	Unknown, RRT 5.555	12.3	µg/L
EB-10-30-06-3	EB	SVOC	10/30/2006	Unknown, RRT 6.186	7.06	µg/L
EB-10-30-06-3	EB	SVOC	10/30/2006	Unknown, RRT 7.989	4.89	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Octadecanoic acid,	2.62	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 4.945	4.11	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 5.56	9.18	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 6.09	6.59	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 6.186	5.92	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 6.748	5.36	µg/L
EB-10-30-06-4	EB	SVOC	10/30/2006	Unknown, RRT 7.989	2.13	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 4.837	2.94	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 5.345	4.02	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 5.426	4.27	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 5.955	3.24	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 6.046	2.12	µg/L
EB-11-13-06-1	EB	SVOC	11/13/2006	Unknown, RRT 6.602	3.22	µg/L
EB-11-13-06-2	EB	SVOC	11/13/2006	Unknown, RRT 4.837	2.89	µg/L
EB-11-13-06-2	EB	SVOC	11/13/2006	Unknown, RRT 5.345	5.54	µg/L
EB-11-13-06-2	EB	SVOC	11/13/2006	Unknown, RRT 6.046	3.71	µg/L
EB-11-13-06-2	EB	SVOC	11/13/2006	Unknown, RRT 6.597	5.55	µg/L
EB-11-13-06-2	EB	SVOC	11/13/2006	Unknown, RRT 7.832	3.67	µg/L
EB-11-13-06-3	EB	SVOC	11/13/2006	Unknown, RRT 5.351	3.17	µg/L
EB-11-13-06-3	EB	SVOC	11/13/2006	Unknown, RRT 5.955	2.55	µg/L
EB-11-13-06-3	EB	SVOC	11/13/2006	Unknown, RRT 6.046	2.09	µg/L

[a] No VOC TICs were reported.
[b] Estimated value.
EB = Equipment blank sample
FD = Field duplicate
N = Primary Sample

Appendix F
Soil Parameter Summary Statistics and Analytical Results

Appendix F: Contents

Tables

Figures

Multivariate Analysis

The spatial distributions of the individual soil parameters measured in this study indicate that there are no broad areas of soil with similar physical characteristics. Although localized areas of similar grain size, total organic carbon (TOC), black carbon, or soil particle surface area observed, local variability is evident throughout the Study Area. Therefore, multivariate analysis of the soil parameter data was performed to evaluate whether spatially distinct areas could be identified based on relationships between parameters.

Statistical clusters were defined for observations in the four-dimensional variable space of black carbon, TOC, sand, and clay or silt. Variable selection was based on the primary factors that influence bioavailability (black carbon and TOC) and two of the physical measures of grain size (either sand and clay or sand and silt). In most of the evaluations, the physical measures were limited to two variables (sand and clay) given that the sum of the percentages for the three grain size values is equal to one; therefore, no meaning is lost if two are evaluated because the third is included by extension. Surface area was excluded due to the positive correlation between surface area and silt.

A statistical "cluster" distinguishes subsets of observations that lie closest to each other within the Study Area (the measurement space); the cluster, therefore, depends upon the distance between observations within that space. For these evaluations, distances were calculated as simple Euclidean distance (that is, the "ordinary" distance between points as measured by a ruler). The number of clusters is predefined and the method aggregates most similar observations into the number of clusters defined. The objective of cluster analysis is to test for the presence of localized areas that exhibit distinctive relationships among the physical and bioavailability soil characteristics.

The tabulated results of the multivariate evaluation (Table 3-6) show the average of each variable in each of the clusters classes: two *versus* four *versus* six and eight. The color-coded clusters identified from this analysis were mapped spatially through the Study Area. The results for the two, four, six, and eight cluster results are shown in Figures F-1A through F-1E. Results from the multivariate cluster analysis are summarized as follows:

- Average concentrations of TOC and black carbon exhibit comparatively tight distributions regardless of number of clusters and analytes included.
- Grain sizes exhibit slightly greater differences in the average value across different clusters, but because of the consistent levels throughout the 337 locations sampled, are comparatively narrow. For example, in the set of four clusters using clay and sand, the average sand level in the clusters ranges from 48.2 percent (17 locations) to 87.2 percent (123 locations) while average clay ranges from 2.4 to 17.2 percent.
- Spatial distribution of the multivariate clusters exhibit similarly small-scale variability, which is consistent throughout the Study Area for the distributions of the individual measures.
- No clusters are localized in exclusively one portion of the Study Area, regardless of number of clusters specified or analytes included in the clustering algorithm.

A sensitivity analysis was performed by varying two factors. First, results from a variable number of clusters were examined by looking at the spatial distribution of two, four, six,

and eight individual clusters of observations defined by a single set of variables (black carbon, TOC, sand, and clay). Second, potential differences between two clusters defined by silt rather than clay (in addition to the fixed black carbon, TOC, and sand) were mapped to see if differences were substantive. The sensitivity analysis showed a 91 percent correspondence of cluster assignment for the 337 samples. These results indicate that silt and clay are more or less interchangeable within the algorithm, resulting in minor deviations in cluster assignment and no overall change in the distribution of clusters within the Study Area.

The cluster data groups were further evaluated to determine if the soil parameter classes (TOC, grain size, surface area) had distributions that vary significantly across the data set. Overall, data within the soil parameter classes are consistent as follows:

- Regardless of the number of multivariate clusters specified, black carbon and TOC levels do not differ significantly across clusters. For example, the samples which aggregate into two unique clusters are not significantly different with respect to black carbon or TOC levels.
- In contrast, the three grain size classes (silt, clay, and sand) and surface area do differ significantly across clusters, regardless of the number of clusters defined.
- The spatial distribution of these clusters indicate that samples from the same cluster do not necessarily lie near one another, and are not limited to localized areas within the Study Area boundaries.

Direct application of these results, in conjunction with the maps of clusters, indicates the following:

- Different soil types within the Study Area are not strongly localized in discrete areas. Therefore, the Study Area cannot readily be stratified into subsections where different levels of bioavailability would be expected.
- There are, however, groups of soil samples which exhibit unique statistical distributions. These "groups" are not necessarily geographically contiguous. The basis for the grouping is dominated by the relative abundance of grain size classes, and is less influenced by either black carbon or total organic carbon.

Application of the multivariate cluster results could be used to identify different ranges of soil characteristics, assuming that the ranges observed in the clusters correspond to ranges over which meaningful differences in the potential for bioavailability of soils are expected.

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	A-02-1-1		A-02-2-1		A-03-2-1		A-03-6-1		A-03-8-1		A-04-2-1		A-04-6-1		A-04-7-1		A-04-9-1		A-05-1-1		A-05-5-1	
		Location ID	A-02-14-21-20-186-1		A-02-14-21-20-305-2		A-03-14-21-10-350-2		A-03-14-21-10-404-6		A-03-14-21-10-408-8		A-04-14-16-40-506-2		A-04-14-16-40-604-6		A-04-14-16-40-606-7		A-04-14-16-40-610-9		A-05-14-16-30-148-1		A-05-14-16-30-156-5	
		Sample Date	10/31/2006		10/31/2006		11/7/2006		11/7/2006		11/7/2006		11/3/2006		11/3/2006		11/3/2006		11/3/2006		11/1/2006		11/1/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.85		3.96		3.63		4.17		2.29		3.26		4.82		3.05		4.8		2.41		5.53	
TOC	Total Organic Carbon %H	%	0.28		0.28		0.34		0.34		0.19		0.36		0.42		0.4		0.39		0.24		0.48	
TOC	Total Organic Carbon %N	%	0.21		0.21		0.26		0.26		0.15		0.25		0.31		0.18		0.29		0.14		0.32	
BC	Black Carbon %C	%	1.18		1.23		0.92		1.22		0.3		0.27		0.93		0.64		1.58		0.64		1.18	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.67		2.73		2.71		2.95		1.99		2.99		3.89		2.41		3.22		1.77		4.35	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.8		0.62		1.51		2.96		0.64		0.71		0.54		1.52		1.21		0.8		0.74	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	18		20		23		17		12		21		20		21		23		12		24	
PS	PERCENT SAND [b]	%	90		88		76		74		88		90		88		84		86		90		84	
PS	PERCENT SILT	%	8		8		18		14		8		8		12		12		14		8		16	
PS	PERCENT CLAY	%	2		4		6		12		4		2		0		4		0		2		0	
PS	Retained on 250 [c]	%	34.5		39		15.8		18.2		26		25.3		40.5		25.1		28.8		40.2		30.9	
PS	Soil Classification [d]	--	Sand		Sand		Loamy Sand		Sandy Loam		Sand		Sand		Sand		Loamy Sand		Sand		Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sieve

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	A-05-6-1		A-05-7-1		A-06-1-1		A-06-5-1		A-06-7-1		A-07-2-1		A-07-5-1		A-07-6-1		A-07-10-1		A-07-11-1		A-08-1-1	
		Location ID	A-05-14-16-30-158-6		A-05-14-16-30-160-7		A-06-14-16-30-022-1		A-06-14-16-30-030-5		A-06-14-16-30-034-7		A-07-14-16-70-126-2		A-07-14-16-70-134-5		A-07-14-16-70-136-6		A-07-14-16-70-144-10		A-07-14-16-70-146-11		A-08-14-16-80-152-1	
		Sample Date	11/1/2006		11/1/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.14		2.92		6.6		2.67		1.23		2.88		5.06		3.31		1.52		1.95		4.36	
TOC	Total Organic Carbon %H	%	0.52		0.33		0.74		0.4		0.27		0.74		0.64		0.61		0.37		0.61		0.57	
TOC	Total Organic Carbon %N	%	0.29		0.21		0.41		0.22		0.1	U	0.28		0.35		0.27		0.12		0.14		0.42	
BC	Black Carbon %C	%	1.07		0.4		0.26		0.12		0.1	U	0.87		0.42		0.42		0.24		0.34		0.76	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.24		0.1	U	0.1		0.1	U	0.1	U	0.12	
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.07		2.52		6.34		2.55		1.13		2.01		4.64		2.89		1.28		1.61		3.6	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.45		0.78		1		0.95		2.7		1.73		1.25		3.1		2.35		4.81		4.06	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	19		21		27		30		25		78		66		32		28		30		44	
PS	PERCENT SAND [b]	%	86		88		88		84		78		72		80		64		68		72		54	
PS	PERCENT SILT	%	12		8		10		14		14		18		16		26		24		12		32	
PS	PERCENT CLAY	%	2		4		2		2		8		10		4		10		8		16		14	
PS	Retained on 250 [c]	%	40.2		38.3		39.5		35.7		42.3		24.8		18.8		12.1		34.7		11		6	
PS	Soil Classification [d]	--	Sand		Sand		Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	A-08-2-1		A-08-4-1		A-08-8-1		A-08-11-1		A-08-11-1-D		A-09-2-1		A-09-4-1		A-09-5-1		A-09-6-1		A-10-7-1		A-10-1-1	
		Location ID	A-08-14-16-80-154-2		A-08-14-16-80-158-4		A-08-14-16-80-174-8		A-08-14-16-80-180-11		A-08-14-16-80-180-11		A-09-14-16-80-380-2		A-09-14-16-80-386-4		A-09-14-16-80-426-5		A-09-14-16-80-430-6		A-10-14-09-50-098-7		A-10-14-09-50-102-1	
		Sample Date	10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/24/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		11/8/2006		11/8/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.67		2.26		3.09		3.74		3.86		4.23		4.08		2.23		3.81		5.68		2.78	
TOC	Total Organic Carbon %H	%	0.84		0.33		0.47		0.94		0.79		1		0.48		0.32		0.6		0.6		0.37	
TOC	Total Organic Carbon %N	%	0.24		0.2		0.27		0.32		0.33		0.35		0.35		0.24		0.33		0.49		0.22	
BC	Black Carbon %C	%	0.41		0.12		0.39		0.39		0.65		0.23		0.42		0.18		0.35		0.59		0.29	
BC	Black Carbon %H	%	0.22		0.1	U	0.1	U	0.1		0.14		0.22		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.14		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.26		2.14		2.7		3.35		3.21		4		3.66		2.05		3.46		5.09		2.49	
SSA	SPECIFIC SURFACE AREA	m^2/g	4.85		3.22		3.39		3.04		3.09		3.63		1.13		1.79		1.64		1.48		1.71	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	35		43		49		47		33		27		25		32		31		27		17	
PS	PERCENT SAND [b]	%	46		48		60		62		62		60		50		78		72		80		70	
PS	PERCENT SILT	%	38		44		34		28		26		24		32		14		22		14		20	
PS	PERCENT CLAY	%	16		8		6		10		12		16		18		8		6		6		10	
PS	Retained on 250 [c]	%	8.7		3		5.2		8.3		12		18.2		6.3		17.8		9.1		5.4		6.4	
PS	Soil Classification [d]	--	Loam		Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Loam		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	A-10-2-1		A-11-1-1		A-12-1-1		A-13-2-1		A-13-4-1		A-13-8-1		A-13-9-1		A-13-11-1		B-01-1-1		B-01-1-1-D		B-03-1-1	
		Location ID	A-10-14-09-50-104-2		A-11-14-09-50-300-1		A-12-14-09-50-300-1		A-13-14-09-70-072-2		A-13-14-09-70-076-4		A-13-14-09-70-084-8		A-13-14-09-70-086-9		A-13-14-09-70-090-11		B-01-14-21-20-004-1		B-01-14-21-20-004-1		B-03-14-21-10-040-1	
		Sample Date	11/8/2006		11/3/2006		11/3/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/14/2006		11/14/2006		11/10/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.79		5.2		4.48		3.65		2.94		2.57		3.28		3.89		2.63		2.14		3.24	
TOC	Total Organic Carbon %H	%	0.67		0.56		0.58		0.67		0.74		0.42		0.53		0.53		0.48		0.33		0.36	
TOC	Total Organic Carbon %N	%	0.34		0.27		0.38		0.34		0.26		0.22		0.31		0.36		0.17		0.14		0.2	
BC	Black Carbon %C	%	0.34		0.1	U	0.26		0.53		0.2		0.2		0.47		0.24		0.48		0.44		1.14	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.45		5.1		4.22		3.12		2.74		2.37		2.81		3.65		2.15		1.7		2.1	
SSA	SPECIFIC SURFACE AREA	m^2/g	4.8		0.88		2.2		2.26		2.58		2.32		3.36		2.4		0.73		0.72		1.11	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	19		29		69		28		18		26		33		28		17		18		16	
PS	PERCENT SAND [b]	%	64		88		76		64		66		66		54		62		84		80		84	
PS	PERCENT SILT	%	18		10		16		26		22		24		32		28		14		14		12	
PS	PERCENT CLAY	%	18		2		8		10		12		10		14		10		2		6		4	
PS	Retained on 250 [c]	%	4.6		7.5		15.7		5		18.1		21.6		5.2		2.7		41.2		45.9		35.3	
PS	Soil Classification [d]	--	Sandy Loam		Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	B-03-4-1		B-03-6-1		B-03-8-1		B-03-8-1-D		B-03-10-1		B-04-1-1		B-04-3-1		B-04-5-1		B-04-6-1		B-04-10-1		B-04-10-1-D	
		Location ID	B-03-14-21-10-046-4		B-03-14-21-10-050-6		B-03-14-21-10-054-8		B-03-14-21-10-054-8		B-03-14-21-10-278-10		B-04-14-16-40-126-1		B-04-14-16-40-130-3		B-04-14-16-40-134-5		B-04-14-16-40-144-6		B-04-14-16-40-152-10		B-04-14-16-40-152-10	
		Sample Date	11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006		11/10/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.17		2.71		1.89		1.84		4.25		0.79		4.76		3.53		3.48		4.33		4.18	
TOC	Total Organic Carbon %H	%	0.3		0.29		0.22		0.21		0.23		0.1	U	0.39		0.4		0.18		0.49		0.46	
TOC	Total Organic Carbon %N	%	0.24		0.15		0.13		0.13		0.18		0.1	U	0.26		0.25		0.19		0.32		0.31	
BC	Black Carbon %C	%	0.56		0.3		0.16		0.43		1.61		0.81		1.35		1.04		1.1		0.98		1.01	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.14		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.61		2.41		1.73		1.41		2.64		-0.02		3.41		2.49		2.38		3.35		3.17	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.93		2.16		0.7		0.65		0.85		0.6		0.8		1.47		0.82		1.93		1.96	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	15		17		15		13		18		8		22		21		20		24		25	
PS	PERCENT SAND [b]	%	86		78		88		88		84		90		80		70		84		74		66	
PS	PERCENT SILT	%	10		12		10		10		14		6		16		22		12		18		26	
PS	PERCENT CLAY	%	4		10		2		2		2		4		4		8		4		8		8	
PS	Retained on 250 [c]	%	32.1		27.4		19.6		18.5		22.2		48		24.1		22.6		36.4		21.3		23.8	
PS	Soil Classification [d]	--	Loamy Sand		Sandy Loam		Sand		Sand		Loamy Sand		Sand		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	B-05-2-1		B-05-3-1		B-05-3-1-D		B-05-5-1		B-05-7-1		B-05-8-1		B-06-1-1		B-06-2-1		B-07-1-1		B-07-5-1		B-07-5-1-D	
		Location ID	B-05-14-16-30-512-2		B-05-14-16-40-238-3		B-05-14-16-40-238-3		B-05-14-16-40-248-5		B-05-14-16-40-284-7		B-05-14-16-40-328-8		B-06-14-16-20-584-1		B-06-14-16-30-200-2		B-07-14-16-20-400-1		B-07-14-16-20-410-5		B-07-14-16-20-410-5	
		Sample Date	11/3/2006		11/3/2006		11/3/2006		11/3/2006		11/3/2006		11/3/2006		11/10/2006		11/10/2006		11/3/2006		11/3/2006		11/3/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.47		3.27		3.29		4.23		8.69		4.55		3.25		3.96		3.1		3.69		3.22	
TOC	Total Organic Carbon %H	%	0.35		0.45		0.47		0.62		0.78		0.55		0.37		0.44		0.55		0.53		0.45	
TOC	Total Organic Carbon %N	%	0.24		0.21		0.2		0.33		0.52		0.34		0.25		0.27		0.26		0.28		0.26	
BC	Black Carbon %C	%	0.54		1.04		1.2		1.07		1.11		0.78		0.4		0.59		0.57		0.49		0.64	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.93		2.23		2.09		3.16		7.58		3.77		2.85		3.37		2.53		3.2		2.58	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.82		0.84		0.79		2.98		1.22		0.96		0.78		0.8		1.6		1.29		1.42	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	25		22		7		29		32		20		20		13		28		23		23	
PS	PERCENT SAND [b]	%	78		80		82		70		80		78		78		80		74		84		80	
PS	PERCENT SILT	%	18		16		16		24		16		20		18		14		20		16		16	
PS	PERCENT CLAY	%	4		4		2		6		4		2		4		6		6		0		4	
PS	Retained on 250 [c]	%	22		27		27.5		10.6		27.2		31.5		29.5		27.8		13.5		7.9		6.1	
PS	Soil Classification [d]	--	Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	B-07-6-1		B-08-2-1		B-08-5-1		B-08-7-1		B-09-1-1		B-09-2-1		B-09-6-1		B-09-7-1		B-09-8-1		B-09-8-1-D		B-10-1-1	
		Location ID	B-07-14-16-20-412-6		B-08-14-16-10-176-2		B-08-14-16-10-182-5		B-08-14-16-10-194-7		B-09-14-16-10-118-1		B-09-14-16-10-126-2		B-09-14-16-10-378-6		B-09-14-16-10-380-7		B-09-14-16-10-382-8		B-09-14-16-10-382-8		B-10-14-09-40-002-1	
		Sample Date	11/3/2006		11/10/2006		11/10/2006		11/10/2006		11/2/2006		11/2/2006		11/2/2006		11/2/2006		11/2/2006		11/2/2006		11/17/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.08		3.56		4.94		2.51		10.04		2.33		4.58		4.13		2.69		2.95		6.35	
TOC	Total Organic Carbon %H	%	0.49		0.65		0.92		0.3		1.21		0.42		0.66		0.59		0.47		0.47		0.71	
TOC	Total Organic Carbon %N	%	0.25		0.33		0.48		0.2		0.88		0.2		0.42		0.36		0.23		0.25		0.47	
BC	Black Carbon %C	%	0.39		0.55		0.65		0.52		1.24		0.41		0.46		0.42		0.38		0.33		0.82	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.69		3.01		4.29		1.99		8.8		1.92		4.12		3.71		2.31		2.62		5.53	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.27		2.46		5.07		2.08		1.92		1.89		2.85		2.38		1.42		1.62		1.89	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	26		20		28		16		90		22		37		35		24		24		21	
PS	PERCENT SAND [b]	%	76		66		40		70		70		74		58		66		62		66		74	
PS	PERCENT SILT	%	22		24		46		24		24		20		32		30		32		30		20	
PS	PERCENT CLAY	%	2		10		14		6		6		6		10		4		6		4		6	
PS	Retained on 250 [c]	%	3.4		15.9		3.2		2.2		24.4		17.6		7.6		3.4		3.3		2.8		2.4	
PS	Soil Classification [d]	--	Loamy Sand		Sandy Loam		Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	B-11-1-1		C-01-1-1		C-01-2-1		C-01-3-1		C-03-1-1		C-03-2-1		C-03-9-1		C-03-11-1		C-03-12-1		C-03-12-1-D		C-04-1-1	
		Location ID	B-11-14-09-50-300-1		C-01-14-22-70-102-1		C-01-14-22-70-104-2		C-01-14-22-70-106-3		C-03-14-22-80-240-1		C-03-14-22-80-246-2		C-03-14-22-80-262-9		C-03-14-22-80-276-11		C-03-14-22-80-278-12		C-03-14-22-80-278-12		C-04-14-15-50-730-1	
		Sample Date	11/3/2006		10/31/2006		10/31/2006		10/31/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/7/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.3		2.85		2.38		2.01		4.85		3.44		3.77		2.21		1.98		1.98		3.61	
TOC	Total Organic Carbon %H	%	0.5		0.48		0.36		0.48		0.32		0.24		0.39		0.35		0.24		0.17		0.26	
TOC	Total Organic Carbon %N	%	0.29		0.18		0.15		0.16		0.29		0.21		0.25		0.14		0.13		0.12		0.22	
BC	Black Carbon %C	%	0.32		0.89		1.19		0.33		1.65		0.92		1.13		0.63		0.15		0.16		0.89	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.98		1.96		1.19		1.68		3.2		2.52		2.64		1.58		1.83		1.82		2.72	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.29		2.93		0.94		1.74		0.76		0.81		0.98		1.07		0.92		0.86		0.86	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	40		19		14		6		19		17		23		14		11		11		20	
PS	PERCENT SAND [b]	%	64		72		88		78		88		90		80		88		90		92		84	
PS	PERCENT SILT	%	28		18		8		12		10		8		16		8		4		4		14	
PS	PERCENT CLAY	%	8		10		4		10		2		2		4		4		6		4		2	
PS	Retained on 250 [c]	%	4.1		34.4		49.1		32.9		28.6		40		21.5		40.4		47.1		43.5		31.2	
PS	Soil Classification [d]	--	Sandy Loam		Sandy Loam		Sand		Sandy Loam		Sand		Sand		Loamy Sand		Sand		Sand		Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	C-04-3-1		C-04-5-1		C-04-6-1		C-04-6-1-D		C-04-10-1		C-05-2-1		C-05-3-1		C-05-5-1		C-05-6-1		C-05-8-1		C-06-2-1	
		Location ID	C-04-14-15-50-734-3		C-04-14-15-50-738-5		C-04-14-15-50-754-6		C-04-14-15-50-754-6		C-04-14-15-50-762-10		C-05-14-15-50-404-2		C-05-14-15-50-406-3		C-05-14-15-50-410-5		C-05-14-15-50-412-6		C-05-14-15-60-484-8		C-06-14-15-60-442-2	
		Sample Date	11/7/2006		11/7/2006		11/7/2006		11/7/2006		11/7/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.48		3.98		4.05		3.87		3.16		4.06		4.19		2.94		3.55		2.95		3.67	
TOC	Total Organic Carbon %H	%	0.39		0.38		0.36		0.44		0.55		0.42		0.58		0.59		0.42		0.21		0.58	
TOC	Total Organic Carbon %N	%	0.3		0.24		0.27		0.27		0.27		0.23		0.29		0.23		0.25		0.2		0.28	
BC	Black Carbon %C	%	1.23		1.19		0.91		0.72		0.96		1.93		0.86		0.81		0.56		0.1	U	0.93	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.13		0.1	U	0.1		0.32		0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.25		2.79		3.14		3.15		2.2		2.13		3.33		2.13		2.99		2.85		2.74	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.87		0.66		1.17		1.18		2.27		1.28		2.65		3.37		0.55		1.26		1.38	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	19		20		23		17		32		23		22		24		18		20		20	
PS	PERCENT SAND [b]	%	86		84		80		78		70		86		74		48		90		74		76	
PS	PERCENT SILT	%	14		14		16		18		22		10		14		36		8		22		16	
PS	PERCENT CLAY	%	0		2		4		4		8		4		12		16		2		4		8	
PS	Retained on 250 [c]	%	23.3		28.2		23		20.5		19.1		22.1		20.3		13.6		21.3		35.4		20.3	
PS	Soil Classification [d]	--	Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam		Loam		Sand		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	C-06-5-1		C-06-8-1		C-06-9-1		C-07-1-1		C-07-4-1		C-07-9-1		C-07-9-1-D		C-07-10-1		C-08-1-1		C-10-3-1		C-10-9-1	
		Location ID	C-06-14-15-60-448-5		C-06-14-15-60-454-8		C-06-14-15-60-456-9		C-07-14-15-70-314-1		C-07-14-15-70-320-4		C-07-14-15-70-332-9		C-07-14-15-70-332-9		C-07-14-15-70-334-10		C-08-14-15-70-440-1		C-10-14-10-50-518-3		C-10-14-10-50-538-9	
		Sample Date	11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/3/2006		11/6/2006		11/6/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.64		3.53		3.67		2.32		2.81		7.83		8.14		3.28		3.57		3.86		2.08	
TOC	Total Organic Carbon %H	%	0.62		0.37		0.42		0.38		0.66		0.89		0.99		0.69		0.63		0.7		0.3	
TOC	Total Organic Carbon %N	%	0.22		0.26		0.25		0.19		0.25		0.64		0.65		0.31		0.29		0.31		0.17	
BC	Black Carbon %C	%	0.49		0.6		0.88		0.29		0.89		1.27		1.66		0.34		0.46		0.76		0.23	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.13		0.13		0.1	U	0.11		0.1	U	0.1	U	0.12		0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.16		0.1	U	0.16		0.1	U	0.1	U	0.1		0.1	U
--	Organic Carbon [a]	%	2.15		2.93		2.79		2.03		1.92		6.56		6.48		2.94		3.11		3.1		1.85	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.86		0.92		1.45		2.83		1.8		2.31		2.38		4.28		4.95		3.34		1.71	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	20		20		45		25		23		28		30		23		29		20		23	
PS	PERCENT SAND [b]	%	64		78		68		66		72		70		74		52		60		76		74	
PS	PERCENT SILT	%	22		18		26		24		22		22		20		32		28		12		16	
PS	PERCENT CLAY	%	14		4		6		10		6		8		6		16		12		12		10	
PS	Retained on 250 [c]	%	23.1		8.7		8.4		7.9		11.8		15.1		14.8		4.1		11.7		6.2		21.9	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Loam		Sandy Loam		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 1 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	C-10-10-1		C-10-12-1		C-10-13-1		C-10-13-1-D		C-11-1-1		C-11-7-1	C-11-7-1-D		C-11-8-1	C-13-1-1	
		Location ID	C-10-14-10-50-540-10		C-10-14-10-50-546-12		C-10-14-10-50-550-13		C-10-14-10-50-550-13		C-11-14-10-60-008-1		C-11-14-10-60-088-7	C-11-14-10-60-088-7		C-11-14-10-60-092-8	C-13-14-10-70-014-1	
		Sample Date	11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/7/2006		11/7/2006	11/7/2006		11/7/2006	11/17/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1	0-1		0-1	0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil	Soil		Soil	Soil	
Group	**Analyte**	**Units**																
TOC	Total Organic Carbon %C	%	2.71		3.07		3.03		2.8		2.99		2.43	2.48		3.75	2.88	
TOC	Total Organic Carbon %H	%	0.79		0.39		0.39		0.42		0.36		0.43	0.47		0.89	0.47	
TOC	Total Organic Carbon %N	%	0.24		0.22		0.2		0.18		0.24		0.21	0.2		0.33	0.25	
BC	Black Carbon %C	%	0.42		0.22		0.32		0.22		0.32		1.05	0.26		0.95	0.44	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	0.1	U	0.52	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.11	0.1	U	0.13	0.1	U
--	Organic Carbon [a]	%	2.29		2.85		2.71		2.58		2.67		1.38	2.22		2.8	2.44	
SSA	SPECIFIC SURFACE AREA	m^2/g	3.45		1.6		1.78		1.48		0.93		2.58	3.47		3.36	3.12	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	24		20		22		24		24		20	20		26	22	
PS	PERCENT SAND [b]	%	74		80		82		84		76		78	72		60	72	
PS	PERCENT SILT	%	10		12		12		12		22		16	12		26	16	
PS	PERCENT CLAY	%	16		8		6		4		2		6	16		14	12	
PS	Retained on 250 [c]	%	6.8		8.7		8.2		7.9		5.7		3.6	7.9		3.9	7.4	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand	Sandy Loam		Sandy Loam	Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) si

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	C-13-3-1		D-02-1-1		D-02-2-1		D-02-3-1		D-02-4-1		D-02-9-1		D-03-2-1		D-03-5-1		D-03-6-1		D-03-11-1		D-04-1-1	
		Location ID	C-13-14-10-70-020-3		D-02-14-15-50-626-1		D-02-14-15-50-628-2		D-02-14-15-50-630-3		D-02-14-15-50-636-4		D-02-14-15-50-674-9		D-03-14-15-50-530-2		D-03-14-15-50-536-5		D-03-14-15-50-538-6		D-03-14-15-50-590-11		D-04-14-15-60-142-1	
		Sample Date	11/17/2006		10/31/2006		10/31/2006		10/31/2006		10/31/2006		10/31/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/11/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.39		2.89		3.15		3.16		4.28		2.77		2.85		4.16		3.54		4.14		3.26	
TOC	Total Organic Carbon %H	%	0.65		0.41		0.35		0.42		0.9		0.42		0.38		0.55		0.73		0.66		0.41	
TOC	Total Organic Carbon %N	%	0.29		0.27		0.18		0.25		0.29		0.21		0.23		0.3		0.3		0.29		0.26	
BC	Black Carbon %C	%	0.51		0.26		1.33		0.46		0.56		0.26		0.95		0.86		0.27		0.98		0.41	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.41		0.1	U	0.1	U	0.1	U	0.22		0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.11		0.1	U
--	Organic Carbon [a]	%	2.88		2.63		1.82		2.7		3.72		2.51		1.9		3.3		3.27		3.16		2.85	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.36		2.04		1.15		1.12		2.5		0.91		1.83		0.92		2.44		0.53		2.04	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	24		28		15		23		23		23		21		25		27		24		29	
PS	PERCENT SAND [b]	%	64		70		86		76		72		86		76		84		72		88		68	
PS	PERCENT SILT	%	26		22		12		18		18		12		20		14		20		10		24	
PS	PERCENT CLAY	%	10		8		2		6		10		2		4		2		8		2		8	
PS	Retained on 250 [c]	%	4.8		19.5		42.5		29		26.8		6.7		16.8		22.6		15.4		13.3		7.3	
PS	Soil Classification [d]	--	Sandy Loam		Sandy Loam		Sand		Loamy Sand		Sandy Loam		Sand		Loamy Sand		Loamy Sand		Sandy Loam		Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sieve

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	D-04-2-1		D-04-8-1		D-04-9-1		D-04-10-1		D-05-4-1		D-05-5-1		D-05-6-1		D-05-7-1		D-05-8-1		E-01-2-1	E-02-1-1	
		Location ID	D-04-14-15-60-144-2		D-04-14-15-60-156-8		D-04-14-15-60-158-9		D-04-14-15-60-162-10		D-05-14-15-60-296-4		D-05-14-15-60-298-5		D-05-14-15-60-300-6		D-05-14-15-60-304-7		D-05-14-15-60-306-8		E-01-14-22-80-420-2	E-02-14-22-80-012-1	
		Sample Date	11/11/2006		11/11/2006		11/11/2006		11/11/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006		11/14/2006	11/14/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	Soil	
Group	**Analyte**	**Units**																					
TOC	Total Organic Carbon %C	%	1.99		3.31		3.22		2.38		2.49		3.12		2.28		4.49		3.9		3.86	6.67	
TOC	Total Organic Carbon %H	%	0.12		0.42		0.52		0.5		0.25		0.44		0.46		0.95		0.49		0.96	0.64	
TOC	Total Organic Carbon %N	%	0.12		0.28		0.28		0.19		0.19		0.24		0.19		0.39		0.3		0.33	0.44	
BC	Black Carbon %C	%	0.37		0.91		0.57		0.59		0.41		0.51		0.36		0.48		0.46		0.86	0.85	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.37	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.16	0.1	U
--	Organic Carbon [a]	%	1.62		2.4		2.65		1.79		2.08		2.61		1.92		4.01		3.44		3	5.82	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.7		1.83		2.13		2.49		1.63		2.3		2.23		2.67		2.14		3.36	0.39	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	19		21		25		24		20		18		18		16		22		22	26	
PS	PERCENT SAND [b]	%	88		78		70		72		78		76		80		72		76		72	88	
PS	PERCENT SILT	%	10		16		20		16		16		18		12		20		16		16	12	
PS	PERCENT CLAY	%	2		6		10		12		6		6		8		8		8		12	0	
PS	Retained on 250 [c]	%	39.1		23.7		13		12.1		11.8		4.4		3.8		5.6		4.2		18.1	25.2	
PS	Soil Classification [d]	--	Sand		Loamy Sand		Sandy Loam		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Sandy Loam		Sandy Loam	Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	E-02-1-1-D		E-03-1-1		E-03-2-1		E-03-3-1		E-03-4-1		E-04-1-1		E-04-2-1		E-04-4-1		E-04-5-1		E-04-7-1		E-05-1-1	
		Location ID	E-02-14-22-80-012-1		E-03-14-15-50-010-1		E-03-14-15-50-012-2		E-03-14-15-50-014-3		E-03-14-15-50-016-4		E-04-14-15-60-096-1		E-04-14-15-60-098-2		E-04-14-15-60-102-4		E-04-14-15-60-104-5		E-04-14-15-60-108-7		E-05-14-15-20-004-1	
		Sample Date	11/14/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/11/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	7.64		2.37		3.35		4.23		2.85		3.09		2.97		2.62		3.08		1.8		3.49	
TOC	Total Organic Carbon %H	%	0.71		0.38		0.53		0.5		0.28		0.21		0.43		0.32		0.45		0.31		0.41	
TOC	Total Organic Carbon %N	%	0.5		0.2		0.28		0.35		0.24		0.22		0.23		0.22		0.24		0.11		0.29	
BC	Black Carbon %C	%	1.82		0.65		0.15		0.83		0.53		0.45		0.44		0.38		0.43		0.16		0.58	
BC	Black Carbon %H	%	0.12		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.18		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	5.82		1.72		3.2		3.4		2.32		2.64		2.53		2.24		2.65		1.64		2.91	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.42		0.86		1.09		1.77		0.5		0.46		0.94		1.04		1.46		2.08		0.98	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	25		13		19		19		17		17		20		21		27		13		28	
PS	PERCENT SAND [b]	%	86		84		76		74		82		80		80		78		70		80		78	
PS	PERCENT SILT	%	12		10		20		20		14		18		18		16		22		10		18	
PS	PERCENT CLAY	%	2		6		4		6		4		2		2		6		8		10		4	
PS	Retained on 250 [c]	%	33.9		14.4		12.1		9.7		13		6.3		5.8		5.6		5.3		31.2		6	
PS	Soil Classification [d]	--	Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	E-06-1-1		E-07-2-1		E-07-5-1		E-07-8-1		E-07-10-1		E-07-11-1		E-08-1-1		E-08-3-1		E-08-9-1		E-08-11-1		E-08-13-1	
		Location ID	E-06-14-15-20-004-1		E-07-14-15-10-432-2		E-07-14-15-10-438-5		E-07-14-15-10-466-8		E-07-14-15-10-470-10		E-07-14-15-10-472-11		E-08-14-10-40-124-1		E-08-14-10-40-130-3		E-08-14-10-40-194-9		E-08-14-10-40-202-11		E-08-14-10-40-206-13	
		Sample Date	11/11/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.15		2.62		2.67		4.76		2.91		4.43		6.24		1.58		2.7		2.67		2.89	
TOC	Total Organic Carbon %H	%	0.63		0.7		0.29		0.37		0.47		0.54		0.89		0.39		0.56		0.32		0.68	
TOC	Total Organic Carbon %N	%	0.4		0.24		0.23		0.24		0.25		0.4		0.55		0.1	U	0.26		0.26		0.24	
BC	Black Carbon %C	%	0.3		0.28		0.21		0.78		0.36		0.21		0.17		0.26		0.23		0.19		0.38	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.24		0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.85		2.34		2.46		3.98		2.55		4.22		6.07		1.32		2.47		2.48		2.51	
SSA	SPECIFIC SURFACE AREA	m^2/g	3.21		4.31		1.21		2.21		2.04		0.97		1.34		2.66		2.01		0.98		2.81	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	30		27		21		25		21		21		28		40		41		22		22	
PS	PERCENT SAND [b]	%	72		64		76		72		72		80		80		78		68		80		66	
PS	PERCENT SILT	%	18		22		18		20		18		16		16		14		26		16		24	
PS	PERCENT CLAY	%	10		14		6		8		10		4		4		8		6		4		10	
PS	Retained on 250 [c]	%	8.4		7.3		12.3		8.4		12.8		7.3		6.9		13.7		4.6		8.6		8.1	
PS	Soil Classification [d]	--	Sandy Loam		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	E-09-3-1		E-09-3-1-D		E-09-4-1		E-09-8-1		E-09-9-1		E-09-11-1		E-10-1-1		E-11-1-1		E-11-2-1		E-11-3-1		E-11-7-1	
		Location ID	E-09-14-10-40-526-3		E-09-14-10-40-526-3		E-09-14-10-40-528-4		E-09-14-10-40-562-8		E-09-14-10-40-564-9		E-09-14-10-40-566-11		E-10-14-10-30-500-1		E-11-14-10-20-604-1		E-11-14-10-20-606-2		E-11-14-10-20-608-3		E-11-14-10-20-618-7	
		Sample Date	10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		11/10/2006		11/3/2006		11/3/2006		11/3/2006		11/3/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.88		4.09		2.52		5.05		3.35		2.33		2.22		2.85		3.33		3.12		1.32	
TOC	Total Organic Carbon %H	%	0.4		0.84		0.51		0.65		0.46		0.3		0.23		0.36		0.52		0.51		0.2	
TOC	Total Organic Carbon %N	%	0.28		0.41		0.23		0.49		0.28		0.2		0.16		0.21		0.28		0.28		0.11	
BC	Black Carbon %C	%	0.4		0.7		0.15		0.5		0.13		0.11		0.1	U	0.15		0.17		0.26		0.1	U
BC	Black Carbon %H	%	0.1	U	0.19		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.48		3.39		2.37		4.55		3.22		2.22		2.12		2.7		3.16		2.86		1.22	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.66		1.85		12.84		1.8		1.11		1.2		0.65		1.08		1.59		1.97		1.13	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	34		33		34		46		39		39		13		23		25		22		14	
PS	PERCENT SAND [b]	%	70		72		84		68		84		78		84		80		78		76		82	
PS	PERCENT SILT	%	26		26		14		26		14		18		14		14		14		20		14	
PS	PERCENT CLAY	%	4		2		2		6		2		4		2		6		8		4		4	
PS	Retained on 250 [c]	%	4.2		7.4		5.6		7		9.2		6.6		13.6		17.1		19.6		17.2		15.9	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	E-11-7-1-D		E-11-9-1		F-01-1-1		F-02-1-1		F-04-2-1		F-04-3-1		F-04-6-1		F-04-7-1		F-04-12-1		F-05-6-1		F-05-8-1	
		Location ID	E-11-14-10-20-618-7		E-11-14-10-20-624-9		F-01-14-22-80-436-1		F-02-14-22-10-180-1		F-04-14-15-30-318-2		F-04-14-15-30-320-3		F-04-14-15-30-326-6		F-04-14-15-30-376-7		F-04-14-15-30-386-12		F-05-14-15-30-034-6		F-05-14-15-30-038-8	
		Sample Date	11/3/2006		11/3/2006		11/14/2006		11/14/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	1.44		1.58		2.07		4.07		7.8		12.89		3.33		3.07		3.01		3.69		2.93	
TOC	Total Organic Carbon %H	%	0.25		0.24		0.45		0.44		1.01		1.3		0.32		0.32		0.46		0.47		0.34	
TOC	Total Organic Carbon %N	%	0.12		0.13		0.17		0.31		0.59		0.92		0.26		0.24		0.25		0.27		0.22	
BC	Black Carbon %C	%	0.1	U	0.1	U	0.53		0.99		1.7		1.73		0.48		0.42		0.35		0.34		0.2	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.5		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.13		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.34		1.48		1.54		3.08		6.1		11.16		2.85		2.65		2.66		3.35		2.73	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.33		1.5		1.36		0.69		2.37		0.88		1.83		0.86		2.12		0.89		1.51	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	14		18		12		26		29		26		17		14		13		16		19	
PS	PERCENT SAND [b]	%	82		84		78		84		66		82		74		86		70		84		76	
PS	PERCENT SILT	%	14		10		16		14		30		16		24		12		24		16		22	
PS	PERCENT CLAY	%	4		6		6		2		4		2		2		2		6		0		2	
PS	Retained on 250 [c]	%	15.9		21.1		32.2		16.6		16.6		24.6		18.4		21.8		12		15		15.6	
PS	Soil Classification [d]	--	Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand		Sand		Sandy Loam		Loamy Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	F-05-11-1		F-05-12-1		F-05-13-1		G-02-1-1		G-03-1-1		G-03-1-1-D		G-04-1-1		G-05-1-1		G-05-2-1		G-05-4-1		G-05-5-1	
		Location ID	F-05-14-15-30-044-11		F-05-14-15-30-046-12		F-05-14-15-30-048-13		G-02-14-22-20-150-1		G-03-14-23-10-100-1		G-03-14-23-10-100-1		G-04-14-15-40-130-1		G-05-14-15-40-064-1		G-05-14-15-40-066-2		G-05-14-15-40-070-4		G-05-14-15-40-072-5	
		Sample Date	11/15/2006		11/15/2006		11/15/2006		10/30/2006		11/9/2006		11/9/2006		11/9/2006		11/7/2006		11/7/2006		11/7/2006		11/7/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.2		4.99		3.06		2.26		1.78		1.81		3.86		3.79		4.84		2.89		3.35	
TOC	Total Organic Carbon %H	%	0.62		0.59		0.36		0.48		0.38		0.28		0.46		0.33		0.52		0.29		0.22	
TOC	Total Organic Carbon %N	%	0.32		0.4		0.25		0.18		0.14		0.14		0.31		0.26		0.34		0.22		0.24	
BC	Black Carbon %C	%	0.87		0.38		0.55		0.45		0.37		0.43		0.36		0.48		0.37		0.32		0.41	
BC	Black Carbon %H	%	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.33		4.61		2.51		1.81		1.41		1.38		3.5		3.31		4.47		2.57		2.94	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.12		0.89		2.21		2.4		2.86		2.94		0.97		0.55		0.5		0.45		0.35	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	44		18		13		23		16		16		41		19		27		15		16	
PS	PERCENT SAND [b]	%	76		80		78		84		76		72		86		90		90		88		92	
PS	PERCENT SILT	%	20		18		16		10		10		12		10		10		8		10		6	
PS	PERCENT CLAY	%	4		2		6		6		14		16		4		0		2		2		2	
PS	Retained on 250 [c]	%	17.9		14.7		14		19.7		30.3		28.9		11.3		7.7		6.2		5.6		13.3	
PS	Soil Classification [d]	--	Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam		Sandy Loam		Loamy Sand		Sand		Sand		Sand		Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	G-05-5-1-D		G-05-7-1		G-06-1-1		G-06-1-1-D		G-07-1-1		G-08-1-1		G-08-2-1		G-08-5-1		G-08-5-1-D		G-08-9-1		G-08-11-1	
		Location ID	G-05-14-15-40-072-5		G-05-14-15-40-102-7		G-06-14-14-60-002-1		G-06-14-14-60-002-1		G-07-14-14-60-002-1		G-08-14-14-70-070-1		G-08-14-14-70-072-2		G-08-14-14-70-078-5		G-08-14-14-70-078-5		G-08-14-14-70-090-9		G-08-14-14-70-094-11	
		Sample Date	11/7/2006		11/7/2006		10/26/2006		10/26/2006		10/27/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.52		1.48		9.54		2.6		4.4		3.48		3.06		2.31		2.09		1.69		2.9	
TOC	Total Organic Carbon %H	%	0.28		0.16		0.92		0.38		0.49		0.48		0.52		0.27		0.33		0.24		0.62	
TOC	Total Organic Carbon %N	%	0.3		0.12		0.54		0.25		0.32		0.31		0.26		0.21		0.18		0.14		0.26	
BC	Black Carbon %C	%	0.41		0.1	U	1.33		0.14		0.35		0.48		0.21		0.24		0.14		0.17		0.54	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.11		1.38		8.21		2.46		4.05		3		2.85		2.07		1.95		1.52		2.36	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.37		0.99		0.85		0.75		0.78		2.47		1.22		2.54		2.42		1.46		1.61	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	17		8		39		38		28		23		21		17		17		12		20	
PS	PERCENT SAND [b]	%	90		88		78		80		88		70		76		68		66		82		76	
PS	PERCENT SILT	%	6		8		20		16		10		18		14		22		26		10		16	
PS	PERCENT CLAY	%	4		4		2		4		2		12		10		10		8		8		8	
PS	Retained on 250 [c]	%	6.5		16.5		6.4		6.8		11.3		15.2		20.8		8.1		8.8		21.1		13.5	
PS	Soil Classification [d]	--	Sand		Sand		Loamy Sand		Loamy Sand		Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	G-09-1-1		G-09-2-1		G-09-4-1		G-09-6-1		G-09-11-1		G-10-2-1		G-10-6-1		G-10-7-1		G-10-8-1		G-10-8-1-D		G-10-9-1	
		Location ID	G-09-14-14-80-184-1		G-09-14-14-80-186-2		G-09-14-14-80-190-4		G-09-14-14-80-194-6		G-09-14-14-80-204-11		G-10-14-14-10-314-2		G-10-14-14-10-496-6		G-10-14-14-10-498-7		G-10-14-14-10-502-8		G-10-14-14-10-502-8		G-10-14-14-10-504-9	
		Sample Date	10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	8.97		2.58		3.19		1.29		3.74		2.61		4.1		3.01		1.47		4.36		3.83	
TOC	Total Organic Carbon %H	%	0.95		0.42		0.49		0.36		0.51		0.35		0.41		0.42		0.2		0.66		0.8	
TOC	Total Organic Carbon %N	%	0.39		0.22		0.28		0.1		0.33		0.24		0.27		0.28		0.15		0.35		0.35	
BC	Black Carbon %C	%	0.16		0.1	U	0.28		0.15		0.17		0.17		1.23		0.35		0.24		0.59		0.56	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.13	
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	8.81		2.48		2.91		1.14		3.57		2.44		2.87		2.66		1.23		3.77		3.27	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.11		1.68		1.17		4.38		1.84		1.13		0.36		0.28		1.16		1.18		2.21	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	69		37		52		24		18		18		36		23		31		31		31	
PS	PERCENT SAND [b]	%	76		84		80		82		76		82		88		92		74		72		68	
PS	PERCENT SILT	%	16		14		16		12		20		16		12		8		22		26		28	
PS	PERCENT CLAY	%	8		2		4		6		4		2		0		0		4		2		4	
PS	Retained on 250 [c]	%	28.7		7.3		10.1		4.7		18.4		6.1		21.3		25.4		5.6		11.6		8.5	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sand		Sand		Loamy Sand		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	G-11-1-1		G-11-3-1		G-11-5-1		G-11-7-1		G-12-4-1		G-12-5-1		G-12-6-1		G-12-6-1-D		G-12-9-1		H-02-1-1		H-03-1-1	
		Location ID	G-11-14-11-40-054-1		G-11-14-11-40-058-3		G-11-14-11-40-080-5		G-11-14-11-40-084-7		G-12-14-11-30-220-4		G-12-14-11-30-222-5		G-12-14-11-30-224-6		G-12-14-11-30-224-6		G-12-14-11-40-476-9		H-02-14-22-20-150-1		H-03-14-21-30-007-1	
		Sample Date	10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		10/25/2006		11/2/2006		11/13/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	1.73		2.24		3.08		3.06		3.38		2.47		3.64		2.97		3.5		3.36		5.06	
TOC	Total Organic Carbon %H	%	0.39		0.44		0.63		0.43		0.59		0.53		0.55		0.8		0.7		0.55		0.72	
TOC	Total Organic Carbon %N	%	0.15		0.18		0.29		0.28		0.27		0.22		0.31		0.31		0.29		0.32		0.37	
BC	Black Carbon %C	%	0.1	U	0.19		0.77		0.12		0.19		0.17		0.55		0.99		0.38		0.23		1.92	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.28		0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.2	
--	Organic Carbon [a]	%	1.63		2.05		2.31		2.94		3.19		2.3		3.09		1.98		3.12		3.13		3.14	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.75		0.52		2.29		0.49		1.66		4.98		4.16		7.03		2.24		4.13		0.86	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	20		21		24		24		25		25		33		35		38		13		30	
PS	PERCENT SAND [b]	%	72		78		74		86		78		70		64		64		66		72		78	
PS	PERCENT SILT	%	26		18		20		12		16		14		22		20		28		18		18	
PS	PERCENT CLAY	%	2		4		6		2		6		16		14		16		6		10		4	
PS	Retained on 250 [c]	%	11.6		6.4		9.7		12.9		6.1		4.9		8.7		12.2		27.7		23.1		9	
PS	Soil Classification [d]	--	Loamy Sand		Loamy Sand		Sandy Loam		Sand		Loamy Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 2 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	H-04-1-1		H-05-1-1		I-01-1-1	I-02-1-1		I-04-1-1		I-04-1-1-D		I-05-1-1		I-06-1-1	
		Location ID	H-04-14-14-60-002-1		H-05-14-14-60-002-1		I-01-14-22-20-150-1	I-02-14-21-30-007-1		I-04-14-23-10-200-1		I-04-14-23-10-200-1		I-05-14-14-30-010-1		I-06-14-14-30-010-1	
		Sample Date	10/27/2006		10/27/2006		11/14/2006	11/14/2006		11/1/2006		11/1/2006		11/17/2006		11/10/2006	
		Sample Depth (in)	0-1		0-1		0-1	0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil	Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**															
TOC	Total Organic Carbon %C	%	5		5.36		2.85	6.41		1.89		1.86		0.96		1.03	
TOC	Total Organic Carbon %H	%	0.54		0.63		0.65	0.51		0.17		0.17		0.21		0.12	
TOC	Total Organic Carbon %N	%	0.36		0.34		0.18	0.43		0.12		0.11		0.1	U	0.1	U
BC	Black Carbon %C	%	0.63		0.62		1.56	1.08		0.26		0.2		0.12		0.1	U
BC	Black Carbon %H	%	0.1	U	0.1	U	0.31	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.11	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	4.37		4.74		1.29	5.33		1.63		1.66		0.84		0.93	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.4		1.87		1.98	0.48		0.56		0.77		3.19		1.24	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	34		32		17	35		14		14		13		7	
PS	PERCENT SAND [b]	%	86		84		80	92		90		90		88		90	
PS	PERCENT SILT	%	12		12		12	6		8		8		10		6	
PS	PERCENT CLAY	%	2		4		8	2		2		2		2		4	
PS	Retained on 250 [c]	%	14.8		8.2		16.3	31.1		9.6		10.3		14.3		13	
PS	Soil Classification [d]	--	Sand		Loamy Sand		Loamy Sand	Sand		Sand		Sand		Sand		Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	I-07-1-1		I-08-1-1		I-09-1-1		I-10-1-1		K-01-1-1		K-03-1-1		K-04-1-1		K-04-10-1		K-04-10-1-D		K-04-12-1		K-04-14-1	
		Location ID	I-07-14-14-30-010-1		I-08-14-14-30-010-1		I-09-14-13-10-800-1		I-10-14-13-10-800-1		K-01-14-21-30-006-1		K-03-14-23-60-132-1		K-04-14-23-30-430-1		K-04-14-23-60-020-10		K-04-14-23-60-020-10		K-04-14-23-60-028-12		K-04-14-23-60-036-14	
		Sample Date	11/10/2006		10/28/2006		10/27/2006		10/27/2006		10/30/2006		11/15/2006		11/7/2006		11/7/2006		11/7/2006		11/7/2006		11/7/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.52		3.31		3.58		3.23		0.8		3.51		1.26		2.88		3.09		2.18		3.86	
TOC	Total Organic Carbon %H	%	0.3		0.32		0.38		0.47		0.12		0.33		0.1		0.39		0.34		0.16		0.59	
TOC	Total Organic Carbon %N	%	0.2		0.21		0.29		0.23		0.1	U	0.25		0.1		0.24		0.26		0.17		0.34	
BC	Black Carbon %C	%	0.21		0.17		0.61		0.31		0.1	U	0.73		0.18		0.32		0.4		0.27		0.69	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	
--	Organic Carbon [a]	%	3.31		3.14		2.97		2.92		0.7		2.78		1.08		2.56		2.69		1.91		3.17	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.49		0.74		0.51		1.05		0.89		0.84		0.96		1.4		1.37		1.07		3.52	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	19		34		52		76		17		19		15		21		17		18		21	
PS	PERCENT SAND [b]	%	88		90		90		88		86		88		90		80		82		84		64	
PS	PERCENT SILT	%	10		10		8		8		8		12		6		10		10		10		24	
PS	PERCENT CLAY	%	2		0		2		4		6		0		4		10		8		6		12	
PS	Retained on 250 [c]	%	4.8		9.4		8.5		7.4		5.4		22.9		12.9		18.6		18.8		27.1		17.7	
PS	Soil Classification [d]	--	Sand		Sand		Sand		Sand		Loamy Sand		Sand		Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sieve

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	K-04-15-1		K-05-1-1		K-05-2-1		K-05-2-1-D		K-05-5-1		K-05-6-1		K-05-14-1		K-06-1-1		K-06-2-1		K-06-2-1-D		K-06-3-1	
		Location ID	K-04-14-23-60-040-15		K-05-14-23-30-266-1		K-05-14-23-30-268-2		K-05-14-23-30-268-2		K-05-14-23-30-274-5		K-05-14-23-30-278-6		K-05-14-23-30-300-14		K-06-14-23-30-032-1		K-06-14-23-30-034-2		K-06-14-23-30-034-2		K-06-14-23-30-036-3	
		Sample Date	11/7/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/6/2006		11/6/2006		11/6/2006		11/6/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.88		2.77		1.7		1.67		1.74		4.66		2.11		4.96		1.96		1.99		2.53	
TOC	Total Organic Carbon %H	%	0.56		0.35		0.24		0.21		0.26		0.76		0.23		0.74		0.22		0.21		0.34	
TOC	Total Organic Carbon %N	%	0.22		0.21		0.14		0.14		0.15		0.41		0.17		0.4		0.16		0.14		0.19	
BC	Black Carbon %C	%	0.6		0.19		0.21		0.1	U	0.1		0.59		0.22		1.21		0.1	U	0.1	U	0.1	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.14		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.17		0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.28		2.58		1.49		1.57		1.64		4.07		1.89		3.75		1.86		1.89		2.43	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.12		0.64		0.81		1.02		0.76		0.94		1.21		1.48		0.66		0.58		0.84	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	21		21		15		10		7		20		19		25		13		13		14	
PS	PERCENT SAND [b]	%	72		84		90		88		86		76		86		74		86		88		86	
PS	PERCENT SILT	%	18		12		6		8		8		16		10		20		12		10		10	
PS	PERCENT CLAY	%	10		4		4		4		6		8		4		6		2		2		4	
PS	Retained on 250 [c]	%	23.1		15.6		18.9		21.7		18.9		21.7		11.5		12.4		24.7		24.3		23.9	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Sand		Sand		Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam		Sand		Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	K-07-5-1		K-07-7-1		K-07-8-1		K-07-9-1		K-08-1-1		K-08-2-1		K-08-5-1		K-08-9-1		K-08-12-1		K-09-1-1		K-10-1-1	
		Location ID	K-07-14-24-70-022-5		K-07-14-24-70-064-7		K-07-14-24-70-066-8		K-07-14-24-70-068-9		K-08-14-24-70-164-1		K-08-14-24-70-168-2		K-08-14-24-70-176-5		K-08-14-24-70-280-9		K-08-14-24-70-289-12		K-09-14-24-70-301-1		K-10-14-24-20-004-1	
		Sample Date	10/25/2006		10/25/2006		10/25/2006		10/25/2006		11/2/2006		11/2/2006		11/2/2006		11/2/2006		11/2/2006		11/9/2006		11/10/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.62		3.94		3.35		2.06		2.03		3.28		2.89		3.54		4.33		2.82		4.63	
TOC	Total Organic Carbon %H	%	0.71		0.52		0.49		0.41		0.26		0.38		0.4		0.81		0.53		0.6		0.62	
TOC	Total Organic Carbon %N	%	0.28		0.35		0.33		0.18		0.18		0.27		0.24		0.27		0.4		0.25		0.31	
BC	Black Carbon %C	%	1.09		0.28		0.27		0.1	U	0.2		0.25		0.35		0.93		0.76		0.58		0.3	
BC	Black Carbon %H	%	0.27		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.25		0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.12		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.11		0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	2.53		3.66		3.08		1.96		1.83		3.03		2.54		2.61		3.57		2.24		4.33	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.38		0.46		1.54		0.9		0.5		0.51		0.6		4.14		0.98		1.94		2.58	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	22		64		23		20		16		20		20		27		20		20		30	
PS	PERCENT SAND [b]	%	76		86		88		78		90		92		88		70		86		68		76	
PS	PERCENT SILT	%	14		10		6		14		10		6		8		16		10		22		12	
PS	PERCENT CLAY	%	10		4		6		8		0		2		4		14		4		10		12	
PS	Retained on 250 [c]	%	36		12		10.7		26.1		17.6		19.1		22.3		12.9		24.4		15.5		20.7	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Sand		Loamy Sand		Sand		Sand		Sand		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	K-10-1-1-D		K-11-1-1		L-02-1-1		L-03-1-1		L-03-1-1-D		L-04-1-1		L-05-1-1		M-01-1-1		M-02-1-1		M-03-1-1		M-04-1-1	
		Location ID	K-10-14-24-20-004-1		K-11-14-24-20-004-1		L-02-14-23-50-050-1		L-03-14-23-50-050-1		L-03-14-23-50-050-1		L-04-14-23-40-310-1		L-05-14-23-40-210-1		M-01-14-26-80-260-1		M-02-14-26-80-260-1		M-03-14-26-80-260-1		M-04-14-26-80-260-1	
		Sample Date	11/10/2006		11/10/2006		11/1/2006		11/1/2006		11/1/2006		11/7/2006		11/9/2006		11/13/2006		11/2/2006		11/9/2006		11/9/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.85		4.84		8.34		5.8		5.91		3.48		4.79		4.04		3.58		1.11		3.73	
TOC	Total Organic Carbon %H	%	0.67		0.62		1.19		0.74		0.76		0.62		0.41		0.82		0.34		0.15		0.33	
TOC	Total Organic Carbon %N	%	0.32		0.36		0.45		0.39		0.4		0.25		0.28		0.37		0.15		0.1	U	0.21	
BC	Black Carbon %C	%	0.34		0.73		1.1		0.88		1.01		0.3		0.61		0.93		0.87		0.26		0.75	
BC	Black Carbon %H	%	0.1	U	0.1	U	1.07		0.1	U	0.11		0.1	U	0.1	U	0.43		0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.15		0.1	U	0.1	U	0.1	U	0.1	U	0.15		0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	4.51		4.11		7.24		4.92		4.9		3.18		4.18		3.11		2.71		0.85		2.98	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.39		1.19		12.5		2.2		2.14		2.02		0.61		4.7		2.27		1.23		1.15	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	39		35		38		41		9		20		29		24		34		6		23	
PS	PERCENT SAND [b]	%	70		76		28		80		78		80		88		46		88		90		86	
PS	PERCENT SILT	%	20		14		32		12		12		12		10		32		8		8		12	
PS	PERCENT CLAY	%	10		10		40		8		10		8		2		22		4		2		2	
PS	Retained on 250 [c]	%	20.8		21.4		10		9.8		9.9		13.1		9.2		12.1		20.3		50.8		13.9	
PS	Soil Classification [d]	--	Sandy Loam		Sandy Loam		Clay		Loamy Sand		Sandy Loam		Loamy Sand		Sand		Loam		Sand		Sand		Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	M-04-1-1-D		M-05-1-1		M-06-1-1		M-07-1-1		M-07-1-1-D		M-08-1-1		M-09-1-1		M-10-1-1		M-11-1-1		R-02-1-1		R-02-2-1	
		Location ID	M-04-14-26-80-260-1		M-05-14-26-80-260-1		M-06-14-26-80-260-1		M-07-14-25-80-240-1		M-07-14-25-80-240-1		M-08-14-25-80-240-1		M-09-14-25-80-240-1		M-10-14-25-80-420-1		M-11-14-25-80-420-1		R-02-120-033-200-251-00-R		R-02-120-033-200-252-00-R	
		Sample Date	11/9/2006		11/9/2006		11/9/2006		11/28/2006		11/28/2006		11/3/2006		11/3/2006		11/2/2006		11/2/2006		10/30/2006		10/30/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.94		4.02		6.53		2.46		2.77		3.2		2.64		7.09		3.33		1.73		2	
TOC	Total Organic Carbon %H	%	0.35		0.38		0.69		0.9		0.83		0.46		0.21		0.72		0.54		0.13		0.22	
TOC	Total Organic Carbon %N	%	0.21		0.27		0.56		0.17		0.2		0.21		0.14		0.36		0.25		0.1		0.13	
BC	Black Carbon %C	%	0.73		0.35		0.76		0.58		0.56		0.52		0.26		0.35		0.29		0.1		0.13	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.98		0.4		0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.21		3.67		5.77		1.88		2.21		2.68		2.38		6.74		3.04		1.63		1.87	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.35		0.61		0.97		10.4		12.21		15.16		0.74		0.81		2.38		0.28		0.83	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	23		30		31		35		36		34		26		72		31		14		18	
PS	PERCENT SAND [b]	%	88		90		88		84		84		90		92		86		74		92		80	
PS	PERCENT SILT	%	10		8		10		14		12		8		8		10		16		6		14	
PS	PERCENT CLAY	%	2		2		2		2		4		2		0		4		10		2		6	
PS	Retained on 250 [c]	%	12.6		11.3		10.5		18.4		16.3		25.9		10.8		8.5		26.4		44.3		27.4	
PS	Soil Classification [d]	--	Sand		Sand		Sand		Loamy Sand		Loamy Sand		Sand		Sand		Loamy Sand		Sandy Loam		Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	R-02-6-1		R-02-8-1		R-02-9-1		R-03-1-1		R-03-1-1-D		R-04-4-1		R-04-6-1		R-04-8-1		R-04-9-1		R-04-9-1-D		S-01-1-1	
		Location ID	R-02-120-755-500-480-00-R		R-02-120-755-500-500-00-R		R-02-120-755-500-510-00-R		R-03-120-033-200-622-00-R		R-03-120-033-200-622-00-R		R-04-120-033-200-470-00-R		R-04-120-033-300-540-00-R		R-04-120-033-300-560-00-R		R-04-120-033-300-570-00-R		R-04-120-033-300-570-00-S		S-01-120-028-300-190-00-I	
		Sample Date	10/30/2006		10/30/2006		10/30/2006		11/7/2006		11/7/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/8/2006		11/13/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.31		2.52		3.15		1.85		1.77		2.6		2.07		2.2		1.35		1.04		2.1	
TOC	Total Organic Carbon %H	%	0.63		0.33		0.42		0.45		0.37		0.67		0.13		0.35		0.14		0.1	U	0.37	
TOC	Total Organic Carbon %N	%	0.22		0.22		0.27		0.17		0.16		0.23		0.16		0.2		0.1	U	0.1	U	0.17	
BC	Black Carbon %C	%	0.63		0.24		0.18		0.17		0.17		0.38		0.1		0.11		0.1	U	0.1	U	0.1	
BC	Black Carbon %H	%	0.12		0.1	U	0.1	U	0.11		0.1	U	0.12		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.68		2.28		2.97		1.68		1.6		2.22		1.97		2.09		1.25		0.94		2	
SSA	SPECIFIC SURFACE AREA	m^2/g	2.25		0.97		1.18		6.08		5.79		3.98		0.5		0.86		1.51		1.58		1.32	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	10		21		35		14		13		21		19		17		12		13		18	
PS	PERCENT SAND [b]	%	72		80		78		56		76		66		84		82		90		92		76	
PS	PERCENT SILT	%	16		12		16		22		4		18		12		12		8		6		16	
PS	PERCENT CLAY	%	12		8		6		22		20		16		4		6		2		2		8	
PS	Retained on 250 [c]	%	22.5		26		26.8		22.3		20.4		17.5		37		45.6		42.6		60.6		30.7	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Loamy Sand		Sandy Loam		SndClyLom		Sandy Loam		Loamy Sand		Loamy Sand		Sand		Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	S-01-1-1-D		S-02-3-1		S-02-8-1		S-02-9-1		S-03-1-1		S-03-2-1		S-03-3-1		S-04-1-1		S-04-3-1		S-04-5-1		S-04-6-1	
		Location ID	S-01-120-028-300-190-00-S		S-02-120-600-500-100-00-S		S-02-120-600-500-160-00-S		S-02-120-600-500-180-00-S		S-03-120-029-400-256-00-S		S-03-120-029-400-280-00-S		S-03-120-029-400-290-00-S		S-04-120-032-100-110-00-S		S-04-120-450-500-010-00-S		S-04-120-450-500-030-00-S		S-04-120-450-500-110-00-S	
		Sample Date	11/13/2006		11/2/2006		11/2/2006		11/2/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006		11/17/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	1.72		4.16		3.06		2.87		1.69		2.18		2.97		2.39		3.61		1.03		2.84	
TOC	Total Organic Carbon %H	%	0.28		0.67		0.69		0.62		0.24		0.27		0.34		0.35		0.33		0.1	U	0.21	
TOC	Total Organic Carbon %N	%	0.14		0.35		0.27		0.25		0.1		0.17		0.18		0.22		0.33		0.1	U	0.18	
BC	Black Carbon %C	%	0.35		0.57		0.66		0.47		0.56		0.16		0.22		0.1	U	0.22		0.12		0.36	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.15		0.12		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.37		3.59		2.4		2.4		1.13		2.02		2.75		2.29		3.39		0.91		2.48	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.27		2.04		3.07		4.61		0.7		0.57		1.25		3.59		0.44		1.35		0.53	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	17		32		30		29		12		14		21		18		20		13		22	
PS	PERCENT SAND [b]	%	78		64		74		58		90		90		88		64		86		88		90	
PS	PERCENT SILT	%	14		28		18		28		10		10		8		28		14		10		10	
PS	PERCENT CLAY	%	8		8		8		14		0		0		4		8		0		2		0	
PS	Retained on 250 [c]	%	34.5		5.7		14.2		13.1		16.2		32.5		30		10.1		20.2		20.2		18.3	
PS	Soil Classification [d]	--	Loamy Sand		Sandy Loam		Sandy Loam		Sandy Loam		Sand		Sand		Sand		Sandy Loam		Sand		Sand		Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	T-01-1-1		T-01-2-1		T-01-3-1		T-01-4-1		T-01-6-1		T-02-1-1		T-03-1-1		T-03-1-1-D		T-03-5-1		T-03-7-1		T-03-9-1	
		Location ID	T-01-120-029-100-885-00-1		T-01-120-029-100-887-00-2		T-01-120-029-100-910-00-3		T-01-120-029-100-953-00-4		T-01-120-029-100-956-00-6		T-02-120-029-100-810-00-1		T-03-120-029-100-530-00-1		T-03-120-029-100-530-00-1		T-03-120-029-100-631-00-5		T-03-120-029-400-865-00-7		T-03-120-029-400-886-00-9	
		Sample Date	11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/15/2006		11/14/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.82		10.2		2.84		2.29		1.63		1.32		1.66		1.76		5.25		2.09		2.35	
TOC	Total Organic Carbon %H	%	0.59		0.11		0.53		0.29		0.34		0.13		0.27		0.21		0.57		0.4		0.56	
TOC	Total Organic Carbon %N	%	0.22		0.1	U	0.22		0.18		0.14		0.1	U	0.14		0.15		0.41		0.17		0.19	
BC	Black Carbon %C	%	0.91		1.42		0.19		0.23		0.11		0.1	U	0.16		0.29		0.47		0.1		0.24	
BC	Black Carbon %H	%	0.15		3.22		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.16		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.91		8.78		2.65		2.06		1.52		1.22		1.5		1.47		4.78		1.99		2.11	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.3		0.95		0.42		1.15		1.65		0.34		2.29		2.49		1.35		2.06		2.63	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	16		6		12		13		13		12		17		16		38		20		23	
PS	PERCENT SAND [b]	%	74		70		84		74		80		86		66		72		76		72		60	
PS	PERCENT SILT	%	16		24		14		20		12		12		24		20		18		16		26	
PS	PERCENT CLAY	%	10		6		2		6		8		2		10		8		6		12		14	
PS	Retained on 250 [c]	%	33.9		51.4		52.3		14		31.3		21.5		22.4		23.1		9.4		35.1		16.5	
PS	Soil Classification [d]	--	Sandy Loam		Sandy Loam		Loamy Sand		Sandy Loam		Loamy Sand		Sand		Sandy Loam		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	T-04-1-1		T-04-3-1		T-04-4-1		U-01-1-1		U-02-1-1		U-03-1-1		U-04-1-1		V-04-1-1		V-04-5-1		V-04-6-1		V-04-7-1	
		Location ID	T-04-120-029-100-550-00-1		T-04-120-029-200-776-00-3		T-04-120-029-200-801-00-4		U-01-14-21-30-006-1		U-02-14-21-30-006-1		U-03-14-21-30-006-1		U-04-14-20-60-280-1		V-04-14-16-60-520-1		V-04-14-16-60-530-5		V-04-14-16-60-538-6		V-04-14-16-60-540-7	
		Sample Date	11/9/2006		11/9/2006		11/9/2006		11/2/2006		11/14/2006		11/10/2006		11/10/2006		11/9/2006		11/9/2006		11/9/2006		11/9/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	2.48		3.16		3.64		2.42		2.67		2.04		2.87		2.24		6.36		2.49		4.19	
TOC	Total Organic Carbon %H	%	0.67		0.42		0.71		0.32		0.76		0.55		0.26		0.59		1.23		0.27		0.45	
TOC	Total Organic Carbon %N	%	0.21		0.26		0.32		0.19		0.15		0.17		0.17		0.17		0.42		0.17		0.31	
BC	Black Carbon %C	%	0.56		0.81		0.37		0.32		0.69		0.43		0.29		0.52		0.79		1.24		0.63	
BC	Black Carbon %H	%	0.11		0.1	U	0.1	U	0.1	U	0.5		0.1	U	0.1	U	0.25		0.21		0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.11		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.92		2.35		3.27		2.1		1.98		1.61		2.58		1.72		5.57		1.25		3.56	
SSA	SPECIFIC SURFACE AREA	m^2/g	4.18		2.56		3.69		1.08		2.23		5.92		9.07		0.53		1.35		0.36		0.85	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	23		28		23		32		14		26		29		19		16		27		20	
PS	PERCENT SAND [b]	%	54		48		48		86		72		50		40		86		82		90		76	
PS	PERCENT SILT	%	36		42		36		12		20		32		36		12		14		8		18	
PS	PERCENT CLAY	%	10		10		16		2		8		18		24		2		4		2		6	
PS	Retained on 250 [c]	%	12.6		6.9		10.5		43.7		54.3		11		10.3		47.1		51.6		44.9		35.2	
PS	Soil Classification [d]	--	Sandy Loam		Loam		Loam		Sand		Sandy Loam		Loam		Loam		Sand		Loamy Sand		Sand		Loamy Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	V-04-9-1		V-05-1-1		V-05-2-1		V-05-5-1		V-05-6-1		V-05-8-1		V-06-5-1		V-06-5-1-D		V-06-7-1		V-06-10-1		V-08-1-1	
		Location ID	V-04-14-16-60-546-9		V-05-14-17-30-060-1		V-05-14-17-30-062-2		V-05-14-17-30-068-5		V-05-14-17-30-070-6		V-05-14-17-30-074-8		V-06-14-17-20-096-5		V-06-14-17-20-096-5		V-06-14-17-20-124-7		V-06-14-17-20-134-10		V-08-14-17-20-240-1	
		Sample Date	11/9/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		11/9/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	3.89		4.19		4.18		3.28		3.72		3.55		3.55		1.93		4.95		6.18		2.16	
TOC	Total Organic Carbon %H	%	0.35		0.42		0.48		0.32		0.38		0.5		0.56		0.36		0.52		0.99		0.59	
TOC	Total Organic Carbon %N	%	0.25		0.3		0.3		0.17		0.22		0.29		0.34		0.21		0.35		0.59		0.18	
BC	Black Carbon %C	%	0.66		0.24		0.62		0.12		1.24		0.15		0.35		0.14		0.68		0.29		0.45	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.23		3.95		3.56		3.16		2.48		3.4		3.2		1.79		4.27		5.89		1.71	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.8		0.64		0.86		0.98		0.79		1.57		0.89		0.84		1.58		1.36		1.53	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	18		27		28		27		18		28		20		22		32		29		14	
PS	PERCENT SAND [b]	%	86		82		80		78		86		80		76		74		76		74		76	
PS	PERCENT SILT	%	10		14		14		18		12		14		16		22		18		18		16	
PS	PERCENT CLAY	%	4		4		6		4		2		6		8		4		6		8		8	
PS	Retained on 250 [c]	%	34.7		44.6		46.9		35.8		45.5		40		32.1		31.9		33.1		35.1		24.7	
PS	Soil Classification [d]	--	Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sand		Loamy Sand		Sandy Loam		Loamy Sand		Loamy Sand		Sandy Loam		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 3 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	V-09-1-1		V-10-1-1		V-10-2-1		V-10-5-1		V-10-6-1		V-10-9-1		W-01-1-1		W-03-11-1		W-03-12-1	
		Location ID	V-09-14-08-40-500-1		V-10-14-08-50-074-1		V-10-14-08-50-076-2		V-10-14-08-50-086-5		V-10-14-08-50-088-6		V-10-14-08-50-094-9		W-01-14-21-20-266-1		W-03-14-21-80-490-11		W-03-14-21-80-492-12	
		Sample Date	11/7/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		10/26/2006		11/15/2006		11/13/2006		11/13/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																		
TOC	Total Organic Carbon %C	%	2.36		3.01		4.46		2.36		2.35		3.43		2.57		3.39		4.2	
TOC	Total Organic Carbon %H	%	0.33		0.54		0.64		0.24		0.39		0.52		0.31		0.33		0.34	
TOC	Total Organic Carbon %N	%	0.21		0.27		0.35		0.2		0.21		0.3		0.2		0.19		0.24	
BC	Black Carbon %C	%	0.42		0.17		0.7		0.1	U	0.24		0.7		0.29		1.13		1.33	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	1.94		2.84		3.76		2.26		2.11		2.73		2.28		2.26		2.87	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.71		2.37		0.66		2.27		2.18		1.07		0.63		0.83		1.3	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	21		17		27		26		29		56		13		18		18	
PS	PERCENT SAND [b]	%	78		66		84		68		70		86		82		88		92	
PS	PERCENT SILT	%	16		24		14		22		22		10		14		12		8	
PS	PERCENT CLAY	%	6		10		2		10		8		4		4		0		0	
PS	Retained on 250 [c]	%	60.3		22.6		35		22.4		13.9		32.8		32.7		2		3.3	
PS	Soil Classification [d]	--	Loamy Sand		Sandy Loam		Loamy Sand		Sandy Loam		Sandy Loam		Loamy Sand		Loamy Sand		Sand		Sand	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 4 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	W-03-5-1		W-03-7-1		W-03-7-1-D		W-03-9-1		W-03-9-1-D		W-04-1-1		W-04-2-1		W-04-6-1		W-04-7-1		W-04-8-1		W-05-1-1	
		Location ID	W-03-14-21-80-478-5		W-03-14-21-80-482-7		W-03-14-21-80-482-7		W-03-14-21-80-486-9		W-03-14-21-80-486-9		W-04-14-16-50-038-1		W-04-14-16-50-040-2		W-04-14-16-50-048-6		W-04-14-16-50-050-7		W-04-14-16-50-052-8		W-05-14-16-50-900-1	
		Sample Date	11/13/2006		11/13/2006		11/13/2006		11/13/2006		11/13/2006		11/20/2006		11/20/2006		11/20/2006		11/20/2006		11/20/2006		11/15/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**																						
TOC	Total Organic Carbon %C	%	4.18		4.73		4.83		2.81		2.74		2.9		1.57		5.05		3.63		2.75		2.69	
TOC	Total Organic Carbon %H	%	0.61		0.32		0.29		0.49		0.42		0.2		0.16		0.38		0.35		0.25		0.48	
TOC	Total Organic Carbon %N	%	0.26		0.22		0.2		0.21		0.19		0.16		0.1	U	0.32		0.25		0.17		0.23	
BC	Black Carbon %C	%	1.15		2.06		2.42		0.44		0.72		1.17		0.12		1.13		0.95		0.76		0.41	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.03		2.67		2.41		2.37		2.02		1.73		1.45		3.92		2.68		1.99		2.28	
SSA	SPECIFIC SURFACE AREA	m^2/g	1.53		1.04		1.11		1.27		1.39		1.53		2.11		0.9		1.38		0.63		3.61	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	21		19		19		18		21		16		10		12		15		11		14	
PS	PERCENT SAND [b]	%	74		82		84		80		78		84		88		86		80		88		70	
PS	PERCENT SILT	%	20		14		12		14		14		14		10		14		16		12		18	
PS	PERCENT CLAY	%	6		4		4		6		8		2		2		0		4		0		12	
PS	Retained on 250 [c]	%	22.7		27.8		30.6		27.4		35.1		34.3		35.7		22.3		21.8		31.1		18.9	
PS	Soil Classification [d]	--	Sandy Loam		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Loamy Sand		Sand		Sand		Loamy Sand		Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sieve

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

TABLE F-1, part 4 of 4
Soil Parameter Analytical Results
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

		Sample ID	W-06-1-1		W-06-2-1		W-06-6-1		W-06-8-1		W-06-10-1	
		Location ID	W-06-14-16-60-402-1		W-06-14-16-60-404-2		W-06-14-16-60-412-6		W-06-14-16-60-446-8		W-06-14-16-60-450-10	
		Sample Date	11/20/2006		11/20/2006		11/20/2006		11/20/2006		11/20/2006	
		Sample Depth (in)	0-1		0-1		0-1		0-1		0-1	
		Sample Type	Soil		Soil		Soil		Soil		Soil	
Group	**Analyte**	**Units**										
TOC	Total Organic Carbon %C	%	3.85		2.75		1.59		3.48		2.07	
TOC	Total Organic Carbon %H	%	0.27		0.24		0.19		0.58		0.31	
TOC	Total Organic Carbon %N	%	0.27		0.18		0.12		0.23		0.16	
BC	Black Carbon %C	%	0.46		0.36		0.29		0.71		0.4	
BC	Black Carbon %H	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
BC	Black Carbon %N	%	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
--	Organic Carbon [a]	%	3.39		2.39		1.3		2.77		1.67	
SSA	SPECIFIC SURFACE AREA	m^2/g	0.35		0.39		0.78		1.6		2.15	
PS	PERCENT MOISTURE (MASS H2O/MASS TOTAL)	%	15		15		13		6		8	
PS	PERCENT SAND [b]	%	88		90		86		80		78	
PS	PERCENT SILT	%	12		8		10		14		12	
PS	PERCENT CLAY	%	0		2		4		6		10	
PS	Retained on 250 [c]	%	29.2		35.2		42.5		29.6		30.6	
PS	Soil Classification [d]	--	Sand		Sand		Loamy Sand		Loamy Sand		Sandy Loam	

[a] Organic carbon = TOC minus BC

[b] Sand, silt, clay fraction derived by ASTM D422-63 Methodology

[c] Retained on 250 = the amount of sand retained on a 250 micron (No. 60) sie

[d] Soil classificaiton based on the USDA textural triangle

U = undetected

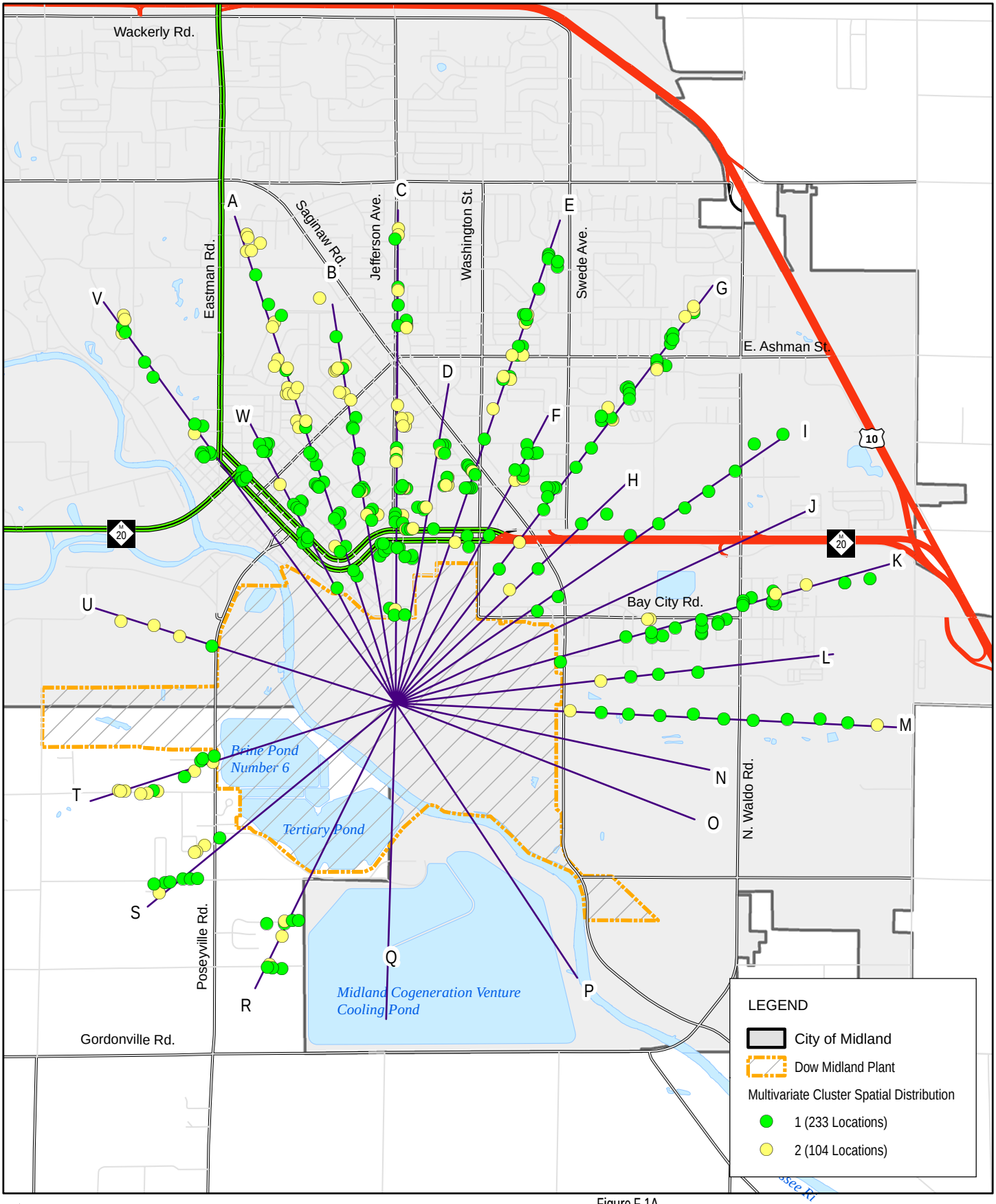

Figure F-1A
2-Group Cluster Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

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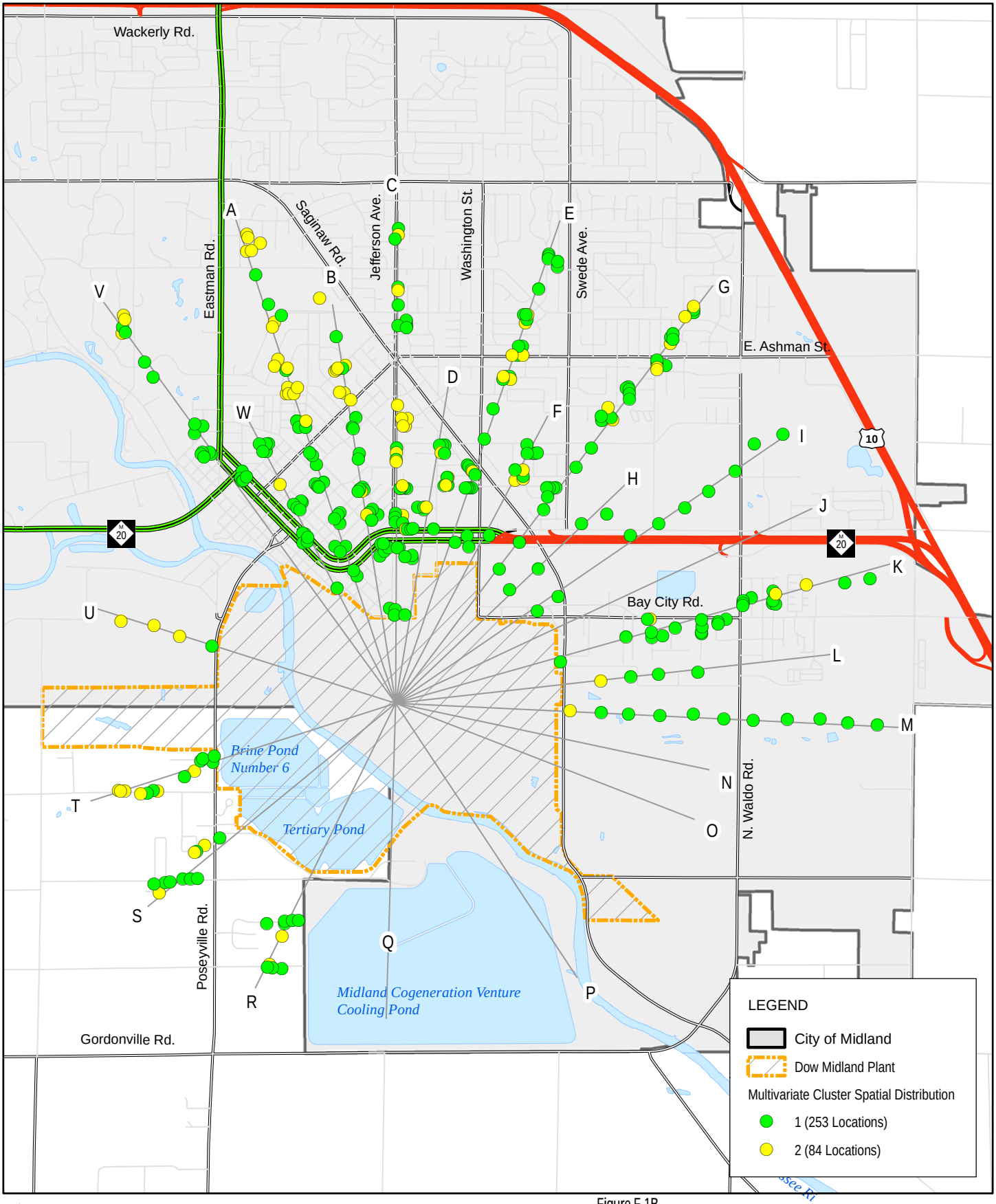

Figure F-1B
2-Group Cluster Distribution (Alt)
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

CH2MHILL

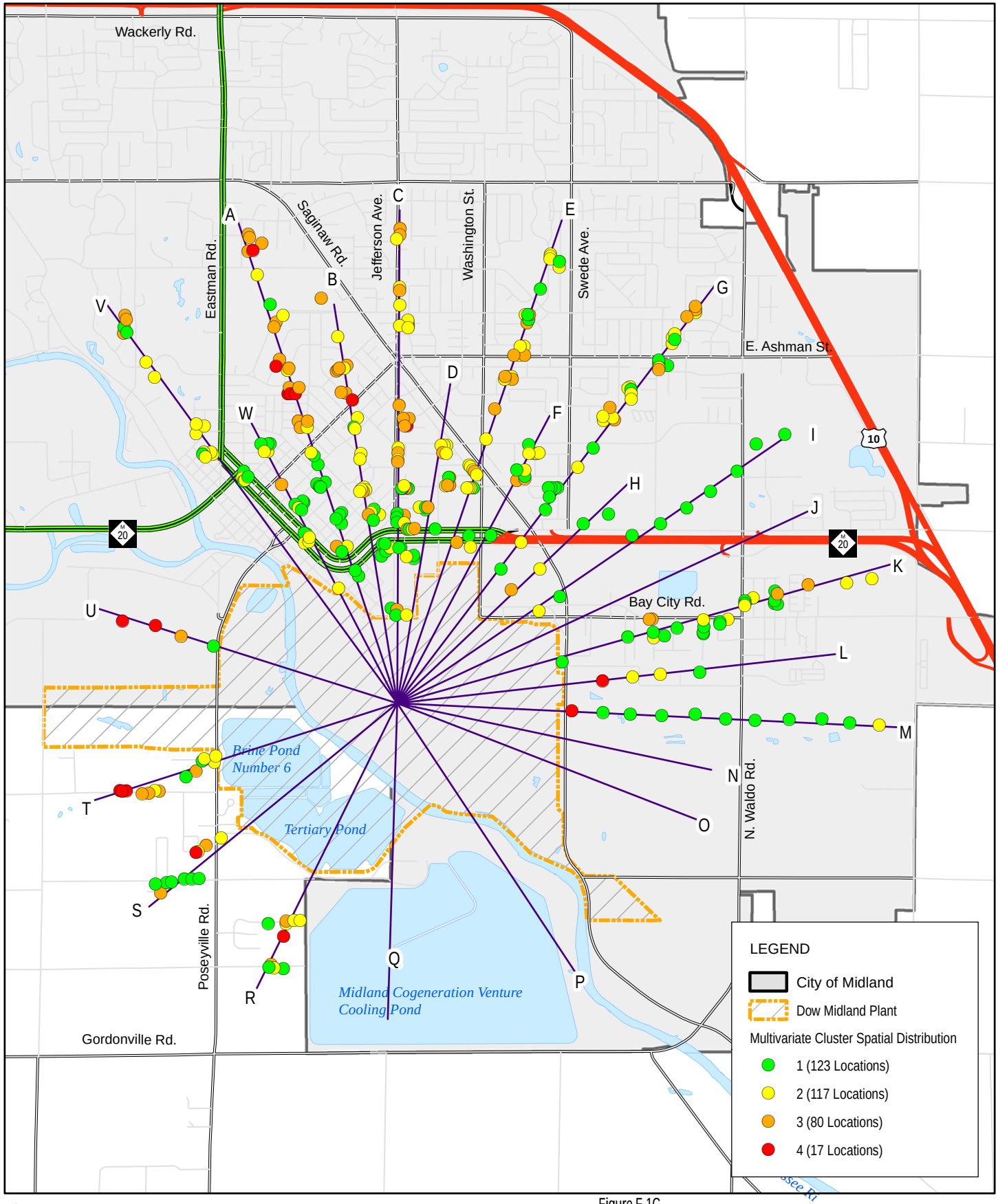

Figure F-1C
4-Group Cluster Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

CH2MHILL

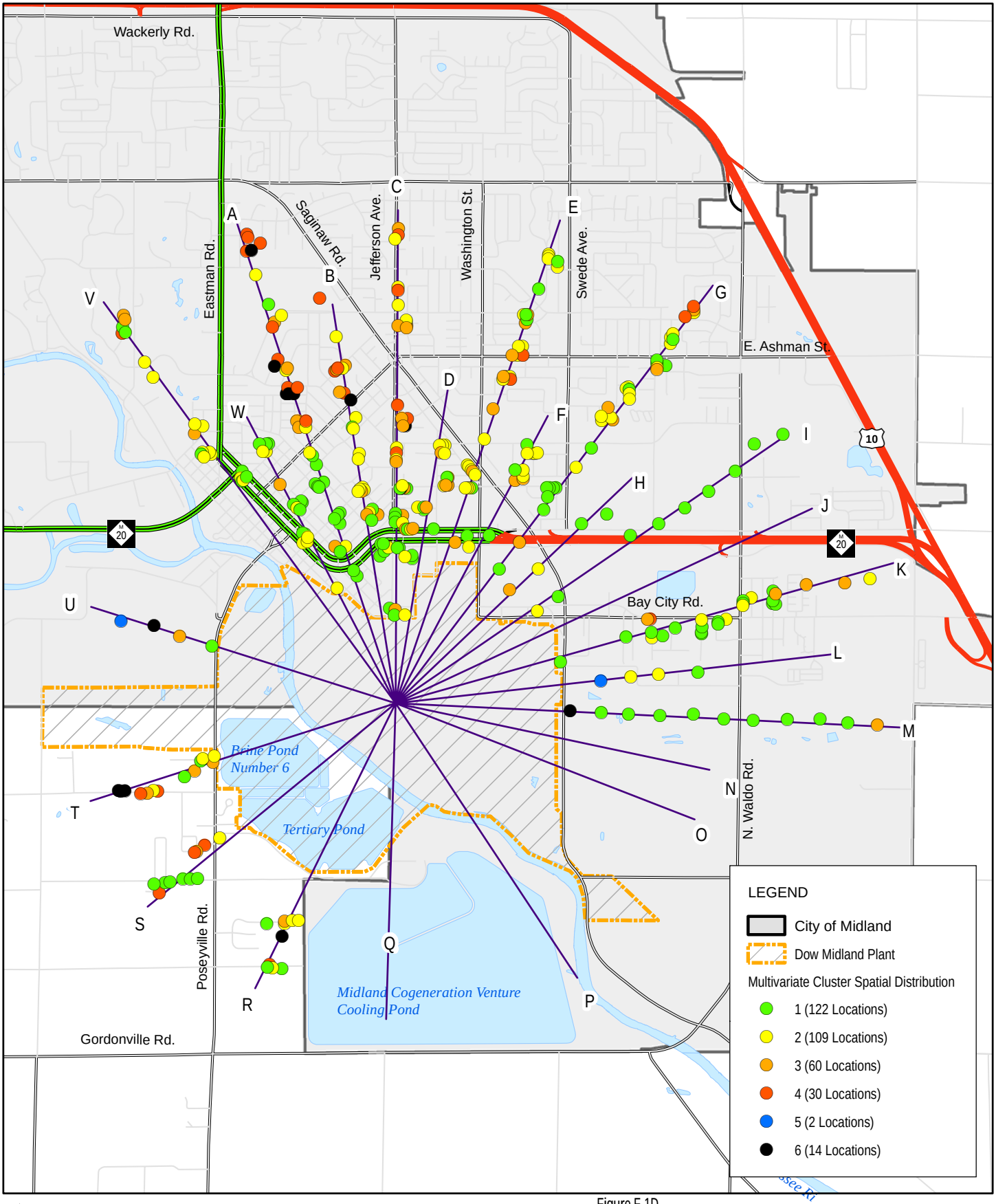

Figure F-1D
6-Group Cluster Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

CH2MHILL

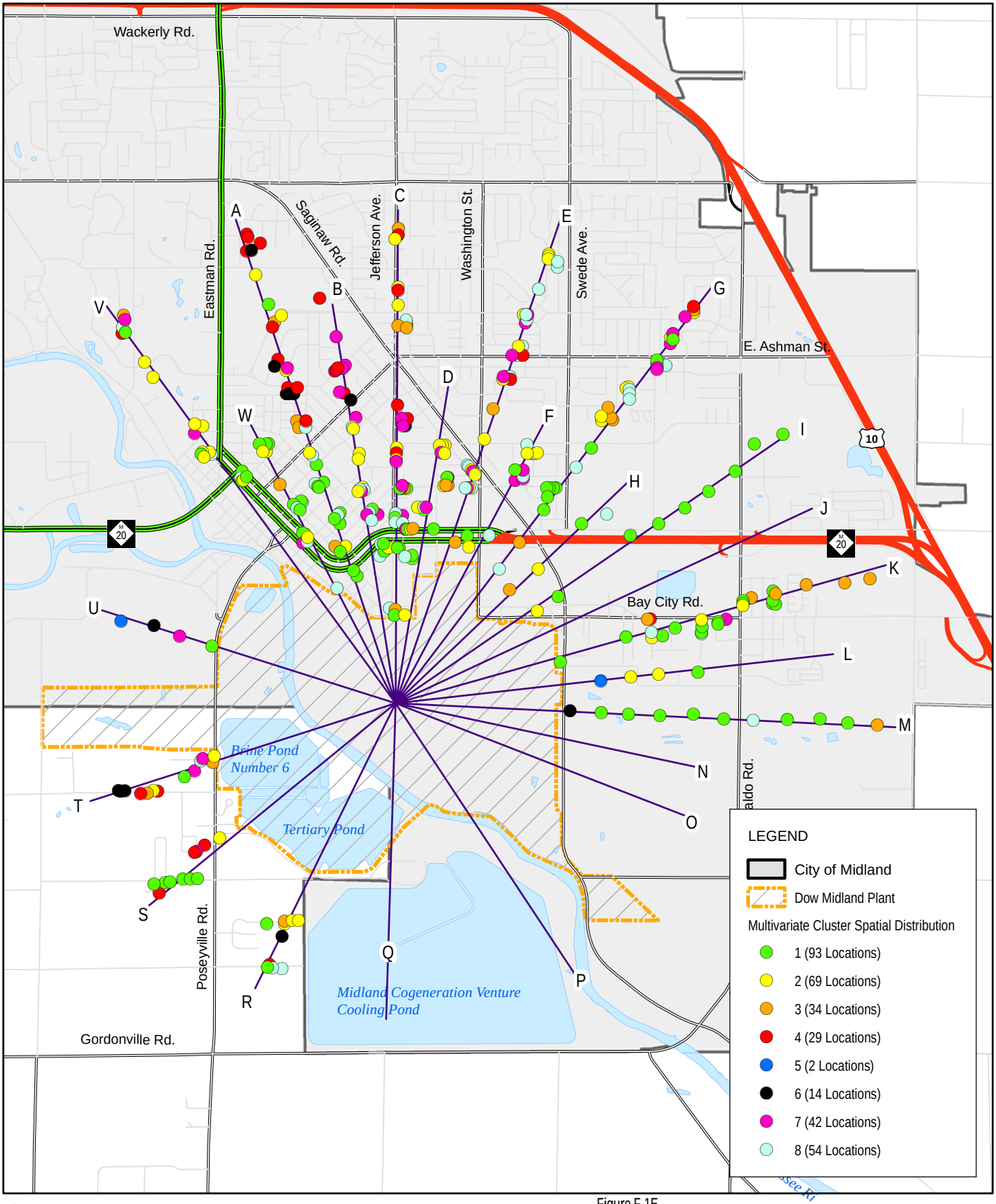

Figure F-1E
8-Group Cluster Distribution
Data Evaluation Report in Support of Bioavailability Study
Midland Area Soils

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