MULTI-AREA FIELD SAMPLING PLAN

12TH STREET LANDFILL SITE (OPERABLE UNIT NO. 4) AND PLAINWELL MILL SITE (OPERABLE UNIT NO. 7)

ALLIED PAPER, INC./PORTAGE CREEK/ KALAMAZOO RIVER SUPERFUND SITE

Revision 05
November 20, 2009

Submitted in connection with Phase II Remedial Investigation Work Plan, Plainwell Mill and the Remedial Action Work Plan, 12th Street Landfill

Prepared by Conestoga-Rovers & Associates in conjunction with RMT on behalf of Weyerhaeuser Company

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µg/kg	micrograms per kilogram
AA	atomic absorption
ARAR	Applicable, or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
BFB	p-bromofluorobenzene
BNA	base-neutral-acid extractable
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CD	Consent Decree
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COPC	constituent of potential concern
CRA	Conestoga-Rovers & Associates
CVAA	cold vapor atomic absorption
DFTPP	decafluorotriphenylphosphine
DI	deionized
DO	dissolved oxygen
DQI	data quality indicators
DQO	Data Quality Objective
ECD	electron capture detector
EDD	electronic data deliverable
Eh	redox
FB	field blank
FS	Feasibility Study
FSK	Field Sample Key
FSP	Field Sampling Plan
GC/MS	gas chromatograph/mass spectrophotometer
HSP	Health and Safety Plan
ICB	initial calibration blank
ICP	inductively coupled plasma
ICPMS	inductively coupled plasma mass spectroscopy
ICS	interface check samples
ICV	initial calibration verification

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

IDW	investigation-derived waste
KRSG	Kalamazoo River Study Group
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LRA	linear range analysis
MDEQ	Michigan Department of Environmental Quality
MDL	Method Detection Limit
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
MSD	matrix spike duplicate
NCP	National Contingency Plan
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pH	negative logarithm (base 10) of hydrogen ion activity
PID	photoionization detector
PQO	Project Quality Objective
POTW	publicly-owned treatment works
PM	Project Manager
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
QL	Quantitation Limit
RAS	routine analytical services
RD/RA	Remedial Design/Remedial Action
RF	response factor
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

RPD	relative percent difference
RL	reporting limit
RPM	Remedial Project Manager
RSD	relative standard deviation
RT	retention time
SAP	Sampling and Analysis Plan
SAS	special analytical services
SOP	standard operating procedure
SOW	Statement of Work
SPCC	system performance check compound
SRI/FS	Supplemental Remedial Investigation/Feasibility Study
SRM	standard reference material
SW846	Test Methods for Evaluating Solid Waste, 1996
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time-Critical Removal Action
TEMP	temperature
TB	trip blank
TSS	Total suspended solids
U.S. EPA	United States Environmental Protection Agency
VAS	Vertical Aquifer Sampling
VOC	volatile organic compound
WATS	Weyerhaeuser Analytical Testing Services

1.0 INTRODUCTION

1.1 BACKGROUND

Weyerhaeuser Company (Weyerhaeuser) was identified as a Potentially Responsible Party (PRP) for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site (Site) in a General Notice letter dated April 8, 2004, that was received by Weyerhaeuser and two other PRPs. Concurrently, Weyerhaeuser was negotiating a Consent Decree (CD) to undertake specific activities on the former Plainwell Mill and 12th Street Landfill sites. On February 22, 2005, Weyerhaeuser entered into a CD with the United States Environmental Protection Agency (U.S. EPA) for the Design and Implementation of Certain Response Activities at the 12th Street Landfill site (Operable Unit No. 4) and the Plainwell Mill site (Operable Unit No. 7). Both sites are part of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site (Figure 1-1), which is located in southwestern Michigan. A Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the 12th Street Landfill site was attached to the CD. A SOW for the Remedial Investigation/Feasibility Study (RI/FS) at the Plainwell Mill site was subsequently issued by the U.S. EPA, with an effective date of August 17, 2006.

The U.S. EPA requires that all parties involved in environmental monitoring and measurement efforts mandated or supported by the U.S. EPA participate in a centrally managed quality assurance program. Any party generating data under this program has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of the data are known and documented. To ensure that the responsibility is met uniformly, a written Quality Assurance Project Plan (QAPP) and associated Field Sampling Plan (FSP) must be prepared for each project. A Multi-Area QAPP for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site has been submitted for review under separate cover. It has been prepared to support field activities by describing specific protocols that will be followed for sampling, sample handling and storage, chain-of-custody procedures, and laboratory analysis for multiple areas of the Site. The Multi-Area QAPP also defines objectives, organization, functional activities, and specific quality assurance (QA) and quality control (QC) activities associated with implementing the following activities:

1. Emergency Response in the former powerhouse discharge channel at the 12th Street Landfill
2. Emergency Response of portions of the riverbank along the Plainwell Mill
3. Predesign investigations for the remedial design for the 12th Street Landfill

4. Phase 2 of Addendum No. 1 Plainwell Mill Investigations
5. Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment
6. Remedial Action for the 12th Street Landfill
7. Phase II RI Work Plan for the Plainwell Mill Investigations

QAPP amendments will be submitted to supplement the current QAPP as additional work activities are authorized and defined.

This associated Multi-Area FSP establishes sample collection and field monitoring methods and procedures to be followed to ensure that sampling and investigatory activities at the Site are conducted in a consistent manner and in accordance with technically acceptable protocols. The objective of the FSP is to facilitate the collection of environmental monitoring data that meet Data Quality Objectives (DQOs) established in the Multi-Area QAPP (CRA, 2009). This FSP will be modified in the future as other sampling programs are developed for Operable Unit Nos. 4 and 7, as well as other areas of the site, as appropriate.

1.2 DOCUMENT ORGANIZATION

This FSP was prepared to establish Standard Operating Procedures (SOPs) for environmental monitoring activities expected or likely to be conducted for purposes of completing activities associated with the following activities:

1. Emergency Response in the former powerhouse discharge channel at the 12th Street Landfill
2. Emergency Response of portions of the riverbank along the Plainwell Mill
3. Predesign investigations for the remedial design for the 12th Street Landfill
4. Remedial Action for the 12th Street Landfill
5. Phase 2 of Addendum No. 1 Plainwell Mill Investigations
6. Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment
7. Plainwell Mill Phase II RI Work Plan
8. 12th Street Landfill Remedial Action Work Plan

Additional SOPs will be submitted as work areas are added or work tasks are modified. SOPs developed as components of amended scope documents will become common to all sampling activities of the same type (e.g., sediment core collection).

As additional work plans are prepared, it is anticipated that they will be incorporated as additional addenda to this document, referencing a combination of the same SOPs, amended SOPs, or additional SOPs. If additional SOPs are required, they will be added to Attachment A. If modified SOPs are required, they will replace existing SOPs in this document. Specific addenda will be provided as standalone documents.

In September 2009, the FSP was amended to include the sampling and analysis activities associated with the Phase II RI Work Plan for the Plainwell Mill and the removal of paper residuals from outside of the landfill footprint as part of the Remedial Action (RA) at the 12th Street Landfill. At that time modifications were made to the FSP to reflect the change in Project Coordinator as defined in the 2005 CD from RMT to Conestoga-Rovers & Associates (CRA).

1.3 PROJECT SETTING

The 12th Street Landfill and Plainwell Mill sites are located in Allegan County, Michigan (Figure 1-2). The 12th Street Landfill is located in Otsego Township (Section 24, Township 1N, Range 12W), and the Plainwell Mill is located in the City of Plainwell (Section 30, Township 1N, Range 11W). Both sites are located adjacent to the Kalamazoo River, with the 12th Street Landfill located approximately 1½ miles northwest and downstream of the Plainwell Mill site. The 12th Street Landfill site is composed of approximately 6.5 acres and is situated on roughly a 24-acre property that is bordered to the east by woodlands and a former hydroelectric powerhouse discharge channel on the Kalamazoo River, to the north and west by wetlands, to the south and southwest by an asphalt plant, and to the south and southeast by industrially developed lands and the Plainwell Dam (which is scheduled to be removed as part of the U.S. EPA-approved TCRA in 2007-2008). The Plainwell Mill site covers approximately 36 acres and is bordered by the Kalamazoo River to the north (to the top of the riverbank, as defined in the CD), the Plainwell central business district to the east, residential properties to the south, and commercial properties and the City of Plainwell wastewater treatment plant to the west.

Weyerhaeuser recently took ownership of the 12th Street Landfill property from Plainwell, Inc., a bankrupt entity with no ongoing business operations. The City of Plainwell is the current owner of the Plainwell Mill property, having purchased the mill site out of the Plainwell bankruptcy in 2006. The Mill property has been vacant since the former Simpson Plainwell Paper Company filed for bankruptcy in 2000. Weyerhaeuser

owned and operated the Mill for an approximate 9-year period, between 1961 and 1970. During that period, dewatered sludge from wastewater treatment operations was excavated from lagoons on the Mill property and transported for disposal at the 12th Street Landfill site.

1.4 APPLICABILITY OF THE FSP

This FSP is applicable for work performed by Weyerhaeuser under its 2005 CD with the U.S. EPA and for other specified work in areas to be determined. The FSP addresses specific projects at operable units at the Site, as well as other projects as may be specified later. The applicable operable units are as follows:

- Operable Unit No. 4 – 12th Street Landfill Site
- Operable Unit No. 5 – Kalamazoo River
- Operable Unit No. 7 – Plainwell Mill Site

The organization and specific Quality Assurance/Quality Control (QA/QC) activities associated with the various data collection activities are presented in the Multi-Area QAPP, which was submitted under separate cover.

This FSP has been developed in general accordance with the U.S. EPA's document entitled, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," dated October 1988.

1.5 SCOPE AND DESCRIPTION OF REVISION PROCESS

This FSP provides guidance for the various fieldwork activities by defining the sampling and data-gathering methods to be used. The scope of the document is outlined as follows:

- Section 1 provides the introduction, purpose, and scope of the FSP.
- Section 2 describes a summary of the sampling program, including sample locations and frequency.
- Section 3 covers the logistics of sample designation and field records.
- Section 4 summarizes the sample handling and analysis procedures to be followed. Details regarding the sample analytical procedures are discussed in the QAPP.

- Section 5 describes field physical measurements.
- Section 6 describes the management of investigation-derived waste.

As new projects are initiated, new information will be added to this Multi-Area FSP to cover the new project and additional revisions will made, as needed. A new revision number will also be assigned to the document (*e.g.*, Revision 02 will be revised to Revision 03, and so on). Specifically, the following additions/revisions will be made:

- **Summary of Sampling Program –** A subsection will be added to Section 2, to provide a summary of the sampling program. In addition, a new table will be added in Section 2 to provide a summary of the sample types and locations for the new project. The subsections and tables in the previous version of Section 2, which describe previous projects conducted under this Multi-Area FSP, will not be revised or deleted.
- **Other Text Sections –** New information will be added to other sections of the Multi-Area FSP, as necessary to cover the new activities. Information pertaining to previous projects will not be revised or deleted.
- **Standard Operating Procedures (Attachment A) –** If the previously developed SOPs, which are included in Attachment A of the Multi-Area FSP, do not cover the sampling procedures that will be utilized for the new project, new SOPs will be added to Attachment A, as necessary. The SOPs that were included for previous projects will not be deleted. SOP revisions will only be made if necessary to update standard sampling procedures or protocols, and if revised, the revision number and date (located in the upper right-hand corner) will be modified as appropriate.
- **Example Forms/Logs (Attachment B) –** If the previously developed sampling forms, which are included in Attachment B of the Multi-Area FSP, do not include forms that will be utilized for the project, new sampling forms will be added to Attachment B, as necessary.

2.0 SUMMARY OF SAMPLING PROGRAM

2.1 OVERVIEW

Environmental sampling for the various activities associated with OU-4, OU-5, and OU-7 will include sampling of various media to meet a range of information needs. These information needs will vary depending upon the specific tasks being conducted. At a minimum, this Multi-Area FSP will be used to support the following work activities:

- Operable Unit No. 4 – Emergency response activities in the former powerhouse discharge channel and RD/RA activities in connection with the 12th Street Landfill, as defined in the CD and SOW.
- Operable Unit No. 5 – Emergency response activities on portions of the riverbank along the Plainwell Mill.
- Operable Unit No. 7 – RI/FS and RD/RA activities in connection with the Plainwell Mill, as defined in the CD and SOW.
- Operable Unit No. 4 – RA Work Plan activities in connection with 12th Street Landfill, as defined in the CD and SOW.
- Operable Unit No. 7 – Phase II RI Work Plan activities in connection with Former Plainwell, Inc. Mill Property (Plainwell Mill).

The subsections below provide a summary of the sample types and locations for each project conducted under this Multi-Area FSP to date, as well as new projects being added in this revision. These projects include the following (note: as described in Subsection 1.5 of this Multi-Area FSP, the summaries of projects included in previous revisions of this document have not been revised or deleted):

- Emergency response activities in the former powerhouse discharge channel at the 12th Street Landfill (as initially described in Revision 00, June 2007).
- Emergency response activities on portions of the riverbank along the Plainwell Mill (as initially described in Revision 01, September 2007).
- Predesign investigations for the remedial design for the 12th Street Landfill (as initially described in Revision 02, April 2008).
- Phase 2 of Addendum No. 1 Plainwell Mill Investigation [Revision 03, September 2008]).
- Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment (added as described in Revision 04, November 2008).

- Remedial Action for the 12th Street Landfill (added in this version of the Multi-Area FSP [Revision 04, November 2008]).
- Phase II RI Work Plan activities at Plainwell Mill including a installation of new groundwater monitoring locations, soil sampling at various locations of the Site, and a Site-wide groundwater monitoring.
- RA Work Plan activities for 12th Street Landfill including removal of paper residuals from outside of the landfill footprint.

The subsections below also reference Standard Operating Procedures (SOPs; Attachment A), and example forms and logs (Attachment B). To date, a total of 17 SOPs have been prepared to describe applicable sampling procedures and protocols (SOPs F-1 through F-17; see Attachment A). New SOPs, forms, logs, and QAPP worksheets, which are developed as part of future work plan submittals, will be included in later revisions of this Multi-Area FSP, as described in Subsection 1.5.

2.2 OU-4: EMERGENCY RESPONSE – FORMER POWERHOUSE DISCHARGE CHANNEL SAMPLING AND MONITORING ACTIVITIES

In late February 2007, the U.S. EPA authorized a Time-Critical Removal Action (TCRA) to remove polychlorinated biphenyl (PCB)-contaminated sediment in the former Plainwell Impoundment (a section of Operable Unit No. 5 of the Allied Paper/Portage Creek/Kalamazoo River Superfund site). This work was subsequently implemented through an administrative settlement agreement and Order on Consent for Removal Action (V-W-07-C-8-63). As part of the TCRA, the earthen section of the Plainwell Dam will be removed and the Kalamazoo River will be rerouted through the former powerhouse channel. The 12th Street Landfill abuts the river and is located directly downstream of the earthen section of the Plainwell Dam. The Plainwell Mill also abuts the Kalamazoo River and PCB-containing materials have been documented along the river bank at the Mill. The change in the Kalamazoo River channel will result in an increased river gradient and higher velocities upstream and along the rerouted channel (USGS, 2004 and USDA, 2004). The modified river flow is expected to mobilize residuals currently present in the powerhouse channel downstream and to erode bank material in the area of the Mill. Thus, the TCRA scope of activities are actions or occurrences which threaten releases of waste material (as defined in the CD) from both the 12th Street Landfill and the Plainwell Mill property. Since any such release may present an immediate threat to public health or welfare of the environment,

Weyerhaeuser has been authorized to conduct several emergency response actions in conjunction with completing the required work under the CD.

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Surface water sampling and field measurements
- Surface water and flow measurement
- Water treatment system sampling
- Sediment sampling
- Soil sampling using direct push equipment

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.2.1 SAMPLE COLLECTION PROCEDURES

Water Monitoring and Field Measurements

Surface water monitoring and field measurements will be performed during the emergency action activities to meet various objectives including:

- Measurement of surface water PCB and total suspended solids (TSS) concentrations in river water.
- Measurement of potentially transported polychlorinated biphenyls (PCBs), and suspended sediments in river water.
- Monitoring of trends in surface water PCB concentrations over time.
- Monitoring of the relative effects of removal activities on turbidity and PCBs in the main river water column outside the channel during the removal actions.
- Monitoring of turbidity of infiltrating groundwater to establish discharge location.
- Evaluation of water quality associated with the water treatment system.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for surface water data collection are

provided in appendices to this document that can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Surface Water and Field Measurement Procedures (SOP F-1). This SOP will be used for the collection of a water column sample for laboratory analysis and can be applied to grab samples, vertically integrated samples, bottle sampling, or sampling using a specific device, such as an ISCO automated sampler or peristaltic pump. This SOP will be used for most samples collected from the river for PCB and TSS analysis. It can also be used for the collection of grab samples from an open channel, the end of a pipe, or from anywhere within a water treatment stream. This SOP includes the use of standard hand-held metering devices and should be used to collect field measurements of surface water quality parameters including turbidity, temperature, dissolved oxygen (DO), and conductivity.

Surface Water Flow Measurement Procedures (SOP F-2). This SOP will be used to measure flow in the river by measuring cross-sectional area and velocities across the channel at the point of measurement.

Water Treatment System Monitoring Procedures (SOP F-3). This SOP describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system, and grab samples for phosphorus at the effluent of the water treatment system.

Sediment Sampling

Sediment sampling will be performed during the OU-4 Emergency Response activities to meet various objectives, including:

- Identify the distribution and physical characteristics of sediments.
- Characterize the nature and extent of PCBs in sediments present in the Former Powerhouse Channel.
- Monitor the effects of removal activities and determine post-removal PCB concentrations in sediment.

To support these objectives, sediment samples will be collected as intact cores to provide samples at depth, or as surficial grab samples to characterize the sediment at the top of the sediment bed. Core samples will be collected using polycarbonate tubing unless

other methods are identified by the area-specific work plan or FSP addendum. Surface grab samples will be collected using sediment core methods or using a petit Ponar dredge. SOPs for sediment collection methods are provided in:

Sediment Sampling Procedures (SOP F-4). This SOP provides field procedures for the collection of sediment samples, sediment cores, and probing for bathymetric surveys.

Geotechnical Soil Sampling

The purpose of the geotechnical investigation is to determine the extent, height and width, and materials used in the berm along the Kalamazoo River so that a slope stability evaluation can be completed. The location of the berm will be used to assess potential adverse affects to the stability of the fill material that may occur as a result of cutting back existing material along the riverfront. Visual observation of the materials used in the construction of the berm will be used to approximate the physical characteristics of the material, which will be used in the stability model. Together, the location and the physical characteristics of the berm will be used to model the stability of the landfill, provide data to help assess whether or not the vegetation present along the river can be preserved, and ultimately to provide inputs to the design of a stable final slope.

Soil Sampling Procedures with Direct Push Equipment (SOP F-5). This SOP provides field procedures for the collection of soil samples utilizing a direct push sampler.

2.2.2 SAMPLE LOCATIONS

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP and this FSP. Available information by sample type is summarized in Table 2-1.

2.3 OU-5: EMERGENCY RESPONSE – PLAINWELL MILL BANKS

In a letter dated June 29, 2007, the U.S. EPA has authorized Weyerhaeuser Company, under Paragraph 67 of their 2005 Consent Decree, to take actions to prevent, abate, or

minimize a release or potential release of hazardous substances from the former Plainwell Mill banks (part of the Kalamazoo River Operable Unit [OU-5]).

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories.

- Surface water sampling and field measurements
- Surface water and flow measurement
- Water treatment system sampling
- Sediment sampling
- Surficial soil sampling

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.3.1 SAMPLE COLLECTION PROCEDURES

Water Monitoring and Field Measurements

Surface water monitoring and field measurements will be performed during the Plainwell Mill Banks Emergency Action activities to meet various objectives including:

- Measurement of surface water PCB and TSS concentrations in river water.
- Measurement of potentially transported PCBs and suspended sediments in river water.
- Monitoring of trends in surface water PCB concentrations over the duration of the construction activities.
- Monitoring of the relative effects of removal activities on turbidity and PCBs in river water column adjacent to the banks during the residual removal actions.
- Evaluation of water quality associated with the water treatment system.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for surface water data collection are provided in appendices to this document that can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Surface Water and Field Measurement Procedures (SOP F-1). This SOP will be used for the collection of a water column sample for laboratory analysis and can be applied to grab samples, vertically integrated samples, bottle sampling, or sampling using a specific device, such as an ISCO automated sampler or peristaltic pump. This SOP will be used for most samples collected from the river for PCB and TSS analysis. It can also be used for the collection of grab samples from an open channel, the end of a pipe, or from anywhere within a water treatment stream. This SOP includes the use of standard hand-held metering devices and should be used to collect field measurements of surface water quality parameters including turbidity, temperature, DO, and conductivity.

Surface Water Flow Measurement Procedures (SOP F-2). This SOP will be used to measure flow in the river by measuring cross-sectional area and velocities across the channel at the point of measurement.

Water Treatment System Monitoring Procedures (SOP F-3). This SOP describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system, and grab samples for phosphorus at the effluent of the water treatment system.

Sediment Sampling

Sediment sampling will be performed during the Plainwell Mill Banks Emergency Action activities to meet various objectives, including:

- Identify the distribution and physical characteristics of bank sediments.
- Characterize the nature and extent of PCBs in sediments present along the Plainwell Mill Banks.
- Monitor the effects of removal activities and determine post-removal PCB concentrations in near-bank sediment.

To support these objectives, sediment samples will be collected as intact cores to provide samples at depth, or as surficial grab samples to characterize the sediment at the top of the sediment bed. Core samples will be collected using polycarbonate tubing unless other methods are identified by the area-specific work plan or FSP addendum. Surface grab samples will be collected using sediment core methods or using a petite Ponar dredge. SOPs for sediment collection methods are provided in:

Sediment Sampling Procedures (SOP F-4). This SOP provides field procedures for the collection of sediment samples and cores.

Post Construction Soil Confirmation Sampling

The purpose of the post construction soil confirmation sampling is to evaluate the success of the residual removal activities in the Plainwell Mill bank along the Kalamazoo River. A geotechnical evaluation may be required in order to evaluate slope stability. The need for this evaluation will be confirmed in the field during removal activities.

Surficial Soil Sampling Procedures (SOP F-6). This SOP provides field procedures for the collection of soil confirmation samples utilizing stainless steel scoops.

2.3.2 SAMPLE LOCATIONS

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP and this FSP. Available information by sample type is summarized in Table 2-2. Additional details regarding the sampling program are included in Table 3-1 of the Design Report.

2.4 OU-4: PREDESIGN INVESTIGATIONS – REMEDIAL DESIGN FOR THE 12TH STREET LANDFILL

Operable Unit No. 4 (OU-4) of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site consists of the closed 12th Street Landfill and four areas outside the landfill where PCB-contaminated residual material has been observed. The 24-acre parcel includes the 6.5-acre landfill and approximately 17 acres of wetlands to the north/northwest of the landfill. Additional portions of OU-4 include the woodland area owned by the State of Michigan (State) under management of the Michigan Department of Natural Resources (MDNR), the asphalt plant operation adjacent to the landfill, and the former powerhouse discharge channel, which are located outside the landfill property line. Contamination in the former powerhouse discharge channel was addressed as part of Emergency Actions implemented in 2007.

The 12th Street Landfill accepted paper residuals from the former Plainwell Mill, located in Plainwell, Michigan, during the period from approximately 1955 to 1981. The landfill reportedly also accepted solid waste from the mill during part of its period of active operation. A number of investigations have been performed at the site. The investigations have confirmed the nature of the material in the landfill and have shown that paper residuals are present in certain areas outside of the landfill (i.e., in the wetlands to the north/northwest, the asphalt plant property, and the State property). Some of the residuals/native soil beyond the toe of the landfill (*i.e.*, outside the footprint of the landfill) may contain PCBs at concentrations exceeding State of Michigan or Kalamazoo River Superfund Site-specific ecological risk-based criteria.

A Record of Decision (ROD) for OU-4 was issued on September 28, 2001. The major components of the selected remedy include the following: "(1) the excavation and relocation into the landfill of contaminated residuals currently in the woodland, wetlands, and adjacent property, and the residuals in the former powerhouse discharge channel that are contiguous with the eastern side of the landfill, followed by the construction of a containment system; (2) the excavation and relocation into the landfill of the east side of the landfill along the former powerhouse discharge channel to create a buffer zone sufficient to insure no hydraulic connection between the wastes within the landfill containment system and the Kalamazoo River or the former powerhouse discharge channel; (3) the restoration of areas excavated, cleared and grubbed, or otherwise affected by the remedial action; (4) the construction of a side wall containment system around the outside of the landfill; (5) the construction of a cover (cap) over the landfill; (6) the installation of an appropriate groundwater monitoring network and the performance of long-term groundwater monitoring; (7) the performance of short-term surface water monitoring; (8) the placement of deed restrictions; (9) the construction of a fence, permanent markers, and warning signs; (10) the investigation of the need for a leachate collection system and, if deemed necessary, the construction of a leachate collection system; and (11) the implementation of long-term maintenance and post-closure care."

In January 2005, Weyerhaeuser negotiated a CD with the U.S. EPA (Civil Action No. 1:05-CV0003) for the design and implementation of certain response actions at Operable Unit No. 4 and the Plainwell Inc., Mill. Specifically, the CD requires RD and RA activities for the 12th Street Landfill and RI/FS and RD/RA activities for the former Plainwell Mill (Operable Unit No. 7). This revision of the Multi-Area FSP has been prepared in fulfillment of the requirements for a RD Work Plan for the 12th Street Landfill that are contained in the CD and the SOW.

The RD Work Plan for the 12th Street Landfill includes a number of predesign investigations, some of which involve field data collection and visual observations. Field data collection activities will include visual information obtained by the advancement of test pits, visual information obtained by the advancement of Geoprobe® borings, and gas concentration measurements (methane, carbon dioxide, and oxygen) in certain existing monitoring wells and in the Geoprobe® borings advanced as part of the predesign investigation. Pressure will also be recorded in certain existing monitoring wells.

The field investigations will involve: 1) a refined estimate of the extent of visible paper residuals beyond the landfill footprint; 2) the collection of data to support the grading design for the landfill; and 3) the collection of data for use in the design of a landfill gas management system. SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.4.1 SAMPLE COLLECTION PROCEDURES

Data for Grading Design

Additional data is required to better estimate the thickness of paper residuals along the property boundaries with 12th Street, the asphalt plant to the southwest, and with the State property to the southeast, in order to reduce uncertainties in designing the final cover grades, and to support discussions with the owners of these adjacent properties concerning access. The scope of the investigative work necessary to obtain these data is as follows:

- Advance approximately nine Geoprobe® borings into the 12th Street Landfill at select locations where fill material is believed to extend beyond the property boundary to the southwest and to the southeast. The borings will be advanced to approximately 5 feet into the native soil underlying the fill, or to refusal. Each borehole will be given a unique identification number.
- Advance a minimum of two soil borings near the southern end of the landfill to confirm the thickness of the fill in this area. Advance the borings approximately 5 feet into the native soil underlying the fill or to refusal. The locations of these

borings may be adjusted in the field as necessary to avoid underground or aboveground utility lines. Additional borings may be installed to the north of the initial borings as may be deemed useful by Weyerhaeuser, in consultation with oversight agencies as needed, for purposes of designing the landfill cover (*e.g.*, if fill material is not encountered at a location where existing data indicates fill is present).

- Prepare a Soil Boring Log (refer to Attachment B for a sample log) for each borehole based on visual observation. Classify the materials encountered based on the procedures outlined in ASTM D2488. The logs will document the borehole identification number, the drilling dates and times, names of field personnel, soil descriptions, sample depths, and recovery. Retain a representative sample of each type of material encountered (no laboratory analyses are planned). As may be appropriate, photographs of the materials encountered or other pertinent observations will be documented. Photographs will be labeled to indicate the subject, location, date, name of photographer, and project identification number.
- The on-site geologist/engineer will prepare the Soil Boring Logs in the field. The logs will be reviewed by the senior engineer in the office. A field notebook will also be maintained by the on-site geologist/engineer to document other pertinent field information. The senior engineer will review the field notebook for clarity and completeness in meeting the investigation objectives.
- Following completion of the borehole logs, abandon the boreholes by filling them with a bentonite grout.
- Dispose of the Geoprobe® samples in an area on-site that will be covered by the final cover and in a manner that will not result in erosion before the final cover is installed.
- Decontaminate the Geoprobe® equipment following completion of the work. Decontamination will be performed at a decontamination pad constructed on top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad.
- Decontamination of Geoprobe® equipment between borings is not necessary because new acrylic tubes will be used at each location to collect material for visual observation (samples are not being collected for laboratory analysis).
- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical

memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).

- Survey the locations and ground surface elevations of the boreholes following completion. The accuracy of the survey will be ± 0.01 foot for the horizontal coordinates and ± 0.1 foot for the vertical elevations. The survey locations will be added to the boring logs.

A more detailed description of field procedures for soil sampling using direct push methods (*i.e.*, Geoprobe®) is provided in SOP F-5 (Attachment A). The decontamination procedures are described above.

Landfill Gas Evaluation

Based on experience at other landfills containing similar materials, a passive gas venting system may to be necessary to prevent potential off-site migration from the landfill and to protect the integrity of the landfill cover. Thus, a detailed design for a passive gas venting system will be prepared during the design phase for the 12th Street Landfill. The design for the gas venting system may include features that support a potential future educational nature park. The passive gas venting system will also be designed such that it could be retrofitted to an active gas system if deemed necessary during the operation, monitoring, and maintenance (OM&M) period for the landfill.

To assist in the design for the passive gas venting system, the following scope of field investigations will be performed:

- As accessible, measure the concentrations of methane, carbon dioxide, and oxygen in the existing groundwater monitoring wells at the 12th Street Landfill that are screened in the vadose zone (MW-6A, MW-7A, and MW-8A), and in the Geoprobe® boreholes used to estimate the depth of the paper residuals along the property boundaries.
- As accessible, measure the gauge pressure in the existing groundwater monitoring wells at the 12th Street Landfill that are screened in the vadose zone (MW-6A, MW-7A, and MW-8A).

A passive gas venting system can be designed without the above information. If these data cannot be readily obtained, additional efforts will not be employed to collect this information.

Field procedures for soil gas collection and sampling, and pressure measurements, are provided in SOP F-7 (Attachment A).

Extent and Depth of Residuals Outside the Landfill Footprint

Wetland Area to the North of the Landfill - The approximate areal extent of visible paper residuals beyond the toe of the landfill within the wetland has been defined through previous investigations. This delineation needs to be confirmed at limited locations as part of the predesign studies. In addition, constructability issues associated with a high water table in the wetland and the degree of difficulty in distinguishing the visible paper residuals from the native soil also need to be evaluated. The scope of the investigative work recommended to provide this information is as follows:

- A backhoe will be used to excavate approximately three test pits in the wetland to the north of the landfill to confirm the approximate areal extent of visible paper residuals beyond the toe of the landfill, to evaluate potential constructability issues associated with working in the wetland, and to assess the degree of difficulty in distinguishing the visible paper residuals from the native soil.
- The test pits are anticipated to be approximately 10 to 15 feet long (perpendicular to the edge of the landfill) and approximately 2 to 4 feet wide. The test pits will be excavated to a maximum depth of 3 feet if no paper residuals are apparent, or to the bottom of visually-identifiable residuals. The depth and lateral extent of residuals in each test pit will be documented in the field by preparing a Test Pit Log (refer to Attachment B for a sample log).
- If visible residuals are observed in the end of a test pit furthest from the landfill, the test pit may be extended further away from the landfill and/or an additional test pit (or more) may be excavated nearby in order to confirm the areal extent of the visible residuals contiguous with the landfill within the wetland. If an additional test pit (or more) is needed, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.
- Equipment used to excavate the test pits will be decontaminated following completion of the work. Decontamination will be performed at a decontamination pad constructed on the top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad. Decontamination of equipment between test pits is not necessary because samples are not being collected for laboratory analysis. Clumps and loose material will be removed from the bucket of the excavating equipment using hand tools as needed to

obtain good visual characterization of the material present in the test pits. The clumps and loose material will be placed in the test pits.

- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).
- In the event that in-field conditions limit use of excavating equipment, other tools, such as hand augers or shovels, may be used instead. In such instances, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.
- In addition, Weyerhaeuser will conduct a kick-off meeting with the U.S. EPA and its field representative(s) at the outset of the predesign field investigation. During this meeting, the schedule for conducting the predesign field activities and the process for obtaining U.S. EPA approval of field modifications will be reviewed.

Asphalt Plant/State Properties - The aerial extent of visible paper residuals on the asphalt plant property to the southwest and on the State property to the southeast need to be delineated and the depth of visible paper residuals needs to be estimated more accurately in order to support discussions with the owners of these adjacent properties concerning access for future removal activities. The scope of the investigative work recommended to provide this information for the asphalt plant/State properties is as follows:

- A backhoe will be used to excavate approximately three test pits on the asphalt plant property and approximately four test pits on the State property.
- The test pits are anticipated to be approximately 10 to 15 feet long (perpendicular to the edge of the landfill) and approximately 2 to 4 feet wide. The test pits will be excavated to a maximum depth of 3 feet if no paper residuals are apparent, or to the bottom of visually-identifiable residuals. The depth and lateral extent of residuals in each test pit will be documented in the field by preparing a Test Pit Log (refer to Attachment B for a sample log).
- If visible residuals are observed in the end of a test pit furthest from the landfill, the test pit may be extended further away from the landfill and/or an additional test pit (or more) may be excavated nearby in order to confirm the areal extent of the visible

residuals contiguous with the landfill within the wetland. If an additional test pit (or more) is needed, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.

- Equipment used to excavate the test pits will be decontaminated following completion of the work. Decontamination will be performed at a decontamination pad constructed on the top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad. Decontamination of equipment between test pits is not necessary because samples are not being collected for laboratory analysis. Clumps and loose material will be removed from the bucket of the excavating equipment using hand tools as needed to obtain good visual characterization of the material present in the test pits. The clumps and loose material will be placed in the test pits.
- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).
- In the event that in-field conditions limit the use of excavating equipment, other tools, such as hand augers or shovels, may be used instead. In such instances, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.
- In addition, Weyerhaeuser will conduct a kick-off meeting with the U.S. EPA and its field representative(s) at the outset of the predesign field investigation. During this meeting, the schedule for conducting the predesign field activities and the process for obtaining U.S. EPA approval of field modifications will be reviewed.

2.4.2 SAMPLE LOCATIONS

Specific sample locations depend upon the types of samples being collected and on the field conditions. Many sample locations will be established in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized in Table 2-3. Additional details regarding the field program are included in the RD Work Plan (RMT, 2008b).

2.5 OU-7: PHASE 2 OF ADDENDUM NO. 1 PLAINWELL MILL INVESTIGATIONS

In a letter to Weyerhaeuser dated February 19, 2008, the U.S. EPA requested additional work along the former Plainwell Mill banks was requested in response to discovery of elevated concentrations of PCBs and oily soil encountered along the Plainwell Mill banks during the separate Plainwell Mill Banks Emergency Response activities. On July 15, 2008, a Draft Phase 2 Addendum No. 1 to the Plainwell Mill Remedial Investigation/Feasibility Study Work Plan was prepared and provided to U.S. EPA for review. The U.S. EPA provided technical review comments on the Draft Phase 2 Addendum No. 1 in a letter dated July 31, 2008. Subsequently, Weyerhaeuser provided response to comments and a redlined version of the Work Plan Addendum in a letter dated August 8, 2008. This Multi-Area FSP Addendum provides information to update the Multi-Area FSP sample collection and field monitoring methods and procedures for the RI/FS activities at the former Plainwell Mill property.
The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Test Pit Sampling
- Photoionization Detector (PID) sampling

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.5.1 SAMPLE COLLECTION PROCEDURES

Test Pit Investigation

Test pit investigation and sampling will be performed during the RI activities to meet various objectives including:

- To assess the validity of the preliminary site conceptual model.
- To identify the source of elevated PCBs.
- To identify the source of oil material impact soil observed during the emergency removal action activities.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for test pit sampling are provided in Attachment A of this document and can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Test Pit Sampling Procedures (SOP F-8). This SOP will be used for the development of test pits and for collection of soil samples for laboratory analysis. This SOP will be used for test pit samples collected from the Plainwell Mill. It can also be used for the collection of additional test pit samples from other Operable Units, as necessary. This SOP includes the use of standard techniques for excavating a test pit and collecting a sample from the excavated soil. Equipment decontamination procedures are also included. A separate SOP is included for the PID readings that will occur with test pit excavation.

Photoionization Detector (PID) Sampling (SOP F-9). This SOP will be used to screen soil samples in the field and establish a background for PID comparison. PID readings will be used as one of the criteria for identification of samples for additional analysis.

2.5.2 SAMPLE LOCATIONS

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized in Table 2-1. Additional details regarding the sampling program are included in Tables 6 and 7 of the Phase 2 Addendum to the RI Work Plan.

2.6 OU-7: PLAINWELL MILL RI/FS – PHASE I INITIAL GROUNDWATER ASSESSMENT

The Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment includes a collection of shallow groundwater samples to assess the possible presence of floating product and to quantify the concentrations of constituents in shallow groundwater that may have been contributed by suspected or known contamination present on site. The limited existing groundwater data, the generally permeable subsurface sands present along the Kalamazoo River, the site history, and the size and configuration of the Plainwell Mill

property make a phased groundwater investigation especially useful for focusing future data collection activities needed to meet the overall objectives of the required RI/FS.

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Groundwater Sampling
- Staff Gage Installation

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.6.1 SAMPLE COLLECTION PROCEDURES

Groundwater Assessment

Groundwater well installation and sampling will be performed during RI/FS – Phase I Groundwater Assessment activities to meet various objectives including:

- Determine direction of groundwater flow on the Plainwell Mill Site and relationship with the Kalamazoo River and Mill Race.
- Evaluate the relationship between the elevation of onsite fill and residuals materials and the groundwater table.
- Evaluate potential for groundwater impacts associated with historic site operations.
- Collect sufficient groundwater analytical data for comparison to MDEQ Part 201 Criteria.
- Evaluate groundwater analytical results and refine list of Potential Contaminants of Concern for future sample analysis.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for groundwater activities are provided in Attachment A of this document and can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Groundwater Well Sampling (SOP F-11). This SOP will be used to collect groundwater samples in the field.

Staff Gage Installation (SOP F-10). This SOP will be used for installation and reading of staff gages elevations.

2.6.2 SAMPLE LOCATIONS

Specific sample locations depend upon both the types of samples being collected and field conditions. Sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized Table 2-5. Additional details regarding the sampling program will be included in the Phase I RI/FS - Groundwater Sampling Work Plan.

2.7 OU-4: REMEDIAL ACTION FOR THE 12TH STREET LANDFILL

As described in Section 2.4, the 12th Street Landfill is composed primarily of the 6.5-acre closed landfill and the four areas outside the landfill where PCB-contaminated residual material has been observed. The landfill is situated with 17 acres of wetlands on an approximately 24-acre parcel. Additional portions of OU-4 that are located outside the landfill property include the woodland area owned by the State under the management of the MDNR, the asphalt plant operation adjacent to the landfill, and the former powerhouse discharge channel. Contamination in the former powerhouse discharge channel was addressed as part of the Emergency Actions implemented in 2007.

A ROD for OU-4 was issued on September 28, 2001 (see Section 2.4 for a description of the major components of the ROD). In January 2005, Weyerhaeuser negotiated a CD with the U.S. EPA (Civil Action No. 1:05-CV0003) for the design and implementation of certain response actions at OU-4 and the Plainwell, Inc., Mill. These actions include the RD and RA activities for the 12th Street Landfill. The addendum to the Multi-Area QAPP has been prepared in fulfillment of the requirements for the Design Report for the 12th Street Landfill, as described in the CD and the SOW.

The Design Report for the 12th Street Landfill (RMT, 2008) includes a number of data collection activities, some of which are short-term activities to be performed during

implementation of the RA and some of which are long-term activities. Short-term monitoring activities include verification soil sampling, ambient air monitoring for fugitive dust and VOCs, and surface water monitoring. Long-term monitoring activities include landfill gas monitoring and groundwater monitoring.

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration of field instruments, as appropriate.

2.7.1 SAMPLE COLLECTION PROCEDURES

Verification Soil Sampling

Upon completion of the excavation activities on the MDNR's property and the asphalt plant property to remove paper residuals, samples of the native soil underlying the excavated paper residuals will be collected and analyzed to confirm the adequacy of the excavation activities. The scope of the verification soil sampling includes the following activities:

- Collect approximately nine soil samples in the excavation on the MDNR's property and approximately 13 samples in the excavation on the asphalt plant property. The soil samples will be collected from approximately 6 inches below the surfaces of the excavation base and sidewalls, and analyzed for PCBs, and for the asphalt plant property, for VOCs. At least one sample will be collected from each sidewall of an excavation. The samples will be collected using a stainless-steel scoop, as described in SOP F-6 (see Attachment A).
- Determine the actual number of soil samples using a systematic random sampling strategy, following the MDEQ's S^{3}TM guidance (see Section 6.1.2 of the Design Report for a detailed discussion). The samples will be submitted to the laboratory for quick-turn analysis, so that the results can be reviewed and the adequacy of the excavation verified before restoring the excavated areas. As necessary, additional excavation, followed by sample collection and analysis, may be performed.
- Prepare samples collected for VOC analysis using the methanol preservation method, as described in MDEQ Procedure for Collection and Methanol Preservation Of Soil Samples for Volatile Organics May 1, 2000. (Attachment C)
- Collect QC samples, including one equipment rinsate blank and one field duplicate soil sample from each excavation (*i.e.*, one on the MDNR's property and one on the

asphalt plant property). Submit the QC samples for analysis of the same parameters as the field samples.

- Prepare a Sample Log (refer to Attachment B for a sample log form) for each sample. Describe the soil samples in the field using the Unified Soil Classification System. The logs will document the sample identification number, the sampling dates and times, the names of field personnel, soil descriptions, and sample depths. As may be appropriate, photographs of the materials encountered or other pertinent observations will be documented. Photographs will be labeled to indicate the subject, location, date, name of photographer, and project identification number.
- Perform decontamination, and manage investigation-derived waste in accordance with Sections 6.1.4 and 6.2.5.

Ambient Air Monitoring for Fugitive Dust

During implementation of the RA, preventive measures will be used to control fugitive dust, including watering frequently traveled unpaved roads and soil, and working surfaces on an as-needed basis. In addition, real-time ambient particulate measurements will be conducted. The general scope of the fugitive dust monitoring includes the following activities:

- Conduct real-time ambient particulate measurements at locations that are downwind of activities that have the potential to create fugitive dust, including the following activities: construction equipment traveling over unpaved surfaces, the unloading of soil, grading activities, cover placement, and other construction activities, as determined by visual observation and best professional judgment.
- During these activities, collect real-time ambient particulate measurements at three to four locations on the landfill property line with an MIE, Inc., Miniram monitor or equivalent, three times each day (*i.e.*, a total of 9 to 12 measurements per day). Each measurement will be taken at a different downwind location, unless elevated readings are measured at a particular location. In this case, readings may be repeated at this location during the day. If applicable, locations in which visible dust is evident will be preferentially selected for monitoring.
- The measurements will be taken in accordance with the active air sampling procedure described in SOP F-12 (see Attachment A). A total of three values will be recorded each time a location is monitored, with the average of the three values being used for comparison with the standards.

Ambient Air Monitoring for VOCs

During implementation of the RA, ambient air monitoring will be performed for VOCs. The general scope of the ambient VOC monitoring includes the following activities:

- Collect VOC measurements with a PID during work at the landfill in which paper residuals will be exposed. The measurements will be taken in accordance with SOP F-9 (see Attachment A).

Surface Water Monitoring

As part of the RA, additional riprap will be placed north of the existing riprap for added protection. During the placement of the riprap, surface water monitoring using a turbidity meter will be performed. The general scope of the surface water monitoring will include the following activities:

- Collect surface water samples at two locations, including an upstream location and a downstream location, at the following times:
  - prior to placement of any equipment or materials in a work area
  - every other hour during the installation of the riprap along the channels edge
  - whenever field conditions warrant additional samples
- Collect turbidity measurements using a hand-held turbidity meter, as described in SOP-F14 (see Attachment A).
- If the turbidity reading at the downstream location is greater than two times the result for the upstream location and exceeds 15 NTUs, work will be suspended until it can be determined what is causing the increased turbidity and the situation is rectified.

Landfill Gas Monitoring

As part of the RA, landfill gas probes will be installed and monitored on the southern side of the property, along the MDNR's property, and along the asphalt plant property. Landfill gas vents will also be installed and monitored in the landfill cover. The general scope of the landfill gas monitoring includes the following activities:

- Install six gas probes at locations spaced approximately 250 feet apart.
- Monitor the gas in the probes for combustible gas, carbon dioxide and oxygen concentrations (as a percent by volume), using a portable combustible gas meter.

Pressure will also be measured at the gas probes. The samples will be collected and analyzed in accordance with SOP F-7 (see Attachment A). The results of the gas monitoring will be evaluated in accordance with Section 3.4 of the PSVP (RMT, 2008d).

- Assess nuisance odors at the property line concurrent with the monitoring of the gas probes, If nuisance odors are detected, then contingency actions will be taken as described in Section 3.4.2 of the PSVP (RMT, 2008d).

Groundwater Monitoring

As part of the RA activities, groundwater monitoring wells will be installed and monitored on the upgradient and downgradient edges of the landfill. The general scope of the groundwater monitoring activities includes the following:

- Install a total of nine shallow groundwater monitoring wells, including two shallow monitoring wells along the upgradient edge of the landfill and seven shallow monitoring wells along the downgradient edges of the landfill. In addition, install a total of three deep groundwater monitoring wells, including one deep monitoring well on the upgradient edge of the landfill and two deep monitoring wells on the downgradient edges of the landfill. The wells will be constructed and developed in accordance with the procedures described in the groundwater monitoring plan (Section 4.4 of the PSVP [RMT, 2008]).
- For at least the first 2 years of monitoring, collect groundwater samples on a quarterly basis from the seven shallow monitoring wells along the downgradient edges of the landfill. During each round of monitoring, the groundwater samples will be analyzed for PCBs, VOCs on the Target Compound List (TCL) for organics, mercury, cyanide, magnesium, and sodium. The samples will be analyzed for additional parameters on a semiannual basis, including semivolatile organic compounds (SVOCs) on the TCL for organics, the remaining metals on the Target Analyte List (TAL) for inorganics, and dioxins. Field parameters will be measured in the groundwater monitoring wells, including groundwater levels, turbidity, temperature, pH, and conductivity. The groundwater samples will be collected in accordance with SOP F-11 (see Attachment A).
- Measure water levels in the two shallow monitoring wells along the upgradient edge of the landfill and in the three deep monitoring wells.
- Measure surface water levels at a staff gauge in the Kalamazoo River.
- Perform decontamination, and manage investigation-derived waste in accordance with Sections 6.1.3 and 6.2.3.

- After the first 2 years of groundwater monitoring, Weyerhaeuser may petition the U.S. EPA to reduce the monitoring frequency, as described in Section 4.8 of the PSVP (RMT, 2008).

2.7.2 SAMPLE LOCATIONS

Specific sample locations depend on the types of samples being collected and on the field conditions. Many sample locations will be established in the field (*i.e.*, soil samples, ambient air samples, and surface water samples), based on site-specific conditions that impact the ability to collect representative samples and the guidelines in the Design Report, QAPP, and this FSP. The locations of the groundwater monitoring wells and the landfill gas probes and vents are shown on Figure 2-1. Available information by sample type is summarized in Table 2-6.

2.8 OU-4: REMEDIAL ACTION WORK PLAN FOR THE 12TH STREET LANDFILL

The scope of the RA for the 12th Street Landfill includes excavation of paper residuals present outside the footprint of the landfill (on adjacent properties), landfill grading, the construction of a landfill cover and erosion protection measures, and surface water management, landfill gas management, construction of access road, abandonment of existing groundwater monitoring wells, installation of groundwater monitoring wells, and various environmental monitoring activities.

2.8.1 EXCAVATION ACTIVITIES

The areal limits of visible paper residuals outside the footprint of the landfill on the MDNR property, the asphalt plant property, and in the wetlands were previously delineated based on information obtained by Geraghty and Miller and the U.S. EPA in 1994 and 2003, respectively (G&M, 1994b and U.S. EPA, 2004), and have been refined based on the findings of the predesign investigation performed by Weyerhaeuser in 2008. Sufficient information is available from previous investigations to implement the excavation activities. Upon completion of the excavation activities on the MDNR property and the asphalt plant property to the visual extent of the distinguishable paper residuals, samples of the native soil underlying the excavated paper residuals at the base of the excavation will be collected and analyzed to confirm the adequacy of the

excavation activities. Collected soil samples will be analyzed for PCBs. In addition samples collected from asphalt plant property will be analyzed for VOCs.

This verification sampling will be used to demonstrate completion with the Michigan Part 201 GRCC pursuant to the MDEQ's Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria (STM; MDEQ, 2002).

2.9 OU-7: PLAINWELL MILL PHASE II RI WORK PLAN

Weyerhaeuser provided the U.S. EPA with a Phase II RI Work Plan for the Plainwell Mill on September 23, 2009. A formal notification from the U.S. EPA to proceed with implementation of the Work Plan has not been received yet.

The Phase II RI Work Plan investigation was developed to meet the following objectives:

- Perform a supplemental groundwater investigation, developed based on the results of the Phase I RI groundwater investigation and review of historical data to further evaluate the nature and extent of impacts to groundwater and their potential sources;
- Further assess shallow, site-specific hydrogeologic characteristics and interconnections with the Kalamazoo River;
- Perform soil investigations in the former wastewater sludge and dewatering lagoon and aeration basin area, the area of the mill buildings, and the north central portion of the Plainwell Mill, to adequately characterize the nature and extent of impacts to soil in the unsaturated zone that may have occurred due to historical operations; and
- Perform surface water sampling to determine the characteristics of the Kalamazoo River and Mill Race for comparison to the MDEQ criteria.

2.9.1 SAMPLE COLLECTION PROCEDURES

To facilitate the evaluation of the historical information, Plainwell Mill Site has been divided into three areas based on their locations and noted historical environmental impacts. The three areas are the former wastewater sludge dewatering lagoons and aeration basin (Area 1), mill buildings area (Area 2), and north central portion area of the Plainwell Mill Site (Area 3).

Table 2-7 provides a tabular descriptions of the sample types, sample locations, and required analysis as described in the following sections.

SOPs for the field activities are provided in Appendix A. The following summarizes the field activities proposed in the Phase II RI Work Plan and the associated SOP Section/Subsection corresponding to each activity.

Soil Sampling

Soil borings will be advanced to predetermined depths as described in Table 2-7 and in accordance with SOP F-5 provided in Appendix A.

To satisfy the needs for a comprehensive soil characterization program to fill the data gaps and confirm the historical exceedances at Plainwell Mill, three soil sampling programs have been developed based on the historical operations at the Site and available information for the purpose of proceeding with the proposed Phase II RI Work Plan sampling activities at the Plainwell Mill. These programs will be referred to during the descriptions of scope of investigatory activities at the Site.

Upon advancement of soil borings, soil cores will be examined for presence of visual and/or olfactory evidence of impact, and will be screened across their entire length using a PID to determine relative concentrations of undifferentiated volatile organic vapors. At each soil boring, soil samples will be collected on a continuous basis (i.e., 2 feet intervals) as described in SOP F-5 and Vertical Aquifer Sampling (VAS) in SOP F-17.

Test Pits

Test pits will be 5 to 10 feet in length and will be completed in accordance with the SOP F-8.

Surface Soil Samples

Surficial soil samples will be collected to determine the quality of surficial soils across the Site. Soil samples will be collected from 0 to 1 foot bgs at locations described in Table 2-7. If non-soil materials are present (i.e., gravel fill or concrete slabs) the soil sample will be collected from 0 to 1 foot below the non-soil material.

Soil Samples collected for VOCs analysis Procedures

To ensure that soil samples collected for VOCs are preserved prior to selection of samples for laboratory analysis, the following process will be completed:

- The 0 to 1 foot soil sample interval (surface sample collected as noted above) will be preserved.
- Sample intervals below the 0 to 1 foot interval will be preserved if the material is non-native and the PID reads are greater then 5 parts per million (ppm). For example, all samples of the fill material will be collected if there is field evidence of VOC impact.
- The first sample below the interface of non-native/native material will be preserved.
- The non-native material samples will not be preserved unless there is field evidence of impacts (i.e., PID, visual, olfactory, etc.).

To aid in the screening of soil quality across the Site, the following sampling programs have been selected for the completion of the RI.

Sampling Program 1:

- One surficial soil sample will be collected at the locations indicted in Table 2-7. One biased soil sample will be collected from what has been deemed fill material from a depth of 2 to 10 feet bgs based on field screening. If no impacts are noted, one soil sample will be collected from 0 to 2 feet above the interface between the fill and native material within the vadose zone.
- One soil sample from 0 to 2 feet below the observed impact will be collected. If no impact is observed the soil sample will be collected from 0 to 2 feet below the interface of the fill/ native material within the vadose zone.
- One soil sample will be collected from the vadose zone, 0 to 2 feet above the saturated zone.

Sampling Program 2:

- One surficial soil sample will be collected at the locations indicted in Table 2-7.
- If no impact noted, a discrete soil sample will be collected from 0 to 2 feet above the interface of the vadose and saturated zone. If impact noted one soil sample will be collected within 2 to 10 feet bgs and a third sample collected from 0 to 2 feet above the interface of vadose and saturated zone.

Sampling Program 3:

- One surficial soil sample will be collected.
- One soil sample will be collected from the fill material which is expected to be encountered at approximate depths of 2 to 10 feet bgs based on field screening methods. Soil borings not exhibiting any evidence of impact will be sampled at 0 to 2 feet above the interface of fill/native material within vadose zone.
- One soil sample will be collected from 0 to 2 feet below the observed contamination. If no evidence of impact is observed the soil sample will be collected from 0 to 2 feet below the interface of fill/native material within vadose zone.
- One soil sample will be collected from vadose zone at 0 to 2 feet above the saturated zone.

Soil samples will be collected at predetermined intervals based on specific data needs. The samples will be classified in accordance with the Unified Soil Classification System (USCS), and field logs will be prepared (SOP F-5).

Groundwater Monitoring Program

Monitoring well purging and groundwater sampling will be performed in accordance to SOP F-11. Groundwater samples will be collected at the locations presented in Table 2-7 and the Phase II Work Plan.

Vertical Aquifer Sampling

The VAS technique will be used to obtain samples from various depths within the aquifer to profile of the potential contaminant distribution. VAS samples will be collected as per SOP F-17.

Surface Water Sampling

Surface water samples will be collected form the Kalamazoo River and Mill Race at approximate location presented on Figure 2-3. Surface water will be collected in accordance with SOP F-16.

2.9.2 REMEDIAL INVESTIGATION ACTIVITIES

The following paragraphs provide a general scope of investigation that has been developed to determine the potential impacts associated with historical activities and provide a complete assessment of the Plainwell Mill Site. As outlined in the Phase II RI Work Plan, surface samples will collected as indicated in Table 2-7.

Inspection of On-Site Buildings

There are several buildings and structures currently present at the Site, including the mill building (Area 2), Former Quality Products and Sludge Dewatering Buildings (Area 3A), and Former Specialty Minerals Inc. Building (Area 3B). Limited information regarding historical land use and operations of these buildings are available. Therefore, additional investigations may be warranted based on initial inspections of the buildings for present of any visual or olfactory evidence of impact which will be conducted during the field activities at the Plainwell Mill Site.

Area 1: Former Wastewater Sludge Dewatering Lagoons and Aeration Basin Area

The proposed sampling and analysis plan for Area 1 is presented in Table 2-7 with proposed sample locations identified on Figure 2-2a and 2-2b. The rationale for the sampling approach for Area 1 is outlined below.

Soil Investigation

The following sampling activities will be conducted to address data gaps identified in the Phase II RI Work Plan and further details including the location of surface samples including depths of soil borings, are presented in Table 2-7:

- Investigation of the identified lagoon areas is proposed to confirm the depth and extent of potential contamination. Installation of two soil borings one at each of the assumed peripheral ends of the former lagoons is proposed. The location of the deep soil borings would be based on field identification to assess physical constraints and previous investigations. An additional soil boring within Lagoon J will be installed to confirm the depth of paper waste in this lagoon area. Soil sampling will be conducted as per Sampling Program 1;

- Confirmation of exceedances noted during historical investigations and further delineation of soil chemistry from across the lagoon area as needed to meet the objectives of the RI. Sampling will be focused on the 0 to 1 foot bgs interval to determine any direct exposure hazards to the public in relation to potential construction activities relating to the redevelopment of the Site;
- Investigation of any potential impacts associated with the aeration basin will be completed as per Sampling Program 1;
- Investigation of potential impacts in the areas adjacent to the lagoons, and aeration basin will be completed as per Sampling Program 1;
- Confirm the extent of the lagoons and, if any, impacts associated with the surrounding soils resulting from migration of contaminants toward the Kalamazoo River will be completed as per Sampling Program 1;
- Determination of potential historical morphing of the lagoon areas will be completed as per Sampling Program 1;
- Investigation of potential impacts associated with the former secondary clarifier. Sampling will be completed as per Sampling Program 1;
- Collection of soil samples as per Sampling Program 1 will occur during installation of MW-13, MW-14 and MW-15;
- Collection of soil samples as per Sampling Program 2 will be conducted in the wooded area as indicated on Table 2-7; and
- Collection of five samples to determine the soil physical properties for risk assessment purposes.

Groundwater Investigation

The following sampling activities will be conducted to address data gaps identified in the Phase II RI Work Plan:

- Installation of one monitoring well (i.e., MW-13) screened within the paper waste to determine contaminate concentrations of the waste for comparison to the Site's analytical data;
- Re-installation of SGWB-2 (i.e., MW-14) located south west of the lagoon areas to characterize groundwater flow direction through this area and provide an upgradient monitoring well location for the lagoon area;
- Installation of a monitoring well north of the former secondary clarifier (i.e., MW-15) to determine any potential groundwater impacts related to prior discharges;

- Completion of VAS at location MW-13 within Lagoon J. This area was selected to characterize the groundwater above, within and below the residual paper waste location in this former lagoon area. As indicated in historical borehole logs, residual paper waste has been noted. Further, this location will provide information related to the depth of potential confining layers within the native soil beneath the paper waste; and
- Sampling of current monitoring wells (i.e., MW-8, MW-9, MW-10, MW-11 and MW-12) and the three new monitoring wells (i.e., MW-13, MW-14, and MW-15) to determine and confirm groundwater impacts.

Area 2: Mill Buildings Area

The soil and groundwater locations in Area 2 are presented on Figure 2-3.

Soil Investigation

The following sampling activities will be conducted to address data gaps identified for this area as presented in the Phase II RI Work Plan including the location of surface samples. Further details, including depths of soil borings are presented in Table 2-7:

- Confirmation and vertical delineation of potential contamination in the area of TP-17 and TP-18 surrounding the historical transformer pad located in the north east portion of the Site adjacent to the Kalamazoo River. Sampling will be conducted as per Sampling Program 1. Collection of one surface sample from each location will be completed.
- Visual inspection of outflow points identified during previous investigations along the Kalamazoo River to ensure capping was conducted properly and no further issues pertain to these outflows. Surface sampling may be conducted if any visual evidence of impact is noted.
- Visual inspection of the surface soils surrounding the mill buildings to determine if any staining is present in relation to historical Site activities. Surface soil sampling may be conducted if necessary.
- Installation of one soil boring (i.e., MW-16) adjacent to the Mill Race to determine soil conditions adjacent to the mill buildings. Samples will be collected as per Sampling Program 1.
- Installation of one soil boring (i.e., MW-17) in the southern corner of the parking lot area adjacent to the Mill Race for visual inspection. Samples will be collected as per Sampling Program 2.

- Completion of three test pits within the undeveloped south parking lot and former background location BK5 to confirm the presence of fill below the parking lot areas and determine impacts associated with historical activities. Sampling will be conducted as per Sampling Program 2 including the collection of surface samples at each location.
- Collection of samples to determine the soil physical properties for risk assessment purposes.

Groundwater Investigation

The following sampling activities will be conducted to address data gaps identified in the Phase II RI Work Plan for this area.

- Installation of a monitoring well (i.e., MW-16) adjacent to the mill buildings near the end of the Mill Race to further define the groundwater flow patterns at this area.
- Installation of one monitoring well (i.e., MW-17) in the southeast portion of the Site to determine influences of the Mill Race on the water levels at the southern property boundary in relation to water levels at SG-1.
- VAS will occur adjacent to MW-4. This location is within the proximity of the Kalamazoo River and downgradient of the mill buildings. Historical impacts have been noted at this location; therefore, sampling will determine the depth of impact within this area and identify potential confining layers along the Kalamazoo River and capturing any residual impacts downgradient of the mill buildings.
- Collection of groundwater samples from previously installed monitoring wells (i.e., MW-1, MW-2, MW-3, MW-4, and MW-5) and the newly installed monitoring wells (i.e., MW-16 and MW-17) to confirm the groundwater chemistry at the Site.

Surface Water Investigation

Sampling within the Mill Race and the Kalamazoo River will be conducted to collect analytical data necessary for use of the applicable Part 201 GSI screening criteria (i.e., collection of hardness data). Sampling will also be conducted for low-level mercury, and methyl mercury to determine levels within the two adjacent water bodies for completion of the RI report. Further, surface water levels will be measured to further understand the hydrogeologic conditions on-Site.

Area 3: North Central Portion Area

The soil and groundwater locations in Area 3 are presented on Figure 2-4.

Soil investigation:

The following sampling activities will be conducted to address data gaps identified for this area as presented in the Phase II RI Work Plan including the location of surface samples. Further details, including depths of soil borings are presented in Table 2-7:

- Test pitting at seven locations will be carried out within the undeveloped areas to confirm the presence of fill materials beneath the parking lot areas. Sampling will be conducted as per Sampling Program 2.
- Eight Test pits (i.e., TP-308 through TP-315) will be excavated to depths of approximately 10 feet bgs to further identify the potential subsurface coal contamination within this area, to determine the locations/depths of potentially contaminated soils, and to confirm soil quality. Soil sampling will be conducted in accordance with Sampling Program 2.
- Three soil borings (i.e., SB-301, SB-302, and SB-321) will be advanced in the northern portion of the Area 3 to confirm the historical exceedances (i.e., DG3, DG4, and SGWB-10) observed at this portion of the Site. Soil sampling activities at this locations will be completed in accordance with Sampling Program 1.
- Five soil borings (i.e., SB-303 through SB-307) will be advanced at the proximity of No. 6 Fuel Tank Area to characterize potential sources of impact. Soil samples will be collected in accordance with Sampling Program 3.
- Five soil borings (i.e., SB-308 through SB-312) around the perimeter of the former Coal Storage Tunnel will be advanced to characterize potential sources of contamination around the fuel oil lines and to determine potential soil impacts at depths below the bottom of the tunnel, based on the results of the Phase I RI. Soil sampling will be conducted in accordance with Sampling Program 2.
- Soil samples will be collected during installation of MW-18 and MW-19 in accordance with Sampling Programs 1 and 2, respectively.

Groundwater Investigation

- Re-installation of SGWB-10 to confirm groundwater exceedances previously noted (i.e., MW-18).
- Installation of one monitoring well (i.e., MW-19) to replace SGWA-5 for confirmation of previous groundwater impacts noted at No. 6 Fuel Tank Area.
- Collection of groundwater samples from existing monitoring wells (i.e., MW-2, MW-6, and MW-7) and the new monitoring well (i.e., MW-18 and MW-19) as part of the proposed Site-wide groundwater monitoring program to confirm the groundwater chemistry at the Site.

3.0 SAMPLE DESIGNATION, CONTROL, AND FIELD RECORDS

3.1 SAMPLE DESIGNATION

Samples will be assigned unique identification designations and will be labeled as follow:

[sample matrix]–[job number]–[sampler's initial]–[date (dd/mm/yy)]–[sample number]
e.g., GW-56393-GC-110609-001

- Sample matrix is a letter which designates a group of samples. This will designate sample type (e.g., sediment, soil, groundwater, surface water, air, etc.), or sample source. For example, "GW" means samples of groundwater, "SW" means samples of surface water, "SO" means samples of soil, etc. Letters should be used, not numbers.
- Job number together with the sample matrix, will allow easier tracking of samples.
- Sampler's initials will allow identification of the sampler, and so allow all project personnel to contact the correct person for information regarding that sample and its collection. The use of three initials is requested. Special arrangements will need to be made if two individuals have the same initials.
- Sample date will allow monitoring of actual holding time of samples and should ensure that all sample numbers are unique, even if sample location designation is used in a system, as opposed to assigned at random.
- Sample identification designation will identify the sample, and can be any numerical or letter designation.

QA/QC samples will be assigned unique identification designations (e.g., TB-56393-GC-110609-001) and will be labeled as described above. QA/QC sampling will be conducted as outlined in the Multi-Area QAPP.

Sample matrixes are provided in Section 3.1.2. MS/MSDs and filed duplicate samples will be labeled as discussed above and will be assigned unique identification designation. Sample information including sample type (e.g., field duplicate, MS/MSDs) and sample location/depth will be documented in Site specific, serially numbered bound field notebooks and the Field Sample Key (FSK). An example of FSK is provided in Appendix B.

Assignment of sampling numbering will be determined prior to initiation of field activities.

3.1.2 SAMPLE MATRIX

The second portion of each alpha-numeric sample descriptor will be a two-letter alphabetical code that describes the sample matrix. Matrix codes for the investigation are as follows:

- "SD" for sediment
- "SW" for surface water
- "SO" for soil
- "EW" for effluent water from treatment system
- "FB" for field blanks
- "TB" for trip blanks
- "FD" for blind field duplicate samples
- "EB" for equipment blank
- "GW" for groundwater samples
- "VAS" for vertical aquifer sampling

3.2 SAMPLE CONTAINERS AND PRESERVATION

The sample containers, preservation and handling procedures will follow the standard analytical requirements as described in the QAPP and collection procedures described in the SOPs. The analytical laboratory will supply the appropriate containers for sample collection and preservation. The field personnel is responsible for proper collection, labeling, recording and preservation (*i.e.*, on ice) of samples. Sample containers will be labeled in accordance will the sample designation described in Section 3.1.

3.3 CHAIN-OF-CUSTODY PROCEDURES

The sampler is responsible for sample custody from the time of sample collection to receipt at the laboratory or until samples are shipped by commercial carrier. A sample is considered under custody if one of the following conditions apply:

- The sample is in a person's possession.
- The sample is in that person's view after being in his or her possession.
- The sample was in that person's possession and then placed in a secured location.
- The sample is in a designated secure area.

Sets of sample containers that are shipped together will be assigned a Chain-of-Custody Record, which will travel with the sample containers. A copy of the Chain-of-Custody Record with its assigned sample numbers will be kept in the laboratory to help identify samples that might become separated from the discrete sample delivery group. When shipped by a commercial carrier, custody seals will be attached to each cooler to ensure that tampering with the samples does not occur in transit, and the shipment airbill will be kept as Chain-of-Custody documentation.

3.4 PACKING

When possible, sample container preparation and packing for shipment should be completed in a well organized and clean area, free of any potential cross-contaminants. Unless weather conditions do not permit it, sample containers should never be prepared for shipment in the field office trailer due to the risk of breakage and area/personnel exposure.

Sample containers should be prepared for shipment as follows:

1. Containers should be wiped clean of all debris/water using paper towels (paper towels must be disposed of with other contaminated materials).
2. Clear, wide packing tape should be placed over the sample label for protection.

The following packing guidelines will be followed:

1. Adequate time to pack the samples will be plan in advance (and make delivery to shipper if applicable). Always more coolers and more padding is desirable rather than crowd samples.
2. Container should not be bulk packed. Each sample must be individually padded.
3. Large glass containers (1 liter and up) require much more space between containers.
4. Ice is not a packing material due to the reduction in volume when it melts.

The following is a list of standard guidelines which must be followed when packing samples for shipment:

1. When using ice for a cooling media, ice will be double bagged in zip-lock bags.

2. The packed cooler will be double checked to ensure trip and temperature blanks have been included for all shipments containing VOCs, or where otherwise specified in the QAPP or Work Plan.
3. The chain-of-custody form will be placed in a zip-lock bag.
4. Custody seals (two, minimum) are placed on each cooler. Coolers with hinged lids should have both seals placed on the opening edge of the lid. Coolers with "free" lids should have seals placed on opposite diagonal corners of the lid. Place clear tape over custody seals.
5. "Hazardous Material" stickers/markings should be removed from coolers being used which previously contained such materials.

3.5 FIELD RECORDS

This section of the FSP describes requirements and procedures for documentation of field activities. It is essential that all field documentation provide a clear, unbiased description of field activities. Examples of all of the forms mentioned in this FSP are included in Attachment B.

3.5.1 DAILY LOG

Serially numbered, bound field notebooks will be used on work assignments requiring field activities. Daily field activities will be recorded in the bound field notebooks. In addition, several sample collection notebooks will contain bound sample collection forms, including soil boring logs, monitoring well construction diagrams, monitoring well development forms, groundwater sampling summary forms, and groundwater and surface water level measurement forms. Representative forms are provided in Attachment B. The Field QA Officer will be responsible for issuing field notebooks. A record will be maintained by the OSC documenting the assignment of field notebooks. The OSC will distribute and track bound and numbered field notebooks. Transfers of field notebooks to other individuals (including subcontractors) who have been designated to document specific tasks on the project will be recorded. No field notes may be destroyed or discarded, even if they are illegible, or known to contain inaccuracies.

Entries into field notebooks will be legibly written and will provide a clear record of field activities. Entries will be made in waterproof ink and in language that is objective, factual, and free of personal opinions or terminology that might later prove unclear or

ambiguous. Errors in the field notes will be indicated by drawing a single line through the text, such that the text in error remains legible. Errors addressed in this manner will be initialed and dated by the person making the correction. The person taking notes in the field notebook will sign, number, and date each page and will document the date, time, location on site, name of field personnel present, and weather conditions observed. Specific sample collection methods will be included in the field notes.

Field personnel responsible for taking notes will log photographs in the field notebook. Locations of the photographs will be referenced to a site sketch or map. Use of measurements and readings from on-site health and safety equipment will be recorded. Observed potential hazards to health and safety will be described. The level of protection and the decontamination procedure used will be documented.

3.5.2 SOIL BORING LOGS

Soil borings completed by the field team will be documented in a Soil Boring Log. The log will document the drilling locations, drilling dates and times, names of drilling personnel and logging personnel, soil descriptions, sample depths, and recovery.

3.5.3 SOIL SAMPLE LOGS

Soil samples collected by the field team will be documented in a Soil Sample Log. The log documents the sample identifiers; soil types; sampling times, depth and location of each sample; sampling equipment used; color, odor, and appearance of the samples; sample parameters; container descriptions; sample preservatives; and names of sampling personnel.

3.5.4 WATER SAMPLE LOG

All surface water and/or groundwater samples collected by the field team will be documented in a Water Sample Log. The log will document the sample identifiers, replicate identifiers, if any; purging (groundwater) and sampling times and locations; sampling equipment; color, odor, and appearance; sample container descriptions; sample preservatives; and sampling personnel.

3.5.5 SEDIMENT SAMPLE LOG

All sediment samples collected by the field team will be documented in the Sediment Sample Log. The log will document the sample identifiers, replicates, sample times, date and location. In addition, sediment appearance, type color, odor etc, will be described. Sample containers, preservatives and sampling personnel will be recorded in the Sediment Sample Log.

3.5.6 CHAIN-OF-CUSTODY RECORD

The Chain-of-Custody (COC) Record is a multi-copy record, which documents the custody of the samples from sample collection through laboratory analysis. The record includes spaces for signatures of those receiving and relinquishing the samples. The sampler, the individual preparing the samples for shipment, and the individual receiving the samples at the laboratory normally sign the record.

The field personnel collecting the sample will fill out the COC Records. The COC process will be initiated upon sample collection. The field person who signs the record will be responsible for the samples until they are transferred to the custody of the laboratory or another custodian. Once the record has been completed, all remaining field sample identification spaces will be crossed through to prevent unauthorized addition of sample information.

The information required on the COC Record includes the complete sample identifier, date and time of sample collection; number of sample containers; analyses and methods required; container type; project number; name of sample collection personnel; complete name, address, and telephone number of the person who will receive analytical reports; turnaround time; and signatures of all sample custodians, excluding shippers. In addition, the method of shipment, and the courier's name and air bill number must be included. The back copy of the record will be retained. The original record will accompany the sample shipment to the laboratory.

3.6 PHOTOGRAPHS

As discussed in Subsection 3.4.1, photographs taken in the field will be documented in the field notebook at the time the photograph is taken. Locations of photographs will be referenced to a site sketch or map. After the film is developed or the images are

uploaded onto a computer, the photographs will be labeled with the following information:

- Project identification number
- Date
- Location
- Direction viewed in photograph
- Roll number (if applicable)
- Frame number
- Sample number (if appropriate)
- Initials of the photographer

4.0 SAMPLE HANDLING AND ANALYSIS

This section presents general sample handling and analysis protocols. Additional detailed information is contained in the QAPP.

4.1 SAMPLE CONTAINERS AND SHIPPING

A table summarizing the sample containers, preservation methods, and holding times for solid and liquid samples, which are collected under this Multi-Area FSP and intended for chemical analyses, is provided in Worksheet #19 in the Multi-Area QAPP. These sample containers, preservation methods, and holding times meet the U.S. EPA and Michigan Department of Environmental Quality (MDEQ) standards. For samples intended for VOC analysis, the sample containers will be filled completely to minimize airspace. Sample containers for other analytical group analyses will be filled to nearly full to avoid overtopping and loss of preservative (if applicable), and to meet the minimum sample volume/mass required by the laboratory (see Worksheet #19 in the Multi-Area QAPP). Soil samples intended only for physical testing (*e.g.*, grain size) will be placed in clean glass jars (minimum 8-oz. volume).

From the time the samples are collected and labeled until delivery to the laboratory, samples will be kept in a dark or otherwise lower temperature location, on ice and within a hard plastic ice chest or cooler that has a white interior. For delivery of samples to the laboratory, the following procedure will be implemented:

1. Collect and preserve the samples as outlined in the FSP and QAPP.
2. Place sample containers in a laboratory shipping container(s). Samples will be packed securely with packing material to protect sample containers from accidental breakage during shipment and to prevent leaks or spills.
3. Fill shipping container with enough ice to last the trip. Double-bag the ice to ensure sample integrity. Dry ice and/or blue ice (ice packs) will not be used.
4. Complete the Chain-of-Custody Record as described in Subsections 3.3 and 3.5.6 and in the QAPP.
5. Tape the Chain-of-Custody Record to the inside of the shipping container lid.
6. Seal shipping container with strapping tape, and place a custody seal (provided by the laboratory) on the shipping container prior to shipping.
7. Deliver or ship the container to the laboratory using an overnight shipping service.

Responsibility for proper use of containers and preservatives will be under the oversight of the OSC.

4.2 SELECTION OF PARAMETERS

The number and location of the samples to be collected and the selection of parameters to be analyzed are summarized in Tables 2-1 through 2-4 and in Worksheets Nos.17-1 through 17-6, and, 18-1 through 18-4in the Multi-Area QAPP.

4.3 ANALYTICAL PROCEDURES

The selection of analytical procedures reflect the U.S. EPA-approved methodology from the SW-846 Methods and MDEQ-approved methodology under the Michigan Part 201 Program, where applicable, as stated in the QAPP. Other methods designed to meet project-specific objectives are also defined in the QAPP. A list of the analytical procedures is provided in Worksheet #23 in the Multi-Area QAPP.

4.4 SAMPLING QUALITY ASSURANCE PROCEDURES

The sample collection procedures presented in this FSP are designed to provide samples of the required quality to meet site investigation objectives. All field personnel will be required to understand the requirements of this FSP and will be trained in the use of the specified equipment and techniques.

The CRA Field QA Officer is responsible for reviewing the day-to-day activities to ensure that the procedures in the FSP are followed. Specific activities that will be implemented by the Filed QA Officer include the following:

- Convene a meeting of field personnel at the start of a specific sampling event to review the sampling requirements of the FSP, the necessary equipment and decontamination requirements and use, and the required documentation.
- Review all documentation on a daily basis for completeness, errors, problems, and corrective actions taken.

- Convene daily project team meetings at the start of the day to discuss health and safety, to address any problems developed during the previous day's work, and to review the work to be completed that day.
- Manage the implementation of in-field corrective actions. The CRA Project Manager will be notified of significant problems and, if necessary, will work with the Field QA Officer to develop corrective actions. The Project Manager will be responsible for implementing corrective actions that need to be applied to areas other than field activities.

4.4.1 FIELD MEASUREMENTS

The equipment used for in-field measurement will be maintained, calibrated, and operated in the field in accordance with the procedures described in the select SOPs in Attachment A. Field calibration of equipment is described within the QAPP Worksheet #22. The process will be documented, and the Field QA Officer will periodically review the documentation and inspect the equipment to ensure that the procedures are followed by the personnel collecting the samples. Significant deviations from the FSP, errors, equipment failures, or other problems will be documented in a bound notebook by the Field QA Officer and reported to the CRA Project Manager. Corrective actions and additional notifications will be coordinated by the Project Manager.

4.4.2 SAMPLE COLLECTION

Personnel involved in the collection of samples are required to read, understand, and follow the procedures specified in this FSP. Problems that may affect the quality of the sampling effort will be documented by the field personnel most directly involved with the problem, and the Field QA Officer will be notified. The Field QA Officer is responsible for coordinating the development and implementation of corrective actions with the CRA Project Manager.

4.4.3 FIELD DATA REDUCTION

Raw data from field measurements and sample collection activities will be recorded in the field logs as specified in Section 3.5. With the exception of the temperature correction for specific conductance, no calculation will be required in field data

reduction. Only direct-reading instrumentation will be employed in the field. The Field QA Officer will proofread all forms and notebooks to for consistency with the planned activities and to also determine if transcription errors have been made by the field crew.

4.4.4 ANALYTICAL QUALITY ASSURANCE CONSIDERATIONS

Field Duplicates

Blind field duplicate samples, prepared by splitting a single sample into two separate containers, will be used to evaluate sampling precision. Points at which duplicate samples are to be collected will be selected by field personnel and will be submitted as blind duplicates to the laboratory. Field personnel are expected to provide a general range of expected concentrations to the laboratory for these samples to minimize impacts on laboratory equipment.

Blind field duplicates will be collected at a frequency of one sample per 10 primary samples for soil and groundwater matrices, as summarized in Worksheet No. 20 in the Multi-Area QAPP. Sample identification protocols are provided in Subsection 3.1 of this FSP.

Field Equipment Blanks

Field equipment blanks consisting of analyte-free water will be collected and submitted to the analytical laboratory to assess the quality of the data resulting from the field sampling program. Field equipment blanks are analyzed to check for procedural contamination at the site that may cause sample contamination. Field blanks will be collected following decontamination of the non-dedicated sampling equipment, including pumps and soil samplers. Field blanks will not be collected for disposable or dedicated sampling equipment, such as tubing dedicated to a specific well.

Field equipment blank frequencies are also provided in Worksheet No. 20 in the Multi-Area QAPP. In general, field equipment duplicates will be collected at the rate of one duplicate per ten primary samples for groundwater and soil matrices. The exception is the low-level mercury sampling locations, at which one equipment blank will be generated for each location sampled. Identification protocols are provided in Subsection 3.1 of this FSP.

Trip Blanks

Trip blanks will be analyzed to assess the possible cross-contamination of VOCs resulting from diffusion through septa during sample shipment. Trip blanks, consisting of 40-mL VOA vials with deionized ASTM Type 2 organic-free water, are generated in the laboratory and accompany VOC sample coolers from the laboratory to the field and back to the laboratory. Trip blank containers are not opened in the field. Trip blanks prepared by the laboratory will meet holding time requirements. One trip blank, consisting of two VOA vials, will be shipped with each cooler containing VOC sample containers. Trip blank identification protocols are provided in Subsection 3.1.

Field Blanks

Field blanks will be analyzed to assess the suitability of the container, preservative, and sample handling. The field blank is generated by pouring the solution provided in one of the sample containers into another sample container the contents of which had been emptied at the facility. One field blank will be collected per every 10 primary samples, as described in Worksheet #20 in the Multi-Area QAPP.

Field blanks identification protocols are provided in Subsection 3.1.

Matrix Spikes/Matrix Spike Duplicates (MSs/MSDs)

MS/MSD samples provide information about the effect of the sample matrix on the sample preparation and measurement methodology. MS/MSD samples will be analyzed in accordance with the laboratory operating procedures provided in the QAPP. In conjunction with other QC data, the spikes and duplicates give information on the precision and accuracy of the analytical method on the various sample matrices. One MS/MSD sample will be collected and prepared for every 20 or fewer primary samples collected during a sampling round, as described in Worksheet #20 of the Multi-Area QAPP. The MS/MSD samples will consist of triple the normal sample volume for each analytical group, provided adequate sample volume is available. Field personnel will select the sampling locations at which MS/MSD samples are collected. MS/MSD identification protocols are provided in Subsection 3.1.

4.5 FIELD AUDITS

The Project Manager/Coordinator will monitor daily field performances through daily communications with the Field QA Officer and Construction Manager. Field performance audits and field system audits will be performed as follows:

- Field performance audits will be conducted in order to confirm that the activities are being performed according to the established plans. The field performance audits will be performed by the Project Manager (or designee) at an appropriate frequency for the field activities. The audits will include a discussion of the project progress with the Project Coordinator and/or Field QA Officer and /or the review of field reports, as appropriate. The Project Manager will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the project coordinator.
- Field system audits will be performed by the QA Officer including a review of rinse and trip blank data to identify potential deficiencies in field sampling and decontamination procedures, and a comparison of the scheduled QA/QC activities described in the QAPP with the QA/QC procedures being performed on the project. Field system audits will be performed at a frequency appropriate for field activities. The QA Officer will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the Project Manager.

4.6 CORRECTIVE ACTION

Field measurement corrective action may be necessary when the sample network is modified or when sampling procedures and/or field analytical procedures require modification in response to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or deficiencies of any activity or issued document by reporting the situation to the CRA Field QA Officer or designee. The Field QA Officer will assess the suspected problems in consultation with the Project Coordinator and/or Project Manager or QA Officer or designee, and will assist in making a decision based on the potential for the situation to impact the data quality. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, the Field QA Officer will issue the nonconformance report. If appropriate, the Field QA Officer will ensure

that no additional work is dependent on the nonconforming activity is performed until the corrective actions are completed.

Details regarding laboratory data reduction, validation and reporting requirements are provided in Worksheet #14 and Worksheets #34 through #36 of the QAPP. In addition details on field and laboratory audits and corrective actions are included in Worksheets #6-1, #6-2, #6-3,#6-4, #6-5 #14, and #31-1, #31-2,#31-3, #31-4, #31-5, #32-1, #32-2, #32-3, #32-4, and #33 in the Multi-Area QAPP.

5.0 FIELD PHYSICAL MEASUREMENTS

Field measurements of topographic features, water levels, reference points, and other physical features will be required during the field investigations. The scope of such measurements depends upon the purpose for the particular measurement data.

Physical measurements will be traceable to the person making the measurement and to the specific piece of field equipment used to make that measurement. Equipment maintenance and calibration records will be kept in a bound field notebook, making all such procedures traceable. Time records will be kept using local time in the 24:00-hour military format, recorded to the nearest 5 minutes.

Sampling locations will be surveyed and depicted on existing topographic maps. Surveying will be conducted according to the standard procedures described below. Control points used during the survey will be marked in the field and noted on the topographic maps.

5.1 SURVEYING OF SAMPLING LOCATIONS

Accurate, complete, and informative surveying field notes are a primary objective in site mapping. The field notes are the most reliable record of measurements made and information gathered in the field. As stated in Subsection 3.5, information gathered will be recorded in bound notebooks. Notes will be permanent, legible, and complete.

The field notes will accomplish the following:

- Provide adequate and complete information that can be understood by someone other than the notetaker.
- Provide documentation of work completed or data gathered.

Two important aspects of each survey to be addressed in the field notes are as follows:

- *Starting and ending points of the survey* - The surveyor will explain and document the starting and ending points of the survey. This applies to both horizontal and vertical control. This will require a paragraph of explanation and sketches and/or cross-references to data in notes of previous surveys.

- *Clear indication of final results and checking procedures* - The final results and checks will be plainly indicated. Erasures will not be used, as they raise uncertainties about the reliability of the data. Alterations, additions, revisions, reductions, or comments added to field notes will be written in colored ink to indicate that such information is not part of the original field record. The person making such notations will initial and date each page so affected.

The following is a checklist of information to be included in the notebook:

- Date
- Names of survey crew members
- Weather conditions: observed temperatures, relative wind speed, and barometric pressure if an electronic distance meter (*e.g.*, a total station) is to be used
- Equipment used, listing the serial number or other identification
- Location of survey by section description or other legal parcel identification
- Project number
- North arrow
- Description of all monuments found
- Measurements (slope distance and vertical angles, temperature, taping, horizontal angles, etc.)
- Corrected distances and angles
- Description of monuments set
- Outline or sketch of major traverse or property boundary

The elevation of the measuring point of monitoring wells and a reference point on staff gauges will be surveyed to allow correlation of water levels. Additionally, ground elevations may be required for topographic purposes. Standard engineering leveling techniques, as described in basic surveying textbooks, establish the methodology for providing vertical control. The datum referenced for elevation control is the National Geodetic Vertical Datum (NGVD) of 1929, informally known as sea level datum, established by the U.S. Coast and Geodetic Survey. Benchmarks of known elevation will be used. If no benchmark is located in the vicinity of a site investigation, an arbitrary temporary benchmark will be established on a permanent location (*i.e.*, foundation or corner post). The locations of benchmarks utilized will be shown on a site sketch map. Elevation surveys will be conducted to form a circuit (*i.e.*, the survey line will be closed back to a benchmark). Third-order accuracy will be obtained on level circuits; for example, on a 1-mile circuit, the closure will be within 0.05 foot. Length of sight will not

ordinarily exceed 250 feet, with turning point back-shots and fore-shots deviating no more than 50 feet from one another.

5.2 SURFACE WATER STAGE

Surface water stage will be measured on staff gauges graduated to 0.01 foot. Staff gauges will be surveyed at the same time that monitoring wells are surveyed, and will be referenced to NGVD. Measurements of water stage will be noted in field logs with date, time, and site location. Water stage will be recorded to the nearest 0.01 foot.

6.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

6.1 PURGE WATER AND DECONTAMINATION WATER

6.1.1 OU-4 AND OU-5 EMERGENCY ACTIONS

Wastewater produced from well development and well purging and decontamination water will be temporarily stored in appropriately sized container. This water will be appropriately managed, as follows.

- All decontamination water generated during cleaning of equipment will be stored in a temporary storage tank(s) at the site.
- During operations, the water will be treated in the on-site treatment system.
- Decontamination water that is generated after the treatment system is unavailable will be characterized to identify appropriate methods of off-site treatment and/or disposal. The water samples will be analyzed for the analytes required by the treatment and/or disposal facility.

6.1.2 OU-4 PREDESIGN INVESTIGATION

Decontamination activities performed during the predesign investigation at OU-4 will be performed at a decontamination pad constructed on top of the landfill. The decontamination pad will be roughly 15 feet wide and 25 feet long and will generally consist of a flexible membrane liner (FML) placed over an area on top of the landfill that is gently sloped and bermed so that the decontamination water will flow to one location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML. The actual construction of the decontamination pad may be modified based on the selected contractor's means and methods.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).

Following completion of the predesign field activities, the decontamination pad will be dismantled and the bermed soil will be regraded to match the existing cover slope. The decontamination pad materials will be stockpiled and covered with the existing cover soil in a designated area that will not erode before the final cover is installed. These materials will be incorporated under the final landfill cover as part of the RA.

6.1.3 OU-7 – PLAINWELL MILL RI/FS – PHASE I INITIAL GROUNDWATER ASSESSMENT

Decontamination water will be collected and containerized in 55-gallon barrels that will be property labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Plainwell Mill RI/FS – Phase I Groundwater Assessment activities.

6.1.4 OU-4 REMEDIAL ACTION

Decontamination activities performed during the predesign investigation at OU-4 will be performed at a decontamination pad constructed near the site entrance of the landfill. The construction of the decontamination pad will be based on the selected contractor's means and methods, but may consist of an approximate 8-foot by 8-foot piece of HDPE flatstock with 6-inch–high sides or a roughly 15-foot–wide and 25-foot–long FML placed over an area near the site entrance that is gently sloped and bermed so that the decontamination water will flow to one location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site

disposal activities will be included in the report documenting the remedial action construction.

6.1.5 OU-4 REMEDIAL ACTION WORK PLAN

Decontamination activities performed during the excavation activities at OU-4 will be performed at a decontamination pad constructed near the site entrance of the landfill. The construction of the decontamination pad will be based on the selected contractor's means and methods, but may consist of an approximate 8-foot by 8-foot piece of HDPE flatstock with 6-inch–high sides or a roughly 15-foot–wide and 25-foot–long FML placed over an area near the site entrance that is gently sloped and bermed so that the decontamination water will flow to one location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the report documenting the remedial action construction.

If groundwater is encountered during excavation activities it will be collected and containerized in 55-gallon barrels and will be transported off-site for proper disposal as described above for decontamination water disposal.

6.1.6 OU-7 – PLAINWELL MILL PHASE II RI WORK PLAN

Decontamination activities performed during the soil investigation activities at OU-7 will be performed at a decontamination pad constructed near the Site entrance of the Plainwell Mill Site. Decontamination activities will ensure that potentially contaminated equipment will not leave the investigation Site. The construction of the decontamination pad will be based on the selected contractor's means and methods, but may consist of an approximate 8-foot by 8-foot piece of HDPE flatstock with 6-inch–high sides or a roughly 15-foot–wide and 25-foot–long FML placed over an area near the site entrance that is gently sloped and bermed so that the decontamination water will flow to one

location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the report documenting the remedial action construction.

Wastewater produced from well development and well purging and decontamination water will be temporarily stored in appropriately sized container. This water will be appropriately managed, as follows.

- All decontamination water generated during cleaning of equipment will be stored in a temporary storage tank(s) at the site;
- During operations, the water will be treated in the on-site treatment system; and
- Decontamination water that is generated after the treatment system is unavailable will be characterized to identify appropriate methods of off-site treatment and/or disposal. The water samples will be analyzed for the analytes required by the treatment and/or disposal facility.

6.2 SOIL

6.2.1 OU-4 AND OU-5 EMERGENCY ACTIONS

Excess soil and samples that are produced during the drilling operations will be temporarily staged at each drilling site and placed on a plastic liner. In the event of rain, and at the end of each work day, the pile will be covered with a plastic sheet. As drilling is completed at each work area, the temporarily staged material will be collected and placed into the sediment management areas at the top of the 12th Street Landfill, or into roll-off bins, barrels, 5-gallon buckets, or equivalent located in the primary staging area. After all drilling operations are completed, samples of the accumulated soil will be collected and characterized in accordance with landfill profile requirements. After determining the proper regulatory classification, the soil will be transported for off-site

disposal at the 12th Street Landfill site or another permitted disposal facility (if necessary).

6.2.2 OU-4 PREDESIGN INVESTIGATION

After the test pits are logged, the excavated material will be placed back into the excavation and compacted sufficiently to prevent erosion from surface water runoff. Vegetation will be reestablished through natural propagation of native species.

Soil cuttings generated during the drilling of Geoprobe® borings will either be placed in appropriately labeled containers (*e.g.*, 55-gallon barrels) or stockpiled and covered with a low-permeability material in a designated area that will not erode before the final cover is installed. These materials will be incorporated under the final landfill cover as part of the RA.

6.2.3 OU-7 – PHASE 2 OF ADDENDUM NO. 1 (TEST PITS)

The soil excavated while performing test pits will initially be placed on a tarp to minimize contact with surface soils. If test pit soils are visually stained, have a strong petroleum odor, or as measured with a PID indicate volatiles greater than 10 (PID units), excavated soils will be containerized in a small lined 5 cubic yard dumpster for landfill characterization and disposal. Three small dumpsters will be on site during the investigative activities to manage contaminated soil encountered from the area of oil impacted soil and elevated PCB area separately and one extra, for use as needed. If soils appear to be native or other non-contaminated fill materials, the soil will be placed back into the original excavation area.

6.2.4 OU-7 – PLAINWELL MILL RI/FS – PHASE I INITIAL GROUNDWATER ASSESSMENT

Excess soil and samples that are produced during the drilling operations will be temporarily stockpiled at each drilling site and placed on a plastic liner. As the drilling activities are completed in each area the temporary stockpile will be collected and placed into 55-gallon drums. After all drilling activities are complete samples of the accumulated soil will be collected and characterized in accordance with landfill profile

requirements. After determining the proper regulatory classification, the soil will be transported for off-site disposal.

6.2.5 OU-4 REMEDIAL ACTION

Excess soil and samples that are produced during the drilling operations will be temporarily stockpiled at each drilling site. As drilling is completed at each work area, the temporary stockpile will be collected and the soil may be thinly spread over areas on the landfill final cover or site access roads. The soil may also be used to backfill erosional channels on the landfill final cover or site access roads.

6.2.6 OU-4 - 12TH STREET LANDFILL REMEDIAL ACTION

Paper residuals excavated from below the water table will be temporarily stockpiled immediately adjacent to the excavation area (within the silt fencing), where the material will be allowed to dewater, (excess water can gravity-drain back into the excavation) prior to being transported to the landfill. After being transported to the landfill, if the paper residuals are still too wet to support additional fill, they may be spread in thin lifts (not exceeding 12 inches) and allowed to air-dry, mixed with mulched materials or dryer fill materials generated from the landfill grading activities, or mixed with solidification agents (e.g., Portland cement).

6.2.7 OU-7 – PLAINWELL MILL PHASE II RI WORK PLAN

Excess soil and samples that are generated during the drilling activities will be placed into 55-gallon drums. After all drilling activities are complete; samples of the accumulated soil will be collected and characterized in accordance with landfill profile requirements. After determining the proper regulatory classification, the soil will be transported for off-site disposal.

The soil excavated while performing test pits will initially be placed on a tarp to minimize contact with surface soils. If test pit soils are visually stained, have a strong petroleum odor, or as measured with a PID indicate volatiles greater than 5 (PID units), excavated soils will be containerized in a small lined 5 cubic yard dumpster for landfill characterization and disposal. Three small dumpsters will be on-Site during the investigative activities to manage contaminated soil encountered from the area of oil

impacted soil and elevated PCB area separately and one extra, for use as needed. If soils appear to be native or other non-contaminated fill materials, the soil will be placed back into the original excavation area.

6.3 USED PERSONAL PROTECTIVE EQUIPMENT AND NONCONTAMINATED REFUSE

Used personal protective equipment and other types of general noncontaminated debris or waste materials produced during the fieldwork will be collected daily in sealed plastic bags, and placed in a waste dumpster that will be brought to the site for the project. The wastes will be disposed by a local commercial waste disposal contractor at the end of the fieldwork.

7.0 REFERENCES

CRA, 2009. Multi-Area Quality Assurance Project Plan, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 03, Addendum 04. September 2009.

CRA, 2009. Phase II Remedial Investigation Work Plan, Former Plainwell, Inc., Mill Property, Plainwell, Michigan. Operable Unit No. 7 of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Version 3. September 23, 2009.

CRA, 2009. Remedial Action Work Plan for 12th Street Landfill, Otsego Township, Michigan. Operable Unit No. 4 of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 2. June 17, 2009.

RMT, Inc. 2008a. Multi-Area quality assurance project plan, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 02, Addendum 03. September 2008.

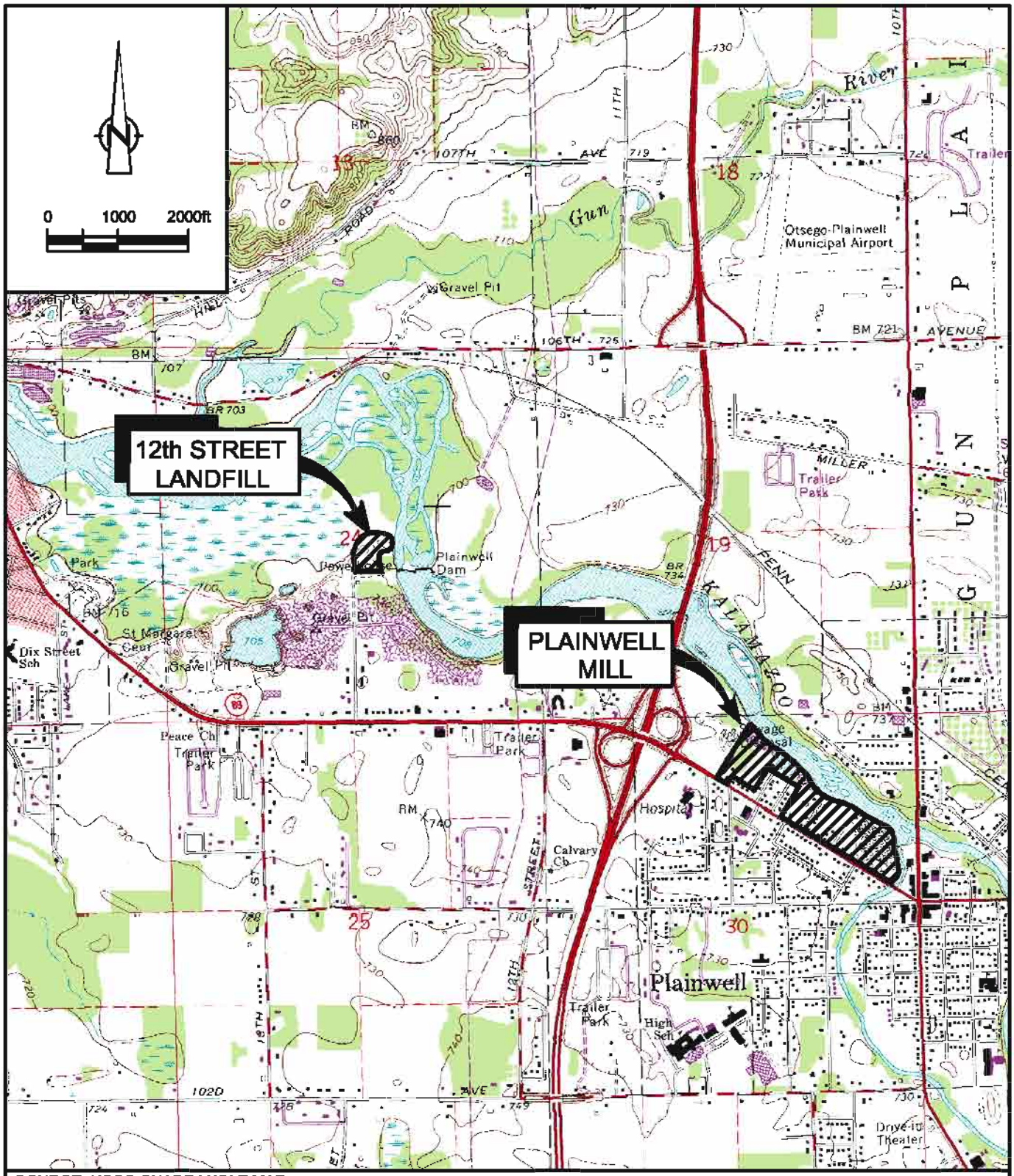
RMT, Inc. 2008b. Remedial design workplan, 12th Street Landfill, Otsego Township, Michigan. Operable Unit No. 4 of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 0. April 2008.

RMT, Inc. 2008c. Remedial design report.

RMT, Inc. 2008d. Performance standards verification plan.

USDA. 2004. Wells, R., E.J. Langendoen, and A. Simon. Numerical simulation of sediment loads and channel changes along the Kalamazoo River between Plainwell and Otsego City, Michigan. USDA-ARS National Sedimentation Laboratory Research Report. No. 44. 46 pp.

USGS. 2004. Syed, A.U., J. P. Bennett, and C.M. Rachol. A pre-dam-removal assessment of sediment transport for four dams on the Kalamazoo River between Plainwell and Allegan, Michigan. U.S. Geological Survey Scientific Investigations Report 2004-5178. 41 pp.



SOURCE: USGS QUADRANGLE MAP;
OSTEGO, MICHIGAN
1967, REVISED 1973

figure 1-1

SITE LOCATION MAP
MILTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC. MILL AND 12TH ST. LANDFILL SITES
Plainwell, Michigan

CRA

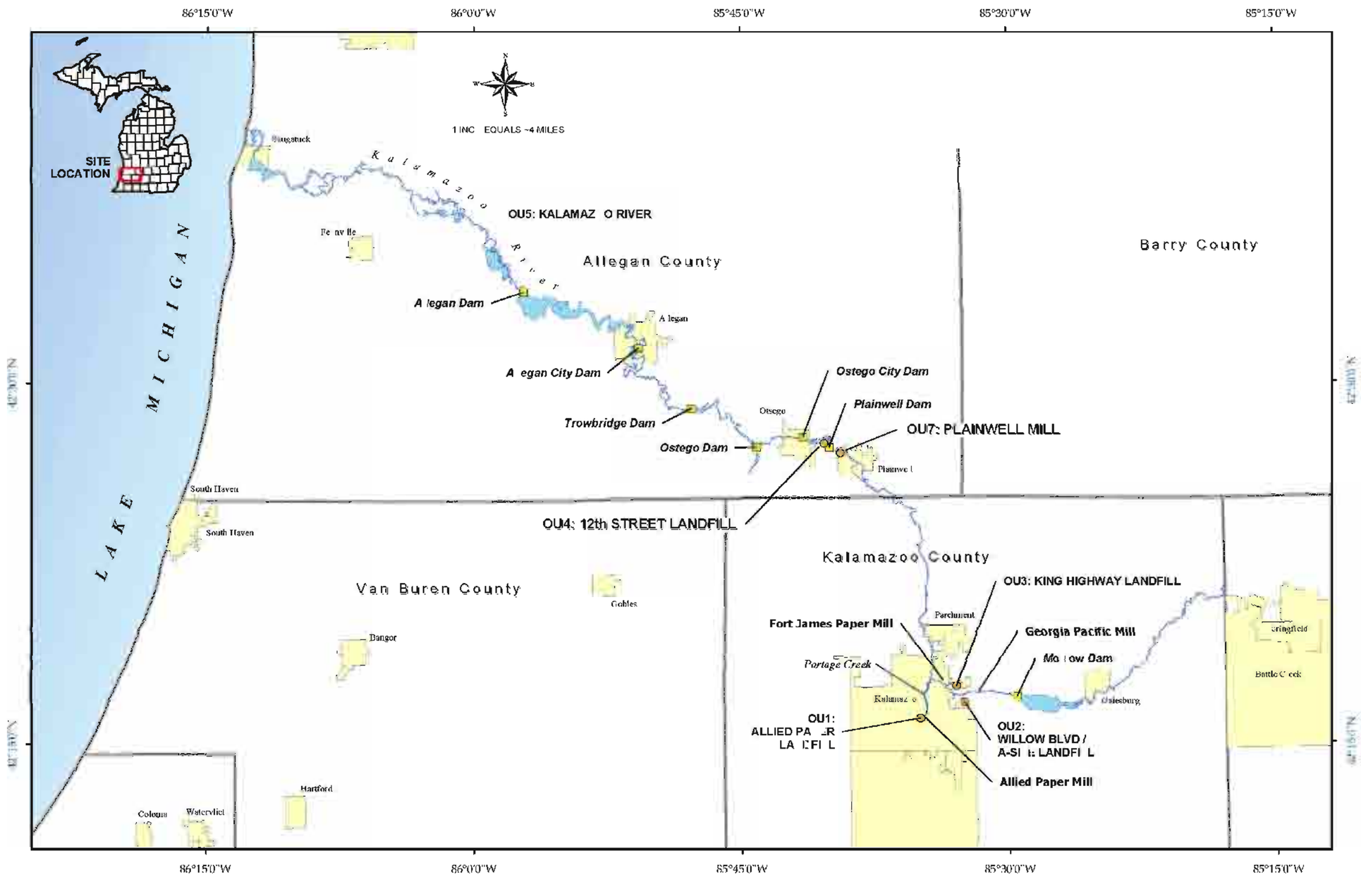
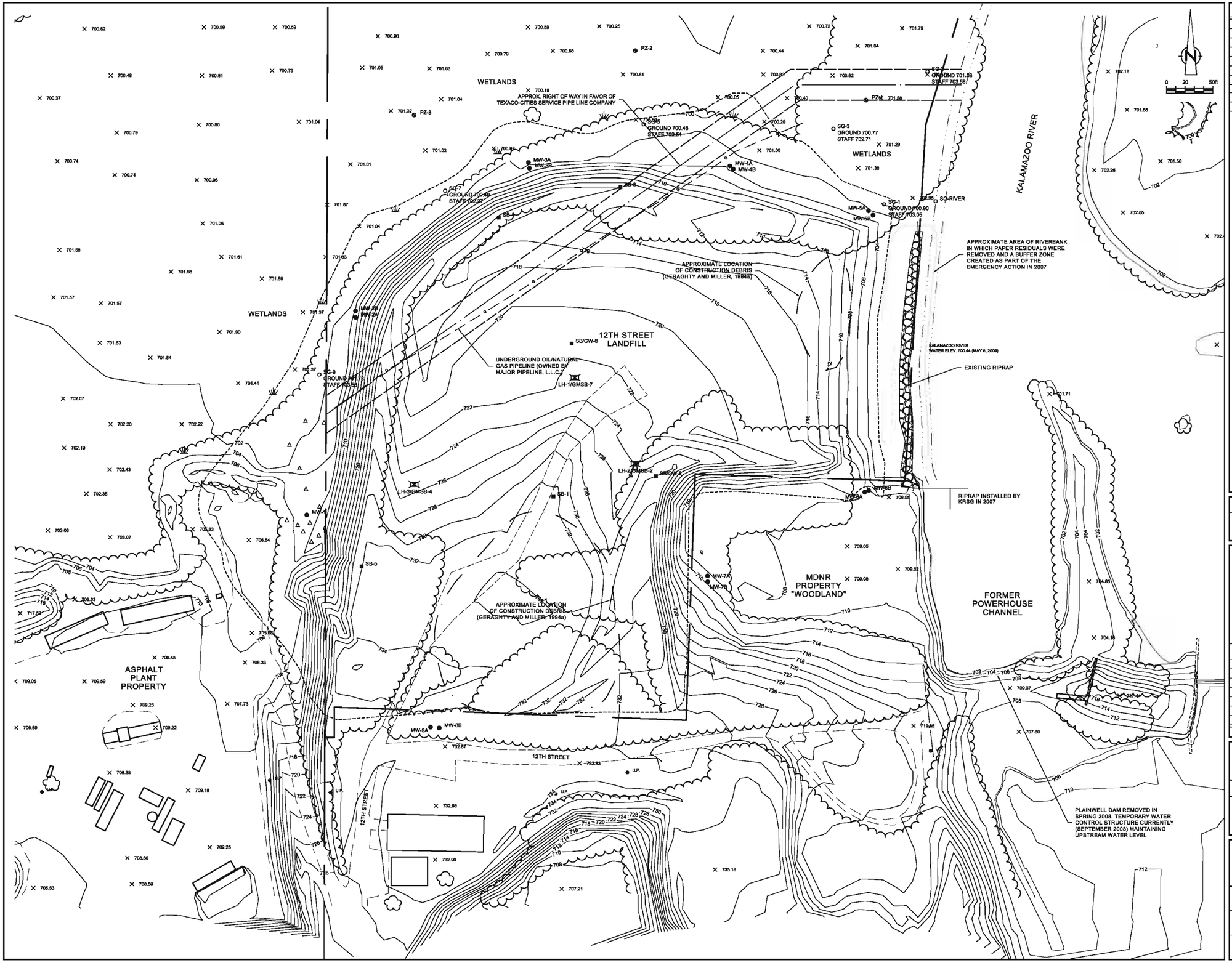


figure 1-2

KALAMAZOO RIVER SUPERFUND SITE
MULTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC. MILL AND 12TH ST. LANDFILL SITES
Plainwell, Michigan

056394-04(005)GN-SC006 SEP 23/2009



NO	Revision	Date	Initial
1	UPDATED FOR SECOND EPA SUBMISSION	JUNE 15, 2009	C.R.H.

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING GROUND CONTOUR ELEVATION
- EXISTING SPOT ELEVATION
- EXISTING TREES AND/OR BRUSH
- EXISTING WET AREA AND WETLAND
- EXISTING EDGE OF WATER
- EXISTING LIMITS OF PAPER RESIDUALS
- APPROXIMATE LIMITS OF CONSTRUCTION DEBRIS
- MW-1 EXISTING MONITORING WELL LOCATION
- PZ-2 EXISTING PIEZOMETER LOCATION
- LH-1/GMSB-7 EXISTING LEACHATE HEAD WELL LOCATION
- SG-1 EXISTING STAFF GAUGE
- EXISTING VANE SHEAR TEST LOCATION
- SB-5 EXISTING INSPEC-SOL SOIL BORING LOCATION
- SB/GW-6 EXISTING INSPEC-SOL SOIL BORING LOCATION/GAS WELL

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY COMPLETED BY PREIN & NEWHOFF ON MAY 18, 2009.
2. THE APPROXIMATE LIMITS OF VISIBLE PAPER RESIDUALS WERE DERIVED FROM THE ALLIED PAPER, INC./PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE REMEDIAL INVESTIGATION, TECHNICAL MEMORANDUM 8, (G & M 1994b) AND REVISED BASED ON THE U.S.EPA'S 2003 PREDESIGN INVESTIGATION (U.S. EPA, 2004), THE EMERGENCY ACTIONS PERFORMED ALONG THE RIVERBANK IN 2007 (RMT, 2008b), AND THE PREDESIGN INVESTIGATION CONDUCTED IN JUNE 2008 (COPIED IN APPENDIX A OF THIS REPORT).
3. THE OIL/NATURAL GAS PIPELINE IS CURRENTLY (SEPTEMBER 2008) INACTIVE. IT WAS BURIED IN NATIVE SOIL PRIOR TO DISPOSAL OF PAPER RESIDUALS IN THE LANDFILL. THIS PIPELINE IS BURIED BELOW GRADE.

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

12th STREET LANDFILL
Otsego Township, Michigan

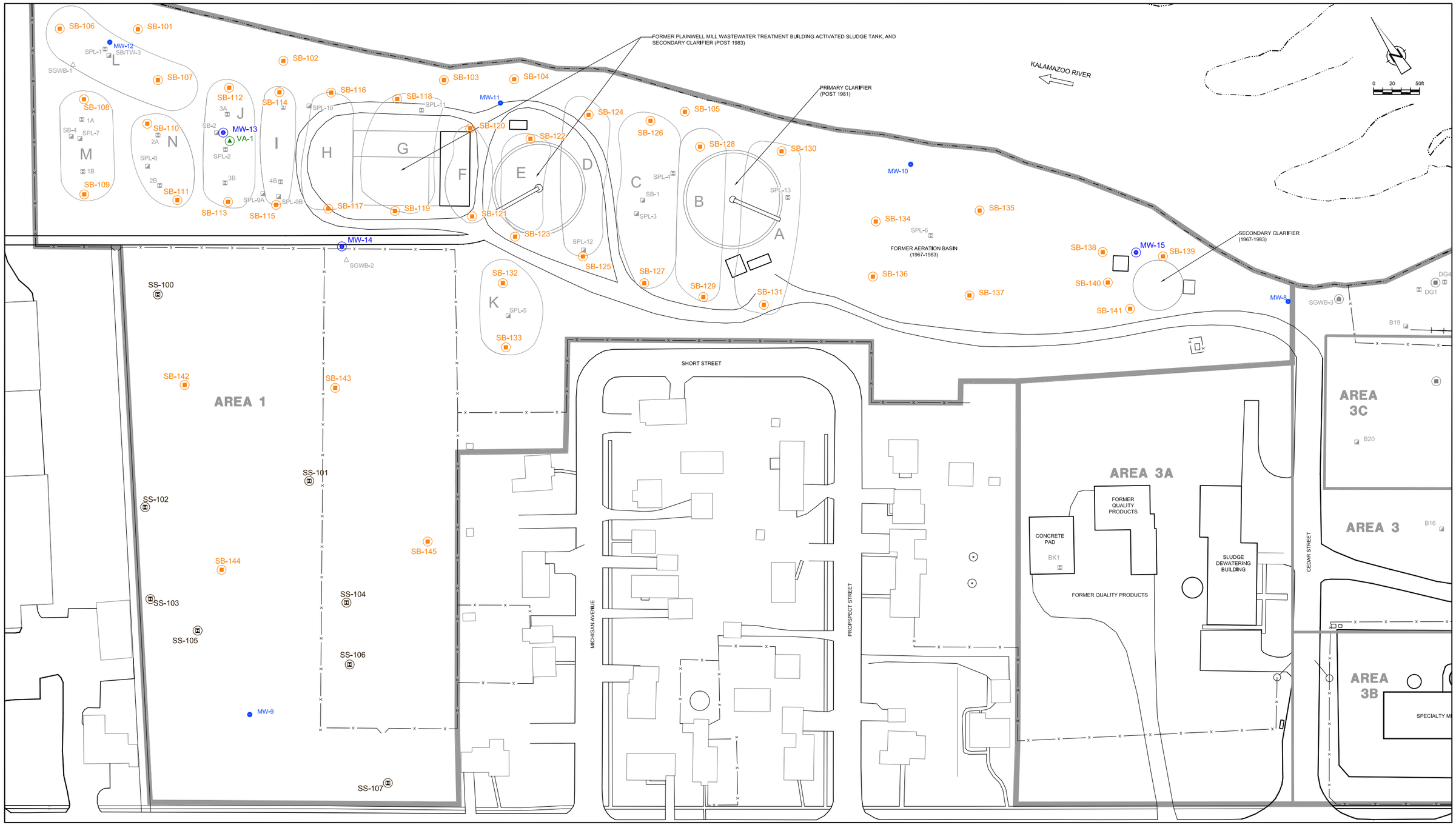
MULTI-AREA FIELD SAMPLING PLAN

ENVIRONMENTAL MONITORING PLAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
BASE ADAPTED FROM PREVIOUS RMT DESIGN

Project Manager:	Reviewed By:	Date:	
G. CARLI	G. BOLOURANI	SEPTEMBER 2009	
Scale: 1" = 50'-0"	Project No: 056394-04	Report No: 005	Drawing No: 2-1



LEGEND

- AREA BOUNDARY
- SHORELINE
- FORMER WASTEWATER SLUDGE DEWATERING LAGOONS
- FENCELINE
- VEGETATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED SURFACE SOIL SAMPLE LOCATION
- PROPOSED VERTICAL AQUIFER SAMPLING LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PREVIOUS SOIL BORING LOCATION
- EXISTING MONITORING WELL LOCATION
- PREVIOUS TEMPORARY WELL LOCATION
- PREVIOUS GROUNDWATER SAMPLE LOCATION
- PREVIOUS STAFF GAUGE LOCATION (APPROXIMATE)

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

AREA 1 PROPOSED PHASE II SAMPLE LOCATIONS

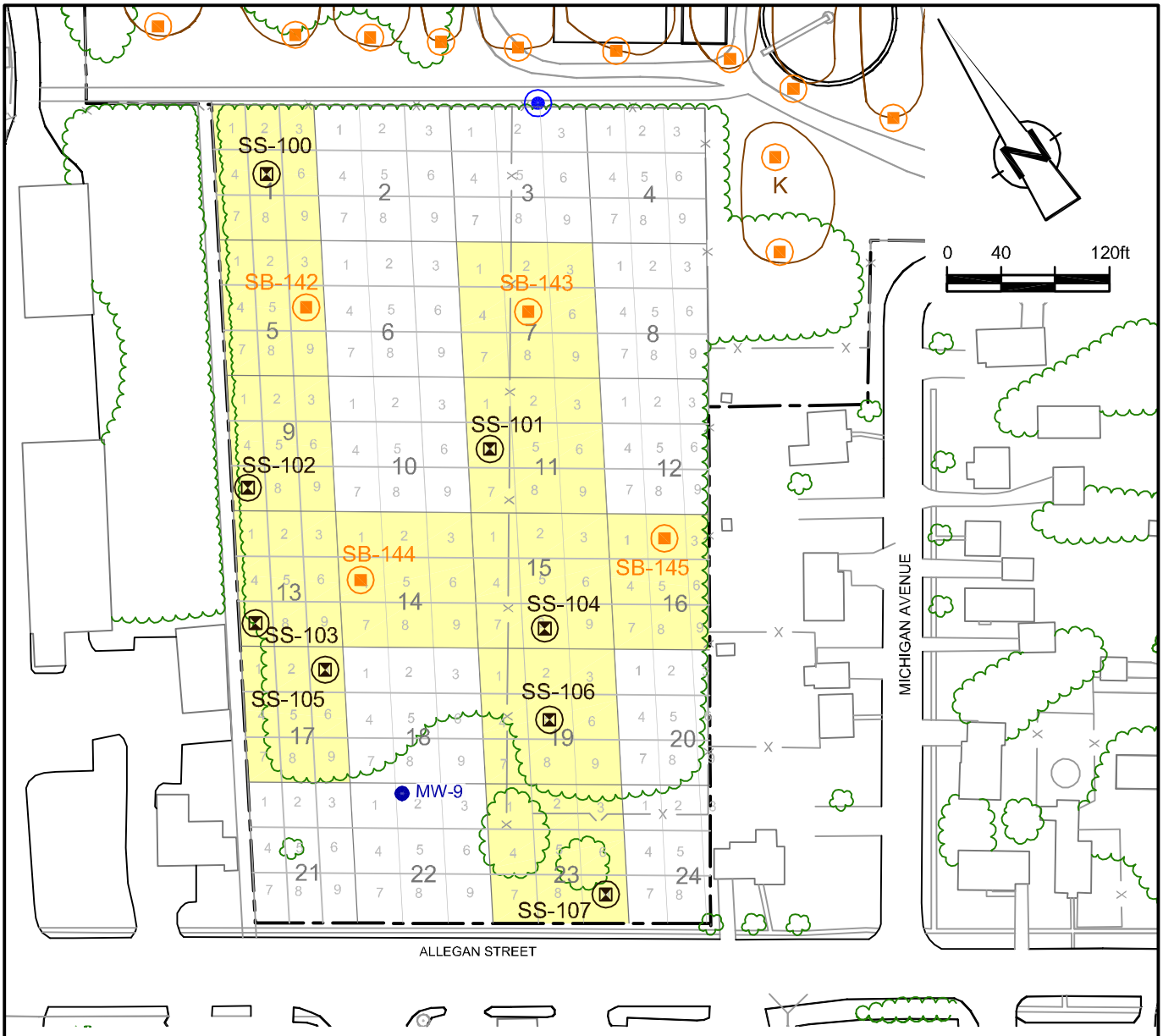
MULTI-AREA FIELD SAMPLING PLAN

FORMER PLAINWELL, INC MILL PROPERTY
PLAINWELL, MICHIGAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date:
RMT PROJ. 00-05121.03			NOVEMBER 2009
Project Manager: G. CARLI	Reviewed By: G. BOLOURANI	Designed By:	Drawn By: C. JACOBI
Scale: 1:100	Project No: 056394-04	Report No: 005	Drawing No: FIGURE 2-2a

056394-04(005)GN-SC009 NOV 18/2009



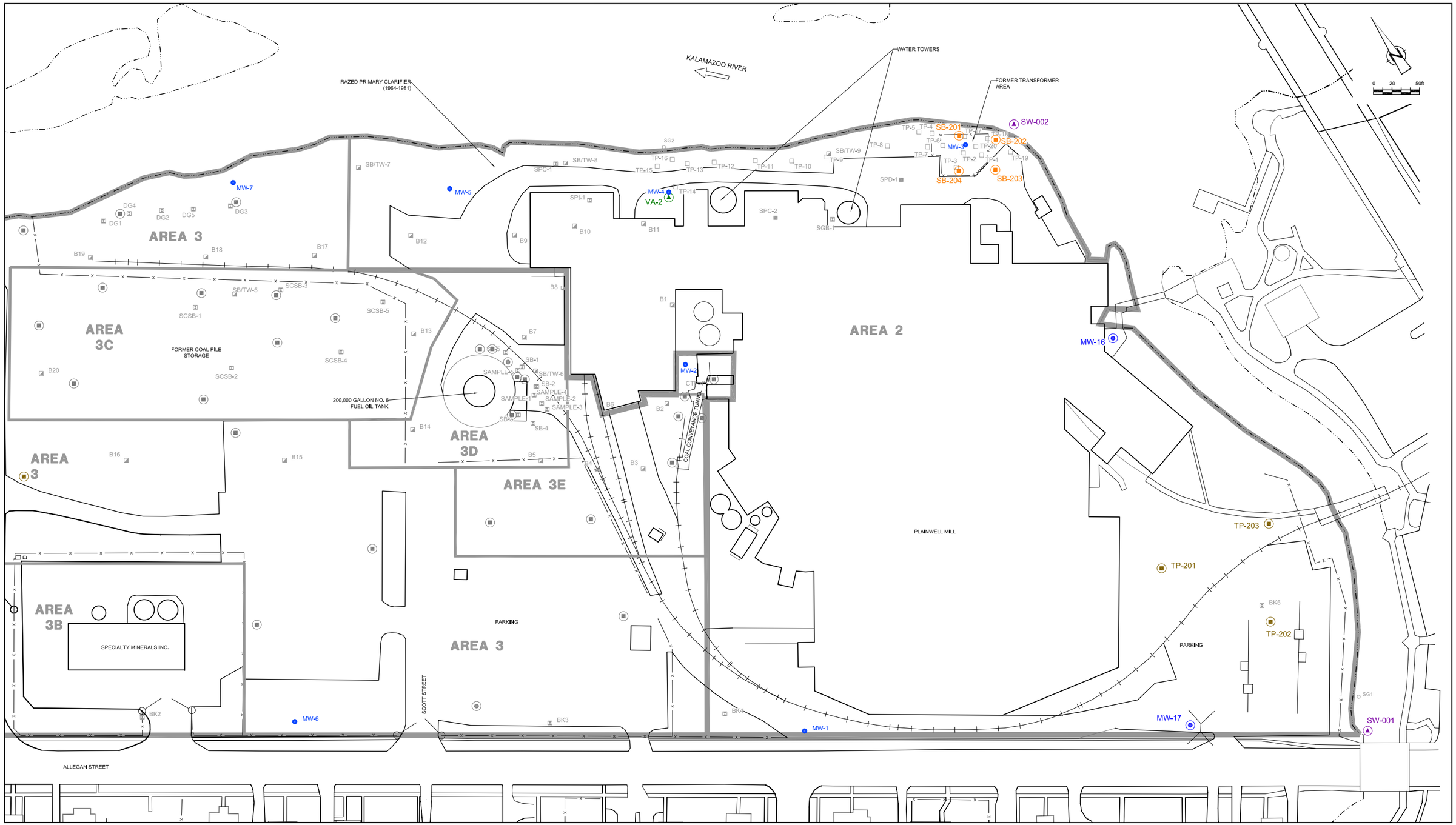
LEGEND

- PROPERTY BOUNDARY
- FORMER WASTEWATER SLUDGE DEWATERING LAGOONS
- FENCELINE
- VEGETATION
- MW-9 — EXISTING MONITORING WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED SURFACE SOIL SAMPLE LOCATION

figure 2-2b

AREA 1 - WOODED AREA PROPOSED SAMPLE LOCATIONS
MULTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC MILL PROPERTY

Plainwell, Michigan



LEGEND

- AREA BOUNDARY
- SHORELINE
- RAILWAY
- FENCELINE
- VEGETATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED TEST PIT LOCATION
- PROPOSED SURFACE WATER SAMPLE LOCATION
- PROPOSED VERTICAL AQUIFER SAMPLING LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PREVIOUS SOIL BORING LOCATION
- PREVIOUS TEST PIT
- PREVIOUS SEDIMENT SAMPLE LOCATION
- EXISTING GROUNDWATER MONITORING WELL LOCATION
- PREVIOUS GROUNDWATER SAMPLE LOCATION
- PREVIOUS STAFF GAUGE LOCATION (APPROXIMATE)

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

AREA 2 PROPOSED PHASE II SAMPLE LOCATIONS

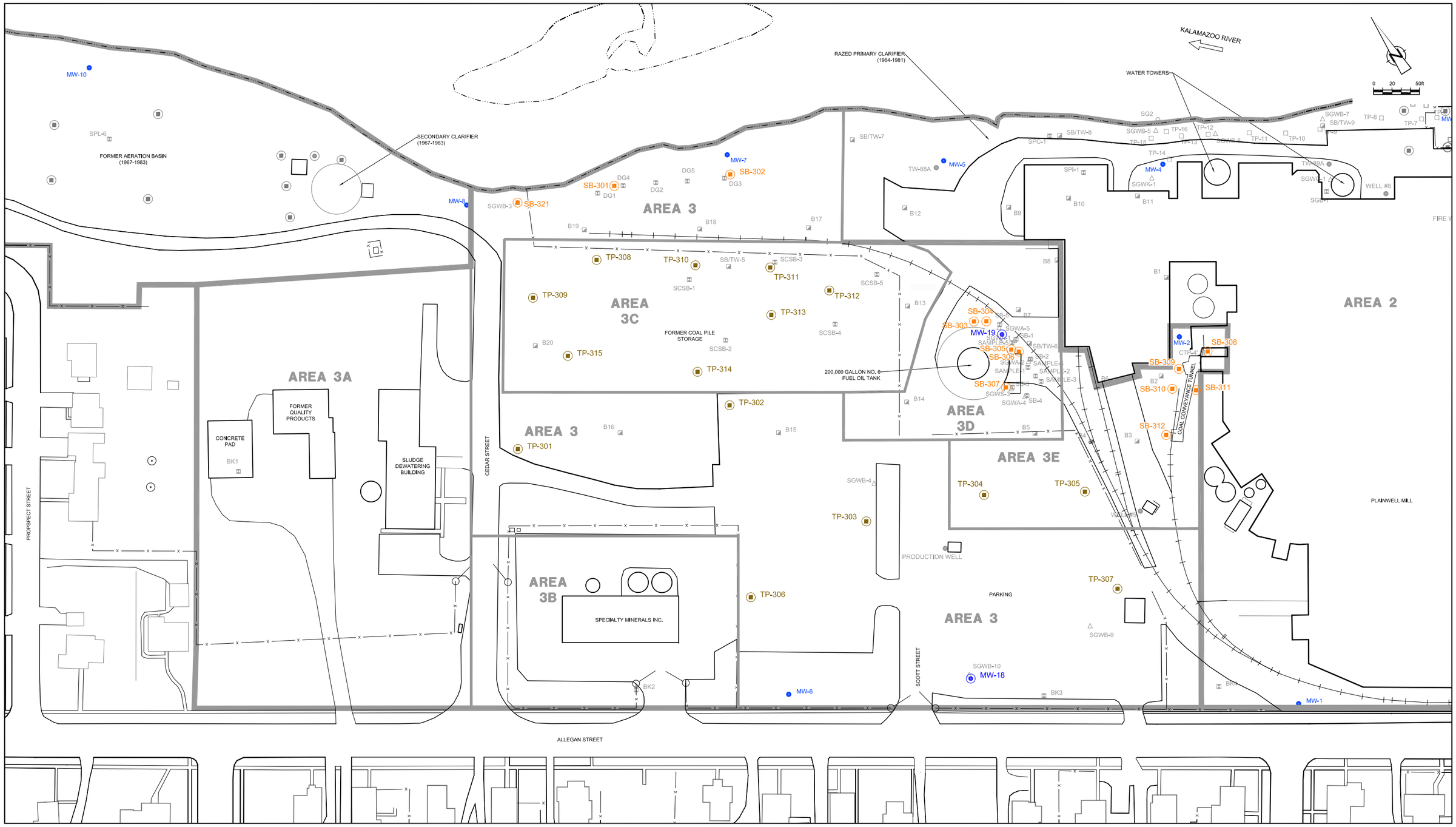
MULTI-AREA FIELD SAMPLING PLAN

FORMER PLAINWELL, INC MILL PROPERTY
PLAINWELL, MICHIGAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date:
RMT PROJ. 00-05121.03			NOVEMBER 2009
Project Manager: G. CARLI	Reviewed By: G. BOLOURANI	Designed By:	Drawn By: C. JACOBI
Scale: 1:100	Project No: 056394-04	Report No: 005	Drawing No: FIGURE 2-3

056394-04(005)GN-SC007 NOV 18/2009



LEGEND

- AREA BOUNDARY
- SHORELINE
- RAILWAY
- FENCELINE
- VEGETATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED TEST PIT LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PREVIOUS SOIL BORING LOCATION
- PREVIOUS TEST PIT
- PREVIOUS SEDIMENT SAMPLE LOCATION
- EXISTING GROUNDWATER MONITORING WELL LOCATION
- PREVIOUS GROUNDWATER SAMPLE LOCATION
- PREVIOUS STAFF GAUGE LOCATION (APPROXIMATE)

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

AREA 3 PROPOSED PHASE II SAMPLE LOCATIONS

MULTI-AREA FIELD SAMPLING PLAN

FORMER PLAINWELL, INC MILL PROPERTY
PLAINWELL, MICHIGAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date:
RMT PROJ. 00-05121.03			NOVEMBER 2009
Project Manager: G. CARLI	Reviewed By: G. BOLOURANI	Designed By:	Drawn By: C. JACOBI
Scale: 1:100	Project No: 056394-04	Report No: 005	Drawing No: FIGURE 2-4

056394-04(005)GN-SC010 NOV 18/2009

Table 2-1
Summary of Sample Types and Locations (Former Powerhouse Discharge Channel)

Type of Sample	Assumed Location	Purpose
Surface Water Quality	Immediately upstream or near the Plainwell Spillway. Mid depth in the water column.	Establish background conditions for turbidity comparisons.
	Approximately 200 and 300 feet downstream of the former powerhouse discharge channel. Sample within the channel may be collected from pier or boat depending upon flow conditions. Mid-depth in the water column.	Establish water quality during removal activities.
	Groundwater collection sump (or equivalent) within isolated removal area (discharge water).	Measure turbidity for comparison to background conditions and determination of discharge location.
Surface Water Flow Measurements	To be determined if needed.	To be determined if needed.
Water Treatment System Monitoring	Effluent sampling from Portable Treatment unit.	To confirm treatment system effectiveness.
Sediment Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of sediment.	Document PCB sediment concentrations after removal is complete.
Geoprobe Soil Sampling	Predesign sample collection at transects along the edge of the landfill closest to the former powerhouse discharge channel.	Determine possible existence of former berm at edge of landfill and assess collected soil samples for implications on slope stability.

Table 2-2
Summary of Sample Types and Locations
(Plainwell Mill Banks)

Type of Sample	Assumed Location	Purpose
Surface Water Quality	Immediately upstream or near the Plainwell Mill banks. Mid depth in the water column.	Establish background conditions for turbidity comparisons. Turbidity will be measured hourly.
	Approximately 200 and 300 feet downstream of the Plainwell Mill banks. Sample within the channel may be collected from pier or boat depending upon flow conditions. Mid-depth in the water column.	Establish water quality during removal activities. Turbidity will be measured hourly
Surface Water Flow Measurements	To be determined if needed.	To be determined if needed.
Water Treatment System Monitoring	Effluent sampling from Portable Treatment unit.	To confirm treatment system effectiveness.
Sediment Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of sediment.	Document PCB sediment concentrations after removal is complete.
Soil Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of soil.	Document PCB soil concentrations after removal is complete.

Table 2-3
Summary of Sample Types and Locations
(Predesign Investigations for the Remedial Design for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Test Pits (visual)(1)	***Wetland Area to the North of the Landfill*** - Advance approximately 3 test pits to confirm the approximate areal extent of visible paper residuals beyond the toe of the landfill. ***Asphalt plant/State Properties*** - Advance approximately 3 test pits within the asphalt plant property and approximately 4 test pits within the State property to delineate the areal extent and the depth of visible paper residuals.	***Wetland Area to the North of the Landfill*** - Evaluate potential constructibility issues in the wetland, and to assess the degree of difficulty in distinguishing the visible paper residuals from the native soil. ***Asphalt plant/State Properties*** - Support discussions with the owners of these adjacent properties concerning access for implementation of the Remedial Action.
Geoprobe® Borings (visual)	Advance approximately 9 Geoprobe® borings into the 12th Street Landfill at select locations where fill material is believed to extend beyond the property boundary to the southwest and to the southeast and a minimum of 2 Geoprobe® borings near the southern end of the landfill. The borings will be advanced to approximately 5 feet into the native soil underlying the fill, or to refusal.	Better estimate the depth of the paper residuals along the property boundaries with 12th Street, the asphalt plant to the southwest, and with the State property to the southeast, in order to reduce uncertainties in designing the final landfill grades.
Gas Monitoring	Measure gas concentrations (methane, oxygen, and carbon dioxide) and pressures at the existing groundwater monitoring wells screened in the vadose zone (MW-6A, MW-7A, and MW-8A). In addition, measure gas concentrations at each Geoprobe® boring used to better estimate the depth of the paper residuals along the property boundaries to the southwest and to the southeast.	To collect readily accessible information about the subsurface landfill gas conditions at the 12th Street Landfill that may be useful in designing a passive gas venting system.

Note:
(1) In the event that in-field conditions limit the use of test pit excavating equipment (*e.g.*, a backhoe), other tools, such as hand augers or shovels, may be used instead.

Table 2-4
Summary of Test Pit Sample Types and Locations

Type of Sample	Assumed Location/ Estimated Sample Number	Purpose
Test Pit Samples	Oil Impacted Soil Area – Estimated 10 test pits	Test pits will be used to identify the source of the oil impacted soil as well as the extent of area impacted. Test Pits will also be used to inspect the area in the vicinity of the oil impacted soil. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons.
	Elevated PCB Area – Estimated 5 test pits along the bank of the Kalamazoo River	Test pits will be used to evaluate whether the two areas of concern are related and whether NAPL, if present is the cause of the high PCB concentrations observed and if there is potential for NAPL to enter the river. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons.

Table 2-5
Summary of Groundwater Sample Types and Locations

Type of Sample	Assumed Location/ Estimated Sample Number	Purpose
Groundwater Samples	Mill Buildings Area – Install five groundwater wells and two staff gages. Northcentral Portion of the Site – Install three groundwater wells. Former Wastewater Sludge Dewatering Lagoons – Install four groundwater wells and one staff gage.	Groundwater well samples will provide additional information on groundwater quality for comparison to applicable ARARs and completion of the risk assessment. In addition, groundwater wells will provide key information regarding the interface between the groundwater system and the river system and the direction of the groundwater gradient at the site.
Staff Gage	Three staff gages will be placed along the bank of the Plainwell Mill. The first will be placed at the upstream end of the Mill Race. The second gage will located near the mill buildings in the Kalamazoo River and the third downstream near the wastewater sludge dewatering lagoons.	Staff gages will be used in conjunction with the groundwater wells to determine the groundwater flow direction onsite. In addition, the slope of the river along the bank of the Plainwell Mill.

Table 2-6
Summary of Sample Types and Locations
(Remedial Action for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Verification Soil Sampling[(1)]	***MDNR's Property*** – Collect approximately nine soil samples at the base and sidewalls of the excavation, and analyze the samples for PCBs. ***Asphalt Plant Property*** – Collect approximately 13 soil samples at the base and sidewalls of the excavation, and analyze the samples for PCBs and VOCs.	To demonstrate compliance with the lowest of the Part 201 GRCC in *Table 2. Soil: Residential and Commercial I*, of the MDEQ's Remediation and Redevelopment Division's Operational Memorandum No. 1 (January 23, 2006). For PCBs, the applicable criterion is 4 mg/kg, which is the criterion for direct contact.
Ambient Air Monitoring for Fugitive Dust	Collect real-time ambient particulate measurements at locations that are downwind of activities that have the potential to create fugitive dust. Collect samples at three to four locations on the landfill property line, three times each day during such activities (i.e., a total of 9 to 12 measurements per day).	To demonstrate compliance with the administrative rules promulgated pursuant to Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act (NREPA).
Ambient Air Monitoring for VOCs	Collect VOC measurements with a photoionization detector (PID) during work at the landfill in which paper residuals will be exposed, at background locations, in the workers' breathing zone, and if necessary, at the downwind property line.	To determine if ambient VOC concentrations are at acceptable levels for compliance with the site health and safety plan.
Surface Water Monitoring	Record surface water turbidity concentrations at two locations, including an upstream location and a downstream location, during the placement of additional riprap along the riverbank.	To determine if the turbidity reading at the downstream location is within two times the result for the upstream location.
Landfill Gas Monitoring	Collect gas samples from six gas probes and 20 gas vents, and determine combustible gas, carbon dioxide, and oxygen concentrations. Pressure will also be recorded at the gas probes.	To demonstrate that combustible gas and other decomposition gases generated by the landfill are not traveling laterally from the landfill or accumulating within structures, and to demonstrate that the concentration of combustible gas is below the Lower Explosive Limit (LEL) at the property line.
	Assess nuisance odors at the property line.	To demonstrate that nuisance odors are not present at the property line.

Table 2-6 (continued)
Summary of Sample Types and Locations
(Remedial Action for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Groundwater Monitoring[2]	Collect groundwater samples from a total of seven shallow groundwater monitoring wells. Measure field parameters, including turbidity, temperature, pH, and conductivity.	To demonstrate compliance with the State of Michigan Part 201 groundwater–surface water interface (GSI) criteria (MDEQ, 2006), for those analytes specified in the ROD (Target Analyte List [TAL] inorganics, Target Compound List [TCL] organics, PCBs, and dioxins).

Note:
(1) The actual number of soil samples will be determined using a systematic random sampling strategy, following the MDEQ's S^{3}TM guidance (see Section 6.1.2 of the Design Report [RMT, 2008] for a detailed discussion).
(2) See the groundwater monitoring plan in the Performance Standards Verification Plan (RMT, 2008) and Section 8.1 in the Design Report (RMT, 2008) for a detailed discussion of parameters, locations, and sampling frequency.

TABLE 2.7
SUMMARY OF PROPOSED SAMPLING ACTIVITIES
MULTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC. MILL PROPERTY
PLAINWELL, MICHIGAN

ACTIVITY/ LOCATION	PROPOSED ASSESSMENT LOCATION			RATIONALE FOR LOCATION SELECTION	SAMPLE/DATA COLLECTION DETAILS	SAMPLE MATRIX	FIELD SCREENING	LABORATORY PARAMETERS	SAMPLE LOCATIONS	INVESTIGATIVE SAMPLES	QUALITY CONTROL SAMPLES			TOTAL NUMBER OF SAMPLES
	DESIGNATION	TYPE	DEPTH (FT BGS)								TRIP BLANKS	FIELD DUPLICATES	MS/MSDS	
Soil Sampling														
Lagoon A through N	SB-106 through SB-133	Soil Boring	20	Confirmation and determination of paper waste	- Collection of surface soil samples - Sampling Program 1 [5]	Soil	Visual and Olfactory Evidence of Impact and PID Screening	TCL VOCs TCL SVOCs TAL Metals SPLP Metals [1] PCBs General Chemistry [2]	28	112	--	12	6	130
Lagoon J (SB-2)	MW-13	Monitoring Well Vertical Aquifer Testing	20 (MW)	Determine the groundwater chemistry at the depth of the residual waste buried within the former lagoon area.					1	4	--	--	--	4
SGWB-2	MW-14	Monitoring Well	20	To determine background groundwater chemistry south of the lagoons					1	4	--	1	1	6
Former Secondary Clarifier	MW-15	Monitoring Well	20	To determine groundwater impacts associated with historical operations					1	4	--	--	--	4
Former Secondary Clarifier	SB-138 SB-139 SB-140 SB-141	Soil Boring	20	To determine extent of impact surrounding the former secondary clarifier					4	16	--	2	1	19
Aeration Basin	SB-137	Soil Boring	20	To determine extent of impact surrounding the aeration basin					1	4	--	--	--	4
Areas adjacent to the lagoons and Aeration Basin	SB-134 SB-135 SB-136	Soil Boring	20	To define historical morphing of the sizes of the lagoons and the aeration basin					3	12	--	1	--	13
North of Lagoon Area	SB-101 SB-102 SB-103 SB-104 SB-105	Soil Boring	20	To determine extent of potential paper waste north of the lagoon area adjacent to the Kalamazoo River					5	20	--	2	1	23
Wooded Area	SB-142 to SB-145 SS-100 to SS-107	Soil Boring/ Hand Auger	20	To confirm no impacts associated with historical operations within this area. Location of samples will be dependant based on inspection of the area.	- Collection of one surficial soil sample at all locations (SS and SB) -Sampling Program 2 [6] at proposed soil boring (SB) locations				12	20	--	2	1	23
Soil Physical Properties	SB-134 SB-135 SB-136 SB-137	Soil Boring/ Hand Auger	5	Collection of samples to determine the potential for vapor intrusion through native soil materials within the unsaturated zone	- Collection of one sample from what is field screened as native material within the vadose zone			Soil Physical Properties [3]	5	5	NA	NA	NA	5
								Soil Sampling Total	*61*	*201*	*0*	*20*	*10*	*231*
Groundwater Sampling														
MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15	--	Groundwater Sample	--	To confirm on-Site groundwater quality	- Completion of a monitoring well inspection - Collection of groundwater levels and surface water levels (at associated staff gauges) - Collection of one groundwater sample per location	Groundwater	pH, Conductivity, Temperature, Dissolved Oxygen, ORP, Turbidity	TCL VOCs TCL SVOCs PCBs TAL Inorganics [4]	8	8	3	1	1	13
MW-13	VA-1	Vertical Aquifer Sampling - Groundwater Samples	40	Complete vertical aquifer testing to determine groundwater conditions below the confining unit	- Collection of groundwater samples every 5 feet until the confining layer is reached or 40 feet bgs			TCL VOCs TCL SVOCs TAL Metals (filtered and unfiltered)	1	8	2	1	--	11
								Groundwater Sampling Total	*9*	*16*	*5*	*2*	*1*	*24*

Notes:
Please see Page 4 for Notes and Sampling Program Details

TABLE 2.7
SUMMARY OF PROPOSED SAMPLING ACTIVITIES
MULTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC. MILL PROPERTY
PLAINWELL, MICHIGAN

ACTIVITY/ LOCATION	PROPOSED ASSESSMENT LOCATION			RATIONALE FOR LOCATION SELECTION	SAMPLE/DATA COLLECTION DETAILS	SAMPLE MATRIX	FIELD SCREENING	LABORATORY PARAMETERS	SAMPLE LOCATIONS	INVESTIGATIVE SAMPLES	QUALITY CONTROL SAMPLES			TOTAL NUMBER OF SAMPLES
	DESIGNATION	TYPE	DEPTH (FT BGS)								TRIP BLANKS	FIELD DUPLICATES	MS/MSD	
Soil Sampling														
TP-17 and TP-18	SB-201 SB-202 SB-203 SB-204	Soil Boring	20	Confirmation of noted potential contamination associated with the former Transformer Pad	- Collection of one surfical soil samples from each location - Sampling Program 1 (5)	Soil	Visual and Olfactory Evidence of Impact and PID Screening	TCL VOCs TCL SVOCs TAL Metals SPLP Metals (1) PCBs General Chemistry (2)	4	16	--	1	1	18
Mill Building Outflow Points	TBD	Hand Auger	2	Inspection and confirmation of capped outflows from the Mill Buildings	- Surface sampling only to be conducted if impacts are suspected from field screening				4*	4*	--	1*	1*	6*
Mill Building	TBD	Hand Auger	2	Inspection of soils around the perimeter of the Mill Buildings	- Surface sampling only to be conducted if impacts are suspected from field screening				5*	5*	--	--	--	5*
North East of Mill Building	MW-16	Monitoring Well	20	Installation of monitoring well to determine hydraulic connection with the Mill Race	- Sampling Program 1 (5) -Collection of one surficial soil sample				1	4	--	--	--	4
South Parking Lot	MW-17	Monitoring Well	20	Installation of monitoring well to determine hydraulic connection with the Mill Race	- Sampling Program 2 (6) - Collection of one surficial soil sample				1	4	--	1	--	5
South Parking Lot and BK5	TP-201 TP-202 TP-203	Test Pit	10	-Confirm the presence of fill material beneath the parking lot area -Determine potential impacts with historical activities	- Sampling Program 2 (6) - Collection of surface samples at all test pit locations				3	12	--	1	1	14
Soil Physical Properties	SB-201 SB-202	Soil Boring/ Hand Auger	5	Collection of samples to determine the potential for vapour intrusion through native soil materials within the unsaturated zone	- Collection of one sample from what is field screened as native material within the unsaturated, vadose zone			Soil Physical Properties (3)	2	2	NA	NA	NA	1
								Soil Sampling Total	*20*	*47*	*0*	*4*	*3*	*53*
Groundwater Sampling														
MW-1, MW-3, MW-4, MW-5, MW-16 MW-17	--	Groundwater Sample	--	To Confirmation of on-Site groundwater chemistry	- Completion of a monitoring well inspection - Collection of groundwater and surface water levels (at associated staff gauges) - Collection of one groundwater sample per location	Groundwater	pH, Conductivity, Temperature, Dissolved Oxygen, ORP, Turbidity	TCL VOCs TCL SVOCs PCBs TAL Inorganics	6	6	3	1	1	11
MW-4	VA-2	Vertical Aquifer Testing-Groundwater Samples	40	Complete vertical aquifer testing to determine groundwater conditions below the confining unit	- Collection of groundwater samples every 5 feet until the confining layer is reached or 40 feet bgs			TCL VOCs TCL SVOCs TAL Metals (filtered and unfiltered)	1	8	2	1	--	11
								Groundwater Sampling Total	7	14	5	2	1	22
Surface Water Sampling														
Mill Race and Kalamazoo River	SW-001 SW-002	Surface Water Sample	--	Confirm surface water quality of the Mill Race and Kalamazoo River related to mercury. Determine analytical data needed for data comparison.	- Collection of two surface water samples -Collection of surface water levels	Water	pH, Conductivity, Temperature, Dissolved Oxygen, ORP, Turbidity	Low level Mercury Methyl Mercury Hardness	2	2	--	1	--	3
								Surface Water Sampling Total	2	2	0	1	0	3

Notes:

Please see Page 4 for Notes and Sampling Program Details

TABLE 2.7
SUMMARY OF PROPOSED SAMPLING ACTIVITIES
MULTI-AREA FIELD SAMPLING PLAN
FORMER PLAINWELL, INC. MILL PROPERTY
PLAINWELL, MICHIGAN

ACTIVITY/ LOCATION	PROPOSED ASSESSMENT LOCATION			RATIONALE FOR LOCATION SELECTION	SAMPLE/DATA COLLECTION DETAILS	SAMPLE MATRIX	FIELD SCREENING	LABORATORY PARAMETERS	SAMPLE LOCATIONS	INVESTIGATIVE SAMPLES	QUALITY CONTROL SAMPLES			TOTAL NUMBER OF SAMPLES
	DESIGNATION	TYPE	DEPTH (FT BGS)								TRIP BLANKS	FIELD DUPLICATES	MS/MSD, MS/DUP	
Soil Sampling														
DG3 and DG4 (Area 3)	SB-301, SB-302	Soil Boring	20	Confirmation of impact noted in historical sampling	- Collection of one surface soil sample at each borehole location - Sampling Program 1 [5]	Soil	Visual and Olfactory Evidence of Impact and PID Screening	TCL VOCs, TCL SVOCs, TAL Metals, SPLP Metals [1], PCBs, General Chemistry [2]	2	8	--	1	1	10
SGWB-10	MW-18	Monitoring Well	20						1	4	--	--	--	4
SGWB-3	SB-321	Soil Boring	20						1	4	--	1	--	5
Coal Pile Storage Area (Area 3C)	TP-308, TP-309, TP-310, TP-311, TP-312, TP-313, TP-314, TP-315	Test Pit	10	Confirmation of extent of coal impacts	- Collection a minimum of 5 surface soil samples - Sampling Program 2 [6]				8	29	--	2	1	32
No. 6 Fuel Oil Tank Area (Area 3D)	SB-303, SB-304, SB-305, SB-306, SB-307	Soil Boring	10	Confirmation of impacted soil removal activities	- Sampling Program 3 [7]				5	20	--	3	1	25
SGWA-5 (Area 3D)	MW-19	Monitoring Well	20	Confirmation of historical groundwater impacts	- Collection of one surficial soil sample-Sampling Program 2 [6]				1	4	--	--	--	4
Former Coal Tunnel (Area 3E)	SB-308, SB-309, SB-310, SB-311, SB-312	Soil Boring	10	Confirmation of potential contamination noted in historical sampling	- Collection a minimum of 3 surface samples - Sampling Program 2 [6]				5	18	--	1	1	20
Undeveloped Lands	TP-301, TP-302, TP-303, TP-304, TP-305, TP-306, TP-307	Test Pit	10	-Confirm the presence of fill material beneath the parking lot area -Determine potential impacts with historical activities	- Collection of surficial soil samples - Sampling Program 2 [6]				7	28	--	2	1	31
Soil Physical Properties (Undeveloped Lands)	TP-302	Soil Boring/ Hand Auger	5	Collection of samples to determine the potential for vapour intrusion through native soil materials within the unsaturated zone	- Collection of one sample from what is field screened as native material within the vadose zone			Soil Physical Properties [3]	1	1	NA	NA	NA	1
								Soil Sampling Total	31	116	0	10	5	131
Groundwater Sampling														
MW-2, MW-6, MW-7, MW-18, MW-19	--	Groundwater Sample	--	Confirmation of on-Site groundwater chemistry	- Completion of a monitoring well inspection - Collection of groundwater and surface water levels (at associated staff gauges) - Collection of one groundwater sample per location	Water	pH, Conductivity, Temperature, Dissolved Oxygen, ORP, Turbidity	TCL VOCs, TCL SVOCs, PCBs, TAL Inorganics [4]	5	5	2	1	1	9
								Groundwater Sampling Total	5	5	2	1	1	9

Notes:
Please see Page 4 for Notes and Sampling Program Details

Notes:

(1) Soil samples for analysis of SPLP will be collected and placed on hold pending results of TAL metal analysis

(2) General Chemistry - Nitrogen compounds and phosphorous

(3) Soil Physical Properties- grain size analysis, dry bulk density, porosity, moisture content, fraction of organic carbon

(4) TAL Inorganics- TAL Metals plus low level mercury, methly mercury, and cyanide

(5) Sampling Program 1
- One surficial soil sample will be collected as indicted in Tables
- One biased soil sample will be collected from what has been deemed fill material from a depth of 2 to 10 feet bgs based on field screening. If no impacts are noted, one soil sample will be collected from 0 to 2 feet above the interface between the fill and native material within the vadose zone
- One soil sample from 0 to 2 feet below the observed impact will be collected. If no impact is observed the soil sample will be collected from 0 to 2 feet below the interface of the fill/ native material within the vadose zone
- One soil sample will be collected from the vadose zone, 0 to 2 feet above the saturated zone.

(6) Sampling Program 2
- One surficial soil sample will be collected as indicted in Tables
- If no impact noted, a discrete soil sample will be collected from 0 to 2 feet abovebelow the interface of the vadose and saturated zone. If impact noted one soil sample will be collected within 2 to 10 feet bgs and a third sample collected from 0 to 2 feet above the interface of vadose and saturated zone

(7) Sampling Program 3
- One surficial soil sample will be collected
- One soil sample will be collected from the fill material which is expected to be at approximately depths of 2 to 10 feet bgs based on field screening methods. Soil borings not exhibiting any evidence of impact will be sampled at 0 to 2 feet above the interface of fill/native material within vadose zone
- One soil sample will be collected from 0 to 2 feet below the observed contamination. If no evidence of impact is observed the soil sample will be collected from 0 to 2 feet below the interface of fill/native material within vadose zone
- One soil sample will be collected from vadose zone at 0 to 2 feet above the saturated zone

* Sampling to be conducted if necessary, the noted number of locations are subject to change depending on field findings.
bgs - below ground surface
MS/MSDs - Matrix Spike/Matrix Spike Duplicates
SPLP - Synthetic Precipitation Leaching Procedure
TAL - Target Analyte List
TCL - Target Compound List
VAS- Vertical Aquifer Sampling
VOC - Volatile Organic Compound
SVOC - Semi-Volatile Organic Compound
TBD - To be determined
PCBs - Polychlorinated Biphenyls
ORP - Oxidation-Reduction Potential
PID - Photoionization Detector
NA - Not Applicable
- Surficial Soil sample will be collected from 0 to 1 foot bgs. If non-soil materials are present (i.e., gravel fill or concrete slab) the soil sample will be collected from 0 to 1 foot below the non-soil material.
- Field Screening will consist of PID readings to determine the presence of undifferentiated volatile organic vapors, visual screening for lithologic changes, stained soils, residuals, and olfactory evidence of impacts
- Collect soil samples on a continuous basis at 2 feet intervals
- Collection of all samples as per Field Sampling Plan and Quality Assurance Project Plan including the references listed below
- Samples to be submitted on a regular turn around time
- All necessary MS/MSDS and Field Duplicates will be added where required
- Groundwater samples will be collected using low flow techniques
- VAS samples will be collected with a bailer and TAL Metals will filtered and unfiltered for metals analysis
- Test pit length is 5 to 10 feet

Field Sampling References:

Sample Type	*Reference Document*	*Procedure*
Soil Sampling with Direct Push Sampler	FSP	Standard Operating Procedure F-5
Surficial Soil Sampling	FSP	Standard Operating Procedure F-6
Excavation and Test Pits and Test Pit Soil Sampling	FSP	Standard Operating Procedure F-8
Photoionization Detector (PID) Screening	FSP	Standard Operating Procedure F-9
Monitoring Well Installation	FSP	Standard Operating Procedure F-15
Groundwater Sampling	FSP	Standard Operating Procedure F-11
Surface Water Sampling	FSP	Standard Operating Procedure F-16
Staff Gauge Installation and Measurement	FSP	Standard Operating Procedure F-10
Vertical Aquifer Sampling	FSP	Standard Operating Procedure F-17
Sample Handling and Analysis/ Quality Assurance	FSP/ QAPP	Section 4/ Section 4.4.4 (with reference to QAPP Worksheets)
Sample Labeling	FSP	Section 3.1
Chain-of-Custody Records	FSP	Section 3.3
Management of Investigation-derived Waste	FSP	Section 6.0
Field Physical Measurements/ Surveying	FSP	Section 5.0/ Section 5.1
Hand Auguring	FSP	Standard Operating Procedure F-6

ATTACHMENT A

STANDARD OPERATING PROCEDURES

Table A-1
Standard Operating Procedures
Applicable for Corresponding Operable Units

SOP		Operable Unit
F-1	Water Sampling and Field Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-2	Surface Water Flow Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-3	Water Treatment System Monitoring Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-4	Sediment Sampling	Operable Unit No. 5 – Kalamazoo River
F-5	Soil Sampling with Direct Push Sampler	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-6	Surficial and Shallow Subsurface Soil Sampling	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-7	Landfill Gas Monitoring	Operable Unit No. 4 – 12th Street Landfill site
F-8	Excavation of Test Pits and Test Pit Soil Sampling	Operable Unit No. 7 – Plainwell Mill site
F-9	Photoionization Detector (PID) Screening	Operable Unit No. 7 – Plainwell Mill site
F-10	Staff Gage Installation and Measurement	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-11	Groundwater Sampling and Field Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-12	Ambient Air Monitoring for Fugitive Dust	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-13	Ambient Air Monitoring for VOCs	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-14	Real-Time Turbidity Measurement Procedures for Surface Water	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-15	Monitoring Well Installation Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site

Table A-1
Standard Operating Procedures
Applicable for Corresponding Operable Units

SOP		Operable Unit
F-16	Surface Water Sampling Procedure	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-17	Vertical Aquifer Sampling Procedure	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site

Standard Operating Procedure F-1
Water Sampling and Field Measurement Procedures

This standard operating procedure (SOP) sets forth the field procedures for the collection of water column samples via boat, sampling from shore, or sampling from a bridge. Water column samples will be collected using a stainless steel Kemmerer water sampler, utilizing a peristaltic pump with Teflon tubing, or using an ISCO automated sampler. Samples collected downstream of construction to monitor TSS and PCB transport will utilize an ISCO automated sampler. Treated water from construction activities will be obtained using a direct grab sampling method.

Decontamination Procedures for Nondedicated Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

The submersible pumps are not designed to withstand acid rinsing. Decontamination of this equipment will therefore consist of washing the downhole portions of the equipment with nonphosphate detergent and rinsing with DI or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Water Column Sampling Procedures

Water column samples will be collected using a stainless steel Kemmerer water sampler, a peristaltic pump with Teflon tubing, or a discrete grab sample in appropriate sample containers. The sample collection method will be determined based on river flow, water depth, and site conditions at the time of collection. The Kemmerer sample collection device is lowered to the appropriate sample depth on a cable in an open position and a weighted messenger is sent along the cable to trip the sampler closed. The peristaltic pump with disposable silicone pump tubing and Teflon sample tubing is lowered to depth and directly pumps water from the river. Grab sample collection is utilized for shallow water river conditions or when collecting water out of a sample port for water treatment system evaluation.

Prior to initiating field activities, the water quality meter will be calibrated according to the manufacturer's instructions and the calibration data recorded in the logbook or on the Water Quality Meter Calibration Log. The procedures for collection of water column samples are provided below.

1. Record the sample location on the sample log or in field notebook along with other appropriate information [include a sketch indicating location relative to shore features, if appropriate].
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Decontamination of the sampling equipment prior to initial use, between sampling at each transect, and at the completion of sampling as follows: distilled water rinse; acetone rinse; hexane triple rinse; and distilled water triple rinse. All decontamination rinsate water will be contained in a MDOT-approved container. If using a peristaltic pump with disposable tubing or a discrete grab sample into appropriate lab supplied glassware, no equipment cleaning is needed.
4. Prepare one rinse-blank sample prior to and after sampling activities, by pouring deionized water supplied by the laboratory through the cleaned Kemmerer and filling the sample containers as described in Steps 8 and 9. If a peristaltic pump and Teflon tubing or a discrete grab sample is used, no rinse blanks are required.
5. Measure the total depth of the water column. Initial field checks with a survey rod will be performed to confirm accuracy.
6. Lower the water sampler to 0.8 times the total water column depth and either release the trigger on the Kemmerer, start peristaltic pump, or lower sample bottle.
7. Raise the water sampler from the water column with minimal disturbance, continue to pump river water, or secure grab sample jars.
8. Remove the covers from the appropriate laboratory supplied containers and slightly tilt the mouth of the container below the sampling device.
9. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the sample container (with minimal entry turbulence).

10. Repeat Steps 6 through 9 for collection of sample at 0.2 times the total water column depth.
11. Repeat Steps 5 through 10 at the other river locations.
12. At each station, collect field measurements for temperature, pH, turbidity, conductivity, and DO at 0.2 and 0.8 times the total water column depth record results on the appropriate in the field logbook or Surface Water Sampling Log.
13. Secure all sample jar caps tightly.
14. Label all sample containers.
15. Place filled sample containers on ice in a cooler.
16. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
17. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples
18. Record required information in the field logbook or Surface Water Sampling Log.

Continuous Water Column Sampling Procedures During Construction

Three movable YSI Sonde units, each equipped with probes to measure dissolved oxygen, turbidity, pH, conductivity, and temperature will be used upstream and two locations downstream of the construction area. The YSI logs the above data at predetermined time intervals. The unit will be programmed to sample hourly during construction operations. The data will be downloaded daily onto a computer hard drive for backup.

Calibration Procedures - The YSI will be calibrated weekly in accordance with manufacturer's instructions. Calibration information will be recorded in the field logbook.

Operation Procedures - The YSI will be operated according to the manufacturer's instructions.

Maintenance Procedures - The YSI will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field logbook. A replacement meter and probes will be available onsite or ready for overnight shipment, as necessary.

The units will be placed within a perforated PVC pipe for protection and anchored to the river bottom. A buoy will be attached to the PVC pipe for accessibility, and the unit attached to shore for security. In addition to the Sonde units, a sampling line will also connected to tubing which feed to an ISCO sampler located on shore for discreet sampling of the water throughout the construction activities. Samples will be taken every 15 minutes during material placement.

The water sample that corresponds to the highest turbidity reading over the placement period should be submitted to WATS laboratory for analysis of Total Suspended Solids (TSS), Volatile Suspended Solids (VSS) and polychlorinated biphenyls (PCBs).

Collection Procedures - The procedures for collection of water column samples using the YSI and ISCO sampler are provided below.

1. Record the sample location on the sample log or in field notebook along with other appropriate information [include a sketch indicating location relative to shore features, if appropriate].
2. Measure the total depth of the water column at mid-river location using a portable depth finder. Initial field checks with a survey rod will be performed to confirm accuracy.
3. Place Sonde unit and ISCO intake tubing at a mid-river location, if possible. Attach the tubing to the upstream side of the monitoring using cable ties. Depending upon site conditions, placement of a station at mid-river may not be safe or feasible. In this event, water samples may be collected from a pier or boat.
4. Set the ISCO composite sampler and portable power source on shore and attach to an immovable object (tree, fence, etc) to deter theft/vandalism.
5. Place necessary glassware in the sampler and surround glassware with up to 20 pounds of ice.
6. Attach the intake tubing to the tubing in the pump head. Ensure that the tubing slopes downhill from the pump head to the intake point to ensure draining between sampling events.
7. Program the sampler according the manufacturers instructions including two rinse cycles prior to collection. Set the appropriate sample time and volume to fill an individual container. Ensure that the sampler is in "Run" mode prior to leaving the sampler. Close the top of the sampler for protection against the elements.
8. Retrieve the sample containers from the ISCO sampler upon completion of the timed sampling event.
9. Download the information from the Sonde unit for the timed sampling event.
10. Match the highest turbidity readings from the Sonde unit with the corresponding ISCO sample.
11. Remove the covers from the appropriate laboratory supplied containers and slightly tilt the mouth of the container below the ISCO sample container.
12. Empty the sample container slowly, allowing the sample stream to flow gently down the side of the laboratory supplied sample container (with minimal entry turbulence).
13. Secure all sample jar caps tightly.
14. Label all sample containers.
15. Place filled sample containers on ice in a cooler.
16. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event or as required. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
17. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples.

18. Record required information on the field logbook or Surface Water Sampling Log.
19. Follow appropriate decontamination procedures describe above for the sample equipment as necessary.

Standard Operating Procedure F-2
Surface Water Flow Measurement Procedures

This standard operating procedure (SOP) describes the field procedures for determining surface water flow at a river transect. In general, these procedures include dividing the width of the channel conveying flow into segments and measuring the average velocity and cross-sectional area of each segment. The total flow is then calculated as the sum of the product of average flow velocity and cross-sectional area of each segment.

Decontamination Procedures for Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

The submersible pumps are not designed to withstand acid rinsing. Decontamination of this equipment will therefore consist of washing the downhole portions of the equipment with nonphosphate detergent and rinsing with DI or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Surface Water Flow Measurement Procedures

The general procedures to be followed when obtaining surface water flow measurements at a river or creek transect are described below.

The following materials will be available, as required, during water column sampling:

- health and safety equipment to be worn when working around surface water, as described in the Multi-Area Health and Safety Plan (HSP)
- field notebook and pen
- calculator
- rope
- survey rod
- duct tape
- 200-foot measuring tape
- electromagnetic velocity meter

Surface Water Flow Measurement Sampling Procedures

The following procedures will be used to determine the velocity profile at a cross-section:

1. Measure the width of the water body, then divide and mark into equally spaced measurement locations. For water bodies less than 30 feet in width, the spacing should be 5 feet. For water bodies between 30 feet and 100 feet in width, the spacing should be 10 feet. For water bodies greater than 100 feet in width, the spacing should be 20 feet.
2. Calibrate the velocity meter according to manufacturer's specifications.
3. Lower the survey rod and measure and record the water depth to the nearest 0.1 foot at each measurement location in the field logbook or on the Velocity Profile Measurement Log. Measurements should be collected at the center of each 5-foot (or 10- or 20-foot) increment.
4. Velocities will be determined using the two-point method. Attach the velocity meter probe to the survey rod, measure and record the velocity in feet per second at depths equaling 0.2 and 0.8 times the total depth at each measurement location. Average the two velocity measurements to obtain the average velocity for that vertical section. Record all measurements in the field logbook or on the Velocity Profile Measurement Log.

5. Calculate the average total flow by multiplying the average velocity reading times the cross-sectional area of the 5-foot (or 10- or 20-foot) increment. The cross-sectional area is determined by multiplying the width of the increment (*i.e.,* 5, 10, or 20 feet) times the average water depth within that increment. The total flow is the sum of the velocity times the area for each increment and can be calculated using the following formula:

$$QT = V1\ A1 + V2\ A2 + ...+ Vn\ An$$

where:

QT = Total flow in cubic feet per second

V1-n = Average velocity for a vertical section (feet per second)

A1-n = Cross-sectional area of each increment (square feet)

6. For flow measurements at bridges, water surface will be measured using a weighted rope or tape measure as a "tape down" distance from a distinct reference point on the bridge.
7. Surface water flow measurement locations and "tape down" locations will be recorded in a field notebook sketch as appropriate.
8. Conduct appropriate decontamination procedures described above.

Standard Operating Procedure F-3
Water Treatment System Monitoring Procedures

This standard operating procedure (SOP) describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the influent, intermediate stage and effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system and grab samples for phosphorus at the effluent of the water treatment system.

Decontamination Procedures for Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Water Treatment System Monitoring Procedures

Grab samples of surface water will be collected at a specified frequency during the response activities for PCB analysis. Surface water samples will be collected from the influent, at the intermediate stage and at the effluent of the water treatment system. Surface water grab samples will be collected at the effluent of the water treatment system for phosphorus and TSS monitoring at a specified frequency during the response activities. Turbidity measurements will also be collected during the water treatment system operation activities. The general procedures to be followed when the surface water grab samples are

collected or measurements taken are outlined below. Specific analytical methods are described in the QAPP.

The procedures for collection of water treatment system grab samples are provided below.

1. Record the surface water grab sample location (*i.e*. effluent, influent) on the sample log or in field notebook along with other appropriate information [include a sketch indicating location of sample relative to the water treatment system].
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Collect the grab samples by quickly immersing the specified sample container with the mouth of the container pointing towards the influent.
4. Raise the sample jar from the water with minimal disturbance and secure the jar.
5. At each station, collect field measurements for temperature, pH, turbidity, conductivity, and DO and record results in the field logbook or Surface Water Sampling Log.
6. Secure all sample jar caps tightly.
7. Label all sample containers.
8. Place filled sample containers on ice in a cooler.
9. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
10. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples.
11. Follow appropriate decontamination procedures described above.
12. Record required information in the field logbook or Surface Water Sampling Log.

Standard Operating Procedure F-4
Sediment Sampling

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer.

Method Summary

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the water, the portion of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type. Sediment is collected from beneath the water either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested.

Equipment/Apparatus

Equipment needed for collection of sediment samples may include:

- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels

- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- "T" handle
- Sediment coring device (tube, suction head, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for sediment sample collection. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

Sample Collection

Selection of a sampling device is most often contingent upon: 1) the depth of water, and 2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

Sampling Surface Sediment with a Trowel or Scoop

The sampling method is accomplished by wading into the surface water body and while facing upstream (into the current), scooping the sample along the bottom of the surface water body in the upstream direction. Excess water may be removed from the scoop. However, this may result in the loss of some fine particle size material associated with the bottom of the surface water body.

This method can be used to collect consolidated sediments but is limited somewhat by the depth of water. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. In surface water bodies that are too deep to wade, but less than eight feet deep, a stainless steel scoop or spoon attached to a piece of conduit can be used either from the banks if the surface water body is narrow or from a boat. The sediment is placed into a glass pan and homogenized.

A stainless steel scoop or lab spoon will suffice in most applications. Follow these procedures to collect sediment samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Sampling Surface Sediment with a Bucket Auger or Tube Auger

This system consists of an auger, a series of extension rods, and a "T" handle. The auger is driven into the sediment and used to extract a core. A sample of the core is taken from the appropriate depth.

Use the following procedure to collect sediment samples with a thin-walled auger:

1. Insert the auger into the material to be sampled at a 0^{o} to 45^{o} angle from vertical. This orientation minimizes spillage of the sample from the sampler. Extraction of samples may require tilting of the sampler.
2. Rotate the auger once or twice to cut a core of material.
3. Slowly withdraw the auger, making sure that the slot is facing upward.
4. An acetate core may be inserted into the auger prior to sampling, if characteristics of the sediments or body of water warrant. By using this technique, an intact core can be extracted.
5. Transfer the sample into an appropriate sample or homogenization container.

Sampling Surface Sediment with a Ponar Dredge

The Ponar dredge uses a self-tripping sampler featuring hinged jaws and a spring loaded pin that releases when the sampler makes impact with the bottom. The top is covered with a stainless steel screen with neoprene rubber flaps which allows water to flow through for a controlled descent and less interference with the sample.

Follow these procedures for collecting sediment with a Ponar dredge:

1. Attach a sturdy nylon or steel cable to the hook provided on top of the dredge.
2. Arrange the Ponar dredge sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.
3. Slowly lower the sampler to a point just above the sediment.
4. Drop the sampler sharply into the sediment, then pull sharply up on the line, thus releasing the trip bar and closing the dredge.
5. Raise the sampler to the surface and slowly decant any free liquid through the screens on top of the dredge. Be careful to retain fine sediments.
6. Open the dredge and transfer the sediment to a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been gained. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

Sampling Subsurface Sediment with a Coring Device

Core samplers are used to sample vertical columns of sediment. They are particularly useful when a historical picture of sediment deposition is desired since they preserve the sequential layering of the deposit, and when it is desirable to minimize the loss of material at the sediment-water interface.

Follow these procedures when using a sample coring device to collect subsurface sediments. It consists of a coring device, handle, and acetate core barrel:

1. Assemble the coring device by inserting the core into the sampling tube assembly.
2. Insert the "vacuum plug" into the tip of the sampling tube with the wire connected through the top portion of sampling equipment.
3. Tighten the plug so the fit is snug within the tube.
4. Tighten the rubber fitting, associated with the sampling equipment, around the top end of the tube.
5. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
6. Place the sampler in a perpendicular position on the material to be sampled.
7. With left hand holding the wire (connected to the plug inside the core assembly), place downward pressure on the sampler into the material to the desired depth. Do not allow the plug to proceed deeper (hold left hand at constant elevation, while advancing core with right hand).
8. Place downward pressure on the device until the desired depth is reached.
9. Withdraw the sampler by puling the sampling assembly upwards, until the bottom of the core can be reached below the surface of the water.
10. Place cap on core, while end of the core is still underneath the water's surface.
11. Remove core from water and loosen rubber fitting.
12. Remove core from sampling equipment and place an additional cap on top of core (it may be appropriate to reduce the core length prior to capping the core).
13. The sample may be used in this fashion, or the contents transferred to a stainless steel or plastic bucket and mixed thoroughly to obtain a homogeneous sample representative of the entire sampling interval.

Sediment Probing and Bathymetric Survey

The metal calibration rod will be used to probe sediment depths along the sediment characterization transects. From a boat, at each station, the water depth to top of sediment will be measured by probing with a surveyor's rod. The sediment depth will then be measured by pushing a calibrated 5/8-inch galvanized hollow pipe into the sediment until refusal using reasonable human force. The depth of the penetrated sediment will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed from the length of the entire rod. Measurements made of location, depth, time, and field samples will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed from the length of the entire rod. Measurements made of location (using a GPS unit, if applicable), depth, time, and field samples will be noted in the field logbook.

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Standard Operating Procedure F-5
Soil Sampling with Direct Push Sampler

The primary means for the collection of subsurface soil samples will be a direct-push technique using a Geoprobe® or equivalent driver. Direct-push soil samples will be obtained using the Macro Core® sampling method on continuous basis using a closed-piston soil sampler with a liner (or equivalent sampling system). The Sampler will be operated in accordance with the manufacturer's recommended operating procedures for the type of equipment used.

Soil samples will be collected at predetermined intervals based on specific data needs. The samples will be classified in accordance with the Unified Soil Classification System (USCS), and field logs will be prepared.

Small subsamples representative of the major soil types will be retained for use in developing visual classification as described later in this subsection, and for physical testing, as required.

Subsamples selected for laboratory analysis will be placed in appropriate sample containers provided by the analytical laboratory, labeled, placed in an iced cooler, and stored in accordance with chain-of-custody requirements specified in the QAPP until shipment to the laboratory (or laboratories) is arranged. Chain-of-Custody Records will be completed for all samples according to the methods described in the QAPP.

Geoprobe®, and support equipment will not come in direct contact with the samples, so cross-contamination of samples is not a concern. However, this equipment will likely come in contact with impacted soil and must therefore be decontaminated prior to moving from one location to another.

The Geoprobe® equipment used for soil sampling and monitoring well installation will be cleaned with high-pressure/hot water washing equipment prior to initiating the field investigation. The same procedure will be applied to all drilling equipment between each boring location. The cleaning will occur at a decontamination pad constructed at a suitable location(s) at the site. Water used for cleaning will be obtained from a local potable water source. Equipment subject to these decontamination procedures includes, but is not limited to, the following:

- Direct Push drill rig
- Direct Push sampler components

In addition, downhole equipment that comes in direct contact with samples will be decontaminated between each sample interval. This procedure will include washing with a nonphosphate detergent and rinsing with clean potable water.

A piece of Direct Push equipment that comes in direct contact with soil samples (*e.g.*, split-barrel samplers) will be selected for collection of one field equipment blank. After the equipment has been cleaned, it will be rinsed with DI water. The rinse water will be collected and submitted for analysis of all constituents for which the normal samples collected with the equipment are being analyzed.

Standard Operating Procedure F-6
Surficial and Shallow Subsurface Soil Sampling

This standard operating procedure (SOP) is applicable to the collection of representative surficial or shallow subsurface soil samples. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for collection of soil samples may include:

- Maps/Plot plan
- Safety equipment
- Compass
- Hand augers
- Spade or Shovels
- Tape measure
- Survey stakes, flags,
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spatula
- Scoop
- Trowel

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for soil sample collection. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

Sample Collection

Sampling Surface Soil with a Trowel or Scoop

The sampling method is accomplished by scooping the soil sample along the top 6 inches of the surface with a stainless steel scoop. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. Once collected, the sample is placed in a glass or stainless still bowl and homogenized.

A stainless steel scoop or lab spoon will suffice in most applications. Follow these procedures to collect soil samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of soil from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Sampling Shallow Subsurface Soil

Several manual methods are available for the collection of shallow subsurface soil samples (e.g., hand augers, post hole augers). Hand auger or post-hole digging equipment to will be used to advance the boreholes to a sufficient depth followed by collection of soil samples as described above.

Standard Operating Procedure F-7
Landfill Gas Monitoring

This standard operating procedure (SOP) is applicable to landfill gas monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for landfill gas monitoring may include the following:

- Portable combustible gas meter
- Pressure gauges with varying sensitivity ranges
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

The gas composition will be monitored in groundwater monitoring wells, Geoprobe® borings, gas vents, or gas probes using a portable combustible gas meter (e.g., a Landtec®, or equivalent). The instrument selected will directly analyze the gas for methane, carbon dioxide, and oxygen (as percent by volume). Although nitrogen is not read directly, it can be calculated in the following manner:

$$\text{Balance gas} = 100\% - (\%CH_4 + \%CO_2 + \%O_2)$$

The balance gas represents the nitrogen content of the gas, as the trace gases typically make up much less than 1 percent of the total gas collected.

In addition, pressure will be measured at gas probes or groundwater monitoring wells, using a pressure gauge (a Magnehelic®, or equivalent) with the appropriate sensitivity range to obtain an accurate pressure reading, to determine if excess landfill gas is contributing to excess pressure.

Operational Procedures

The portable combustible gas meter and pressure gauges will be operated according to the manufacturers' instructions. A summary of the operational procedures that will be used for the portable combustible gas meter and pressure gauges (*i.e.*, calibration and monitoring procedures) is provided below.

General Information

On each day that landfill gas monitoring is being performed, record the following general information:

- Date
- Weather conditions
- Barometric pressure and trend
- Temperature
- Ground condition (saturated, frozen, etc.)
- Names of personnel performing the monitoring

Meter Calibration

Prior to initiating gas monitoring, the portable combustible gas meter will be calibrated in an area where the ambient concentrations of gases of concern are not present. The oxygen sensor and methane sensor will be calibrated in accordance with the manufacturer's recommended procedures.

The pressure gauges are calibrated by the manufacturer and do not require field calibration. Prior to measuring pressures, the appropriate pressure gauge will be selected (*i.e.,* the gauge with the appropriate sensitivity range to obtain an accurate pressure reading), and the pressure gauge will be set to zero, to the extent possible. If the pressure gauge cannot be set precisely to zero prior to monitoring, the initial reading will be noted and subtracted from the measured reading.

Landfill Gas Monitoring at Gas Vents, Gas Probes, or Groundwater Monitoring Wells (Pressure and Composition)

If sampling gas probes or vents, the probes or vents will be installed with sampling ports. If sampling groundwater monitoring wells, the wells will be retrofitted with a sampling port. The sampling port will include a labcock valve (or equivalent), which will be used to connect the portable combustible gas meter. For gas probes or groundwater monitoring wells, the sampling will also be used to connect the pressure gauge (or gauges, if appropriate).

The following procedures will be followed to monitor the gas composition and gauge pressure (if present):

Pressure

1. Attach the low-pressure port of the pressure gauge to the monitoring port using silicone tubing. Open the labcock valve, record the pressure, and then close the labcock valve. If the gauge indicates a negative reading, switch the tubing on the gauge to the high-pressure sampling port and repeat the previous steps.

Gas Composition

1. Attach the portable combustible gas meter to the monitoring port using silicone tubing. Engage the internal pump of the combustible gas meter, and open the labcock valve. When the readings stabilize, record the concentrations and close the labcock valve.
2. After each reading using the portable combustible gas meter, remove the tubing from the monitoring port and allow the methane and carbon dioxide readings to return to zero.

Landfill Gas Monitoring at Geoprobe® Boreholes (Composition)

The following procedures will be followed to measure the gas composition within Geoprobe® borings:

1. After reaching the desired vertical depth with the Geoprobe® rods, retract the rods approximately 1 foot to disengage the expendable drive point.
2. Push the Post-Run Tubing (PRT) adapter into the landfill gas sampling tubing. Insert the adapter end of the tubing down the inside of the probe rods until it hits the bottom on the expendable drive point holder.
3. Turn the tubing in a counterclockwise direction, and apply slight downward pressure to engage the adapter threads with the expendable drive point holder.
4. Connect the outer end of the tubing to a silicone tubing adapter (if needed) or directly to the portable combustible gas meter. Engage the internal pump of the combustible gas meter, and purge the tubing for a minimum of 1 minute prior to recording and/or measuring the landfill gas concentrations (methane, oxygen, and carbon dioxide). When the readings stabilize, record the concentrations.

Maintenance Procedures

The portable combustible gas meter and pressure gauges will be maintained according to the manufacturers' instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-8:
Excavation of Test Pits and Test Pit Soil Sampling

This standard operating procedure (SOP) is applicable to the excavation of test pits and the collection of soil samples from the test pits. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for excavation of test pits and the collection of test pit soil samples may include:

- Excavation equipment (*e.g.,* backhoe)
- Hand augers
- Spade or Shovels
- Maps/plot plan
- GPS
- Safety equipment
- Tape measure
- Survey stakes, flags,
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spatula
- Stainless Steel Scoop
- Plastic or Stainless Steel Spoons
- Trowel

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for excavation of test pits and collection of soil samples from test pits. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Attachment 7 (MDEQ, 2004).

The field decontamination of the excavation equipment (backhoe) will take place on a specified decontamination area. Equipment used to excavate the test pits will be decontaminated following completion of each test pit Decontamination of the excavator bucket will consist of removing remaining soil at the test pit location. The backhoe will then move to the decontamination area and the bucket washed with decontamination water. The decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and analyzed for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the Remedial Investigation Report. Final

decontamination of the backhoe bucket and tires will be performed prior to the equipment leaving the site.

The field decontamination of soil sampling equipment (stainless steel scoops, etc.) will take place at the sampling location or decontamination area. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination area for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Attachment 7 (MDEQ, 2004).

Test Pit Excavation Procedures

Prior to initiation of the excavation activities, a kick-off meeting with the field representatives will be conducted. The health and safety guidelines will be discussed during the meeting. Additional information regarding health and safety measures is included in the Health and Safety Plan prepared in conjunction with the Remedial Investigation. All sampling locations will be clear of any overhead or identified buried utility.

Test pits will be excavated using a backhoe or other appropriate equipment at approximate locations according to the sampling plan. In the event that in-field conditions limit the use of excavation equipment, hand augers or shovels may be used. Test pit locations will be identified in the appropriate project workplan. Test pits will not be located immediately adjacent to the waterways (e.g. Kalamazoo River) or rip rap present along the banks in order to maintain the current containment. Appropriate spill containment and control measures will be implemented at each test pit location. Spill kits will be available on site for immediate deployment if needed according to the site specific Spill Response Contingency Plan.

Depending upon conditions the size of test pits can have a wide range. Typically test pits are anticipated to be approximately 5 to 15 feet long and approximately 2 to 4 feet wide. The text pits will be excavated to a depth of 3 to 12 feet depending on field conditions. In general, test pits are placed to a depth to either intersect the groundwater table or to natural soils. Test pits may be excavated to a greater depth if conditions warrant and all visual observations will be documented. Test pits may be used to identify free product or oil saturated soil for PCB investigations. The test pits will be logged according to the Unified Soil Classification System by the on-site field geologist or engineer.

At a minimum, field logs for the test pits will include the following documentation:

1. Plan and profile sketches of the test pit showing materials encountered, the depth of material, and sample locations

2. Sketch of the test pit and distance and direction from permanent, identifiable location marks as appropriate.
3. A description of the material removed from the excavation
4. A record of samples collected
5. The presence or absence of water in the test pit and the depth encountered
6. Other readings, or measurements taken during excavation, including field screening reading

Unless otherwise specified and the site-specific Health and Safety Plan discusses appropriate procedures, no personnel will enter the test pit. In addition, all test pits will be backfilled on the day of excavation. In most cases, excavation materials will be used to fill the test pit. In the event that highly contaminated soil is encountered, excavated soils may be stockpiled on polypropylene or placed within lined dumpsters and the excavation will be filled with clean soil.

Test Pit Soil Sample Collection

Sampling Surface Soil from a Test Pit

The sampling method is accomplished by scooping a representative soil sample of the excavated soil from the backhoe bucket with a stainless steel scoop. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. Once collected, the sample is placed in a glass or stainless steel bowl and homogenized. Samples will be collected and analyzed for PCBs and total petroleum hydrocarbons. Other select analysis will be performed based upon visual and olfactory conditions observed in the test pits. Samples will also be screened with a photoionization detector (PID) following procedures presented in SOP-8.

A stainless steel scoop or lab spoon will be used for sampling in most applications. Follow these procedures to collect soil samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of soil from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Samples will be visually classified for soil types in the field and screened with a photoionization detector (PID). Selected samples with elevated PID readings or the presence of industrial fill material will be submitted for analysis of PAHs, VOCs and/or metals. The selection of samples to submit for analysis will utilize a biased sampling approach that will rely on a variety of specific site observations including:

- visible residuals;
- visible petroleum impacts;

- PID readings greater than a baseline of 10 ppm above background ambient air readings which will be taken on site beyond the influence of exhaust from equipment;
- notable odors; and
- soil stratigraphy.

The number of samples collected for analysis from each test pit is also dependent upon specific observations made during the test pit excavations. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. This sample will be taken at one of several locations:

- From unsaturated soil just above the saturated soil zone as evidenced by the visible presence of groundwater
- From the center bottom of the test pit if there is no groundwater visible

If observed conditions in the test pit warrant collection of additional samples, a total of up to three soil samples may be collected within a single test pit and analyzed for selected parameters based upon visible conditions. Samples will be collected for analysis based upon several possible test pit conditions including:

- Changes in fill or soil types
- Modifications in soil color or soils with noticeable odors
- Presence of free product
- Extended size of the test pit that needs additional characterization

Standard Operating Procedure F-9
Photoionization Detector (PID) Screening

This standard operating procedure (SOP) is applicable to the use of a PID/FID instrument during in-field soil sampling activities. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for PID screening of soil samples may include:

- PID/FID instrument
- Clear glass jar
- Ziploc bags

Procedure

When using PID/FID instrument the following procedure must be used:

1. Half- fill **either** a glass jar, or a Ziploc® baggie.
   a) When using glass jars:
      i) Fill jars with a total capacity of 8 oz. or 16 oz.
      ii) Seal each jar with one (1) or two (2) sheets of aluminum foil with the screw cap applied to secure the aluminum foil.
   b) When using Ziploc® baggies:
      i) Half fill bags from the split spoon or the excavation.
      ii) Zip to close.
2. Vigorously shake the sample jars or bags for at least thirty (30) seconds once or twice in a 10-15 minute period to allow for headspace development.
3. If ambient temperatures are below 320 Fahrenheit (00 Celsius) headspace development is to be within a heated vehicle or building.
4. Quickly insert the PID/FID sampling probe through the aluminum foil. If plastic bags are used, unzip the corner of the bag approximately one to two inches and insert the probe or insert the probe through the plastic. Record the maximum meter response (should be within the first 2 to 5 seconds). Erratic responses should be discounted as a result of high organic vapor concentrations or conditions of elevated headspace moisture.
5. Record headspace screening data from both jars or bags for comparison.

6. A PID equipped with a 10.2 eV lamp source will be used. Calibration will be checked/adjusted daily. In addition, all manufacturers' requirements for instrument calibration will be followed.
7. If sample jars are re-used in the field, jars will be cleaned according to field decontamination procedures. In addition, headspace readings must be taken to ensure no residual organic vapors exist in the cleaned sample jars.
8. Plastic bags will not be re-used.

Standard Operating Procedure F-10
Staff Gage Installation and Measurement

This standard operating procedure (SOP) is applicable to the installation and measurement of staff gages. This SOP is generic in nature and may be modified in whole or part depending on constraints presented by site conditions and equipment limitations. Modifications of methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities. The procedures have been adapted from the Oklahoma Water Resources Program Division procedures for installation and monitoring of non-recording staff gages.

Installation of Staff Gages

The gage height is a critical component for establishing the stage to discharge relationship and can be measured through a variety of accepted means. It is used to establish the river gage, or height of water to a known fixed point. This known fixed point is referenced or leveled to a Reference mark or Benchmark. These marks are assigned either an arbitrary elevation or known elevation that is tied to a national elevation network. Thus over time, with periodic leveling, the reference points can be measured for movement. Movement of these points will affect the stage discharge rating; therefore, it is critical that periodic measurements be conducted so that the gage heights remain leveled with the stage datum. This document is meant to be a guide only. Since staff gage equipment varies with respect to installation requirements, this SOP will be provided for a guideline and the specific manufacturer's instruction manual will be relied upon for more detailed guidance on the use of specific staff gages.

Accuracy and Use of Staff Gages

Vertical Staff Gages

Vertical staff gages are used as a stand-alone outside gage, an outside gage at a recording station, or a reference gage to another non-recording device. Vertical gages are available in a variety of lengths, widths, and increments in both U.S. and metric scales. However, because of the necessary accuracy, comparability, and ruggedness, gages should be a Style A gage, if available, which is made of porcelain enameled iron sections measuring 3 1/3' by 4" and graduated at every foot, tenth, and 0.02 foot. They are accurate only to 0.02 foot and can be damaged or lost due to high flows or ice. They have a tendency to drift if not consistently kept free of debris. Accuracies to 0.01 foot may be obtained if needed by reading the gage with a point gage.

Inclined Staff Gages

Because of their uniqueness to each station, inclined gages are normally not available commercially for stream gaging. They are used in situations where placement of another type of outside gage is not possible. They can be used as stand-alone outside gages or as an outside gage at a recording station.

Inclined gages have a low level of accuracy of up to 0.10 foot. Because of issues with installation, maintenance, and accuracy, inclined staff gages should be used only when other options are not feasible.

Installation and Measurement of Staff Gages

A vertical gage is mounted to permanently placed structure such as a piers or beam sunk to bedrock. If mounted in a stable location, a number of plates may be mounted one on top of the other. When mounting, find the high water bench and attempt to place the top of gage above that mark. Vertical height of gages should be kept to one plate and may require the installation of two or more to account for the vertical height of banks and potential high water level. When mounting to a pier, special equipment may be needed. The gage should be kept free of obstructions and be in an area readily accessible by personnel. A reference point should be placed on the backing of the gage plates and tied into the level circuit, and a reference point reading should be noted by measuring against the steel plate using a steel tape. During subsequent surveys, new RP readings should be made and compared to the elevation for that reference point. If these are different, a correction should be made to the gage datum. If a series of gages are used, each should be tied to the level circuit with a separate reference point.

The water level is read by a three-step method. The following example describes the three step process:

1. As an example, 20.64 is used as a measurement.

2. The footmark, 20.0, is noted. The next mark (6) is the inch mark.

3. The next step is to locate the hundredth mark and count 8 the marks backward from the next highest inch mark.

Using the example, the water level is at 0.64, and to determine the hundredth mark (0.04), the technician would count back from 0.7 to the water level. In this instance, the count was 0.06. By subtracting 0.06 from the inch mark, the hundredth mark (0.04) is obtained.

References

Oklahoma Water Resources Board, 2004. Standard Operating Procedure for the Installation of Nonrecording Gages and Measurement of Stage in Streams. Water Quality Program Division, Oklahoma City, OK.

Oklahoma Water Resources Board, 2004. Standard Operating Procedure for Surveying Gaging Stations. Water Quality Program Division, Oklahoma City, OK.

Standard Operating Procedure F-11
Groundwater Sampling and Field Measurement Procedures

This standard operating procedure (SOP) sets forth the field procedures for the sampling of groundwater. The procedures include monitoring well inspection, groundwater elevation measurement, decontamination of nondedicated sampling equipment, and groundwater sampling. A separate SOP, F-15 is included for well construction activities.

Monitoring Well Inspection

The condition of the monitoring wells will be inspected and documented during each sampling event prior to the collection of data. The following information will be noted on a monitoring well inspection form (Attachment B):

- The ground surface condition around the well (vegetation, safety hazards, access hazards, etc.)
- Well security features (presence of lock, lock key number, protective bollards, paint, visibility devices, evidence of tampering, traffic hazards, etc.)
- Condition of the well surface completion, including surface protector, protector cover, inner casing cap or plug, and concrete pad
- Evidence of potential contamination at the wellhead, including staining or suspicious containers

Groundwater Elevation Measurement

In order to determine the static water elevation (SWE), the static water level (SWL) will be measured prior to purging and sampling at each monitoring well in the sampling program. All static water level measurements will be obtained on the first day of the sampling event or within a 24-hour period, except as described in the following section. The measurements will be obtained prior to purging the monitoring wells for water quality sampling. Each well has a top-of-casing (TOC) reference point marked on it, from which all water level measurements will be taken. The vertical reference points have been surveyed to the nearest 0.01 foot and referenced to North American Vertical Datum (NAVD) 88.

Decontamination Procedures for Nondedicated Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.

3. Rinse with deionized (DI) or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Groundwater Sampling Procedures

The wells will be developed to ensure that the wells have a good hydraulic connection with the shallow aquifer. The wells will be developed by surging and purging with a surge block and submersible pump system. Well development will be performed until the water discharged from the wells is free of sediment, if possible. Well development procedures involving the introduction of water will be performed in consultation with the U.S. EPA and are further described in SOP-15, included in this FSAP.

Groundwater samples from monitoring wells will be collected using a low-flow sampling methodology specifically designed for the project specific analytical sampling as described in the workplan. Low-level sampling and analytical methods will be used for mercury, as appropriate. The sampling will be consistent with Attachment 7 (MDEQ, 2004).

Low-level mercury sample collection is performed by a strict protocol designed to minimize contamination. The protocol involves a two-person team approach. One member of the team is designated as “Dirty Hands,” and the second member is designated as “Clean Hands.” “Clean Hands” handles all operations involving contact with the sample bottle and transfer of the samples from the tubing or pump outlet to the sample bottle. “Dirty Hands” prepares the sampling equipment, operates the sampling equipment, and is responsible for any other activities that do not involve direct contact with the sample. Non-talc gloves and lint-free outer clothing are required to protect the samples from contamination by lint and dust. Sampling equipment, materials, and containers are cleaned and double-

bagged for protection from contamination during storage and transportation. The field equipment is decontaminated with deionized water. The samples are preserved with high-purity, diluted hydrochloric acid (HCL).

Each monitoring well will be pumped using a peristaltic pump and fluoropolymer tubing. At wells where the depth to water is greater than 20 feet, a QED bladder pump (or equivalent) will be used instead of the peristaltic pump. The bottom of the tubing (or bladder pump intake) will be placed approximately 1 to 2 feet above the base of the well screen, and the well will be pumped at a flow rate ranging from 0.1 to 0.7 liter/min. The pumping rate for each monitoring well is dependent on the hydraulic properties of the formation the well is screened across, and will be determined in the field to be the highest flow rate attainable without creating drawdown greater than approximately 0.1 meter, or at a minimum of 100 mL/min. In the event that the aquifer transmissivity is too low to yield sufficient water to limit drawdown to 0.1 meter at the lowest specified pumping rate (0.1 liter/min), sampling will be conducted at the 0.1 liter/min rate since this is the minimum flow rate necessary for accurate measurements through the flow-through cell.

A Geotech P3 flow-through cell (or equivalent) equipped with temperature, turbidity, dissolved oxygen, specific electrical conductance, and pH electrodes will be connected to the discharge tubing from the peristaltic pump. Equipment operation manuals for this meter is included in this SOP. In addition, a hard copy of the instruction manual specific for the field instrument will be available in the field during implementation activities. If this specific model is unavailable at the time of sampling, a comparable model will be substituted and the appropriate version of the instruction manual will be provided to the USEPA in the next monthly progress report. Each of these parameters will be measured at each well during purging to evaluate stabilization. Wells will be considered stable when the following conditions apply between three successive 1-liter sampling intervals:

- The temperature change is within 0.5°C.
- The conductance change is within 20 µhmos/cm.
- The turbidity change is ± 10 percent or <10 NTUs.
- The dissolved oxygen change is within 0.5 mg/L.
- The redox (Eh) change is within 30 mv.
- The pH change is within 0.2 pH units.

The wells will be sampled immediately following stabilization. The samples will be taken from the pump discharge after the flow-through cell has been disconnected. The low-level mercury sample will be collected first following the Clean Hands/Dirty Hands method described in Attachment 7 (MDEQ, 2004). The remaining sample bottles will then be collected from the pump discharge.

Regardless of the sampling technique used, efforts will be made to minimize agitation/disturbance of samples during purging and sampling activities. Likewise, efforts will be made to avoid purging wells dry if at all possible.

Groundwater purged during sampling, used pump tubing, and other general waste materials generated by the sampling process will be collected and managed as investigation-derived waste.

Calibration Procedures - The pH, ORP, specific conductance, turbidity, and dissolved oxygen meters will be calibrated daily in accordance with manufacturer's instructions. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel. Calibration information will be recorded in the field logbook.

Operation Procedures - The sampling pump, flow-through cell, and meters will be operated according to the manufacturer's instructions. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel.

Maintenance Procedures - The sampling pump, flow-through cell, and meters will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field logbook. Replacement sampling pumps, flow-through cells, and meters will be available on-site or ready for overnight shipment, as necessary. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel.

Sample Handling and Chain of Custody

Field personnel will be aware of the holding times for specific parameters and will make arrangements to have the samples delivered to the laboratory to meet these holding times. No samples will be held overnight for field activities lasting longer than 1 day. All samples will be stored on ice after collection and shipped to the laboratory on the same day on which they are collected.

This Chain-of-Custody documentation enables possession of a sample to be traced from sample collection through analysis and disposal. A Chain-of-Custody protocol will be established to document control of the samples from the point of collection to delivery to the analytical laboratory. Samples will be under the custody of a designated person at all times. The control of custody will be documented on a Chain-of-Custody form supplied by the laboratory. The Chain-of-Custody form will document the names, signatures, and affiliations of personnel in custody of the samples, and the dates and times custody was transferred. The sampling personnel will be responsible for sample custody in the field. The laboratory sample custodian and analysts will be responsible for custody of the sample at the laboratory.

A copy of the Chain-of-Custody form will be placed in the project files, and the original will accompany the samples to the laboratory. The identity of field duplicate samples will not be disclosed to the analytical laboratory. Sample analysis request forms will be prepared by sampling personnel and

reviewed by the project coordinator or project manager. The analytical request forms will either accompany the samples to the laboratory or will precede the delivery of samples to the laboratory.

Shipping containers will be sealed and will be accompanied by the Chain-of-Custody form, with appropriate signatures. The transfer of custody is the responsibility of the sampling personnel and the laboratory staff. The procedures to be implemented are as follows:

- Place completed chain-of-custody forms in a plastic bag, seal the bag, and tape it to the inside cover of the shipping container.
- After the samples are iced, seal the coolers with strapping tape and custody seals (if applicable), add the date to the custody seals, and ship the coolers to the laboratory using overnight delivery or by delivering them directly to the laboratory.
- Identify common carriers or intermediate individuals on the Chain-of-Custody form, and retain copies of all bills-of-lading.
- When the samples are received in the laboratory, handle and process them in accordance with the procedures in the laboratory's standard operating procedures (SOPs), or specified analytical methods.

In the laboratory, a sample custodian will be assigned to receive the samples. Upon receipt of the samples, the custodian will inspect the condition of the samples, reconcile the samples received against the Chain-of-Custody form, check the temperature of the samples, log the samples in the laboratory log book, and store the samples in a secured sample storage room or cabinet maintained at an appropriate temperature until assigned to an analyst for analysis. Custody will be maintained until the samples are discarded.

When samples requiring preservation by either acid (except samples for VOC analysis) or base are received at the laboratory, the pH will be measured and documented. The laboratory sample custodian will adjust the pH, if necessary, and will notify the laboratory Quality Assurance/Quality Control (QA/QC) Coordinator of the pH adjustment so that sample collection procedures can be reviewed to determine if a modification is necessary.

Discrepancies observed between the samples received, the information on the Chain-of-Custody form, and the sample analysis request sheet will be resolved before the sample is assigned for analysis. The laboratory QA/QC Coordinator will be informed of any such discrepancy, as well as its resolution. Results of the inspection will be documented in the laboratory sample logbook. Discrepancies will be documented in the analytical case narrative, as appropriate.

Field Filtering

Scope and Application:

This method is applicable to groundwater sampling. Field filtration will be performed if dictated by the project Work Plan. Field filtering is required for some parameter, including but not limited to dissolved metals (unless samples are sent unpreserved to the laboratory and analyzed within 24 hours of collection) and dissolved organic carbon (DOC). Sediment presence can interfere or bias sample results; false positive findings have been observed when turbid samples for hexavalent chromium (and other analytes) are analyzed. Field filtration can eliminate this concern; generally applicable to only inorganic/DOC/PCB analysis. In line disposable filter cartridges are generally the easiest and quickest method for field filtration.

Equipment: In line disposable 0.45 μm filter cartridges.

Procedure:

- Purge the monitoring well to achieve stabilization prior to sampling.
- Attach the in-line disposal filter cartridge to the sample tubing.
- Collect the groundwater sample.
- Use a new filter at each location and discard used filters following appropriate procedures after each use.
- Repeat steps 1 through 3 for each sample.

References

MDEQ. 2004. Remediation and Redevelopment Division operation memorandum Number 2, Appendix 7.

Standard Operating Procedure F-12
Ambient Air Monitoring for Fugitive Dust

This standard operating procedure (SOP) is applicable to fugitive dust monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for fugitive dust monitoring may include the following:

- Miniram monitor or equivalent
- Personal attachment pump (if performing active air sampling)
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Airborne particles will be measured using an MIE, Inc., Miniram monitor or equivalent. This is a hand-held field instrument that measures dust concentrations in the range of 0.001 to 400 milligrams/cubic meter (mg/m^3). The Miniram monitor displays the 10-second averaged concentration, as well as the real-time concentration, on a direct-read liquid-crystal display.

Operational Procedures

General Information

On each day that fugitive dust monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken

- Maintenance performed
- Monitoring results
- Miniram calibrations
- Concerns or complaints from the public

Meter Calibration

Prior to initiating fugitive dust monitoring, calibrate the Miniram monitor in accordance with the manufacturer's recommended procedures.

Data Collection

- Before initiating data collection, zero the Miniram monitor in a particle-free area, in accordance with the manufacturer's recommended procedures.
- Conduct passive or active air sampling, as follows:
    - **Passive Air Sampling** – The collection of passive air samples involves allowing ambient air to freely access the sensing chamber of the instrument by means of convection, diffusion, and adventitious air motion. No additional equipment (i.e., pump) needs to be connected to the Miniram monitor.
    - **Active Air Sampling** – The collection of active air samples involves connection of a personal attachment pump to the Miniram monitor. The pump flow rate is set at 2 L/min for standard applications, but can be adjusted according to the anticipated particle size.
- Record the following measurements: run start time and date, time-averaged concentration, elapsed run time, maximum and short-term exposure limits (STEL) with times of occurrence, and end run time.
- Download the data from the Miniram monitor to a computer.

Maintenance Procedures

The Miniram monitor will be maintained according to the manufacturer's instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-13
Ambient Air Monitoring for VOCs

This standard operating procedure (SOP) is applicable to ambient volatile organic compound (VOC) monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for ambient VOC monitoring may include the following:

- Photoionization detector (PID)
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Organic vapors will be measured using a PID, or equivalent. This is a hand-held field instrument that measures the concentration of organic vapors in the range of 0.1 to 1,000 ppm.

Operational Procedures

General Information

On each day that ambient VOC monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken

- Maintenance performed
- Monitoring results
- PID calibrations

Meter Calibration

Prior to initiating ambient VOC monitoring, the PID will be calibrated in accordance with the manufacturer's recommended procedures. In addition, the PID will be recalibrated in accordance with the operating procedures.

Data Collection

- Power the PID on. The liquid crystal display (LCD) displays the real-time organic vapor concentration while the PID is running.
- Wait for the concentration to stabilize before recording a value.

Maintenance Procedures

The PID will be maintained according to the manufacturer's instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-14
Real-Time Turbidity Measurement Procedures for Surface Water

This standard operating procedure (SOP) sets forth the field procedures for the collection of surface water samples from shore for the measurement of turbidity.

Equipment

Equipment needed for turbidity monitoring may include the following:

- Hand-held turbidity meter
- Polyethylene scoop with an extended handle
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Turbidity will be measured using a hand-held turbidity meter.

Operational Procedures

General Information

On each day that turbidity monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken
- Maintenance performed
- Monitoring results
- Turbidity meter calibrations
- Concerns or complaints from the public

Meter Calibration

Prior to initiating turbidity monitoring, calibrate the turbidity meter in accordance with the manufacturer's recommended procedures.

Surface Water Sampling Procedures

Surface water samples will be collected using a polyethylene scoop with an extended handle and analyzed using a hand-held turbidity meter. Prior to initiating field activities, the turbidity meter will be calibrated according to the manufacturer's instructions, and the calibration data will be recorded in the logbook or on the Water Quality Meter Calibration Log. The procedures for collection of the surface water samples are provided below.

1. Record the sample location on the sample log or in field notebook, along with other appropriate information (include a sketch indicating location relative to shore features, if appropriate).
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Lower the scoop into the water, and raise it from the water column with minimal disturbance.
4. Measure the turbidity of the sample, and record it in a logbook or on a Surface Water Sampling Log.

Maintenance Procedures

The turbidity meter will be maintained according to the manufacturer's instructions. A replacement meter will be ready for overnight shipment, if needed.

Standard Operating Procedure F-15
Monitoring Well Installation Procedures

This standard operating procedure (SOP) sets forth the field procedures for the installation of monitoring wells.

Equipment

Equipment needed for installation of monitoring wells may include the following:

- Personal Protective Equipment (PPE) and safety equipment;
- Decontamination equipment;
- Maps, figures, or plot plans;
- Drilling method is selected based on site geologic and hydrogeologic conditions;
- PVC well screen and riser pipe;
- Stainless steel well screen and riser pipe;
- Stainless steel screen and black iron (low carbon steel) riser pipe;
- Stainless steel screen and PVC riser pipe;
- Sand pack;
- Filter pack placement;
- Bentonite seal;
- Grout;
- Protective casings and well caps;
- Surface seal;
- Protective posts (if required);
- Well development equipment including waterra, surge block, pumping/overpumping/backwashing, bailing, or airlifting;
- Camera and film; and
- Logbook.

Decontamination Procedures

Prior to use and between each borehole location, drilling and sampling equipment must be decontaminated in accordance with the Work Plan, the QAPP, or the methods presented in the following section.

The minimum wash procedures for decontamination of drilling equipment are:

- High pressure hot water detergent wash (brushing as necessary to remove particulate matter); and
- Potable, hot water, high pressure rinse.

Cover the clean augers with clean plastic sheeting to prevent contact with foreign materials. For geotechnical, geologic, or hydrogeologic studies where no contaminants are present, it is sufficient to clean the drilling or excavating equipment simply by removing the excess soils.

Monitoring Well Installation Procedure

1. Select the exact location of each well consistent with the site and project requirements. If a well must be relocated more than 20 feet (5.7 m) from the initially identified location, confirm the new location's suitability with the Project Coordinator. Ensure all utilities have been cleared prior to initiating borehole advancement activities;
2. To the extent practical, wells should be located adjacent to permanent structures (e.g., fences, buildings) that offer some form of protection and a reference point for future identification. Wells located in high traffic areas or road allowances or low lying wet areas are undesirable, but may be unavoidable. Field tie ins must be completed to accurately identify each well location. These will ensure that the wells are properly identified on plans and for future identification in the field;
3. The following drilling methods are listed in order of preference. However, final selection will be based on Site geologic and hydrogeologic conditions. During drilling activities, it is required that detailed descriptions of the Site geologic conditions be documented:

    a. Hollow Stem Augering (HAS);
    b. Direct Push Drilling;
    c. Dual Wall Reverse Circulation Air Drilling;
    d. Rotosonic Drilling; and
    e. Rotary Method.

4. The diameter of a well is primarily dictated by the purpose of the well. Generally, wells installed for groundwater and hydraulic monitoring should be between 1 and 2 inches in diameter. The diameter is also dependent on the drilling method being used;
5. Screen length should be consistent with the hydrogeologic conditions and the desired monitored interval. A 5 to 10-foot long screen is suitable for groundwater table wells when the screen is completely submerged and a specific monitoring interval is required;
6. Well slot sizes are described in thousandths of an inch. For most monitoring wells, a No. 10 slot (0.01 inch) well screen is adequate in most hydrostratigraphic units. PVC wells screens are typically available in No. 10 (0.01 inch) or No. 20 (0.02 inch) slot sizes. Stainless steel screens are available in a wider range of slot sizes. Typically, stainless steel screens must be specially ordered and require additional delivery time. Wells screens can be slotted, continuous slot, or louvered. Well points come in very limited slot sizes;
7. The silica sand pack placed around the well screen should be no finer than the slot size of the screen. Grain size curves should be obtained from the driller or well materials supplier to ensure proper sand size prior to placement;
8. All wells must be properly sealed. A seal is placed over the silica sand pack. Cuttings must never be used to seal a well. Certain well applications require specific well seals including bentonite gravel or chips, bentonite grout, cement/bentonite grout, and cement

grout. Prior to initiating well installation activities, confirm sealing requirements with local, state/provincial, or federal regulations;

9. Well installation requires the components includes annular space, instrumentation details, filter pack placement, bentonite seal, grouting, protective casings and well caps, surface seal, protective posts (if required);
10. Prior to installation through the auger or into the borehole, the well assembly (i.e., well screen and riser components) and the length of each component must be measured and recorded. The borehole must be measured to ensure installation at the desired interval to be monitored;
11. Placement of the primary filter pack is as follows:

    i. The primary filter pack is placed using the tremie line method;
    ii. A minimum 6 inches of the primary filter pack material is placed under the bottom of the well screen. This interval of primary filter pack provides a firm footing for the well;
    - Where DNAPL is present, or is being monitored for, the well may be sumped into a confining unit. In this case, no primary filter pack is placed under the bottom of the well screen;
    - The top of the primary filter pack is determined in the field based on the geologic and hydrogeologic conditions encountered during borehole advancement;
    - The primary filter pack should extend a minimum of 2 feet above the top of the well screen;
    - For shallow overburden wells it is common to extend the primary filter pack to about 2 feet above the water table to account for anticipated seasonal groundwater fluctuations;
    - In shallow overburden wells the sand pack should not be extended across a native and fill unit. For deeper overburden wells, it is common to select a specific hydrogeologic unit to monitor; and
    - The primary filter pack should never extend through a confining unit causing two or more permeable units to become connected.

12. Placing the primary filter pack by pouring may be acceptable if measurements are taken to ensure that the filter pack is reaching the assigned depth;
13. Install the secondary filter pack. The secondary filter pack is finer than the primary filter pack. The first secondary filter pack prevents the intrusion of grout from reaching the primary filter pack. The final secondary filter pack limits the migration of grout material into the bentonite seal. Generally, a bentonite seal over the primary filter pack is sufficient to stop grout from reaching the primary filter pack;
14. Install a protective casing over the completed well and sealed in place. Once installed and grouted, the casing should extend about 2.5 feet above ground surface. The outer protective casing is made of steel and has a locking cap that is hinged, waterproof, and resistant to vandalism. The protective casing should have sufficient clearance around the inner well casing so that no contact is made with the outer protective casing;

15. Install flush a concrete surface seal to promote drainage away from the outer protective casing at a depth below the frost line to deter frost heaving. Check local, state/provincial, and federal regulations pertaining to requirements for concrete surface seals;

16. The well is installed as follows:

- Before placing the well assembly at the bottom of the borehole, place at least 6 inches of filter pack at the bottom of the borehole to serve as a footing;
- If monitoring for DNAPL, the well assembly may be set directly on the bottom of the borehole. Place the well into the borehole plumb;
- On a well installed to a depth greater than 50 feet, centralizers are required. Place the centralizers on the well casing or well assembly above the proposed bentonite seal interval. Place the centralizers so as not to interfere with the placement of the filter pack, bentonite seal, and annular grout. (Generally, wells less than 50 feet deep will not require centralizers unless required by local, state / provincial, or federal regulations, or the Work Plan.);
- During well installation through a HSA, slowly pull back the auger as the filter pack, bentonite seal, and annular grout are tremied or poured in place;
- When the well has been lowered into the borehole, place the filter pack around and above the top of the screen, as required;
- When the filter pack has been installed, place a minimum 2-foot thick bentonite seal directly on top of the filter pack;
- Allow the bentonite seal to hydrate for a reasonable amount of time (generally, 30 minutes is sufficient);
- When the bentonite seal has hydrated sufficiently, seal the remaining borehole annular space grout placed with a tremie line using positive displacement methods. Generally, the grout will be brought to 2 feet (0.6 m) below ground surface or below the frost line, whichever is greater. In situations where no concrete seal is being placed, the grout can be brought to 0.5 to 1 foot (0.15 to 0.3 m) below ground surface;
- During grout placement, ensure the end of the tremie line is always submerged in the grout to ensure positive displacement;
- During grout placement on contaminated sites, containerize all fluids for future disposal;
- Allow the grout to set for about 24 hours before installing the concrete surface seal. If the grout level has subsided, top off the borehole annular space with grout or bentonite pellets to the required depth; and

- Install protective casings in a minimum 2-foot (0.6 m) thick concrete surface seal graded to divert surface water away from the monitoring well. Check local, state / provincial, and federal regulations for concrete surface seal requirements. Some agencies require that concrete pads be constructed around the wells.

17. When installation is complete, label the well in at least two locations for future identification;
18. After installation of the monitoring well ensure that monitoring wells are installed and develop properly;
19. Record activities undertaken in the field correctly and completely in a bound field books; and
20. Notify the Project Manager or Project Coordinator of any improprieties or failures on the part of the contractor.

Surveying Activities

Geodetic benchmark elevations are established relative to a vertical datum such as Mean Sea Level. Benchmarks (BM), at the national level, are precisely established by federal agencies utilizing first order survey methods and first order instruments. The same high requirements are also specified for state and provincial networks. Wherever possible, the use of geodetic benchmarks is recommended.

Please refer to SOP F-5 for more information on surveying activities.

Standard Operating Procedure F-16
Surface Water Sampling Procedures

This standard operating procedure (SOP) sets forth the field procedures for surface water sampling.

Equipment

Equipment needed for installation of monitoring wells may include:

- Bailers;
- Fluoropolymer (FEP, PTFE) sample bottles/preservatives;
- Ziploc bags;
- Ice;
- Coolers;
- Chain of Custody records, custody seals;
- Field data sheets;
- Decontamination equipment;
- Maps/plot plan;
- Safety equipment;
- Compass;
- Tape measure;
- Camera and film;
- Logbook/waterproof pen; and
- Sample bottle labels.

Decontamination Procedures

Equipment is decontaminated between sampling locations and prior to leaving the site. Upon completion of the sampling program, all equipment is decontaminated at the site and then returned clean to the appropriate field equipment manager.

For surface water sampling programs, sampling equipment is cleaned as follows:

- Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates;
- Rinse with tap water;
- Rinse with deionized water;
- Air dry for as long as possible;
- Rinse with 10-percent nitric acid (only if samples are to be analyzed for metals);
- Rinse with deionized water;
- Rinse with appropriate solvent (pesticide grade isopropanol, methanol, acetone, hexane, if required);
- Rinse again with deionized water;

- Air dry for as long as possible; and
- Wrap samplers in aluminum foil to prevent contamination.

Surface Water Sampling Procedure

General

Surface water sampling is performed to obtain samples for surface water bodies that are representative of existing surface water conditions.

Surface water sampling locations for surface water quality and groundwater interaction studies are selected based on the following:

- Study objectives.
- Location of point surface discharges;
- Non point source discharges and tributaries;
- Presence of structures (e.g., bridge, dam); and
- Accessibility.

Surface Water Sample Location Selection

Prior to conducting surface water sampling activities, the first requirement is the consideration and development of surface water sampling locations. It is important that all surface water sampling locations be selected in accordance with the Work Plan and described to and discussed with the Project Coordinator. Representative surface water samples will be collected in sections of surface water bodies that have a uniform cross section and flow rate.

Surface water samples must be collected with no suspended sediments. Surface water samples are collected commencing with the furthest downstream location to avoid sediment interference with upstream locations.

Sampling Procedure

When collecting surface water samples, direct dipping of the sample container into the stream or water is acceptable unless the sample container contains preservatives. However, surface water samples being analyzed for low level mercury and methyl mercury requires preservatives for both filtered and unfiltered samples. Therefore, a pre-cleaned unpreserved sample container should be used to collect the surface water sample. The surface water sample is then transferred to the appropriate preserved sample container. When collecting surface water samples, submerse the inverted bottle to the desired sample depth and tilt the opening of the sample container upstream to fill. During surface water sample collection, wading or movement may cause sediment deposits to be re-suspended and can result in biased samples. Wading is acceptable if the stream has a noticeable current and the samples are collected directly in the sample container when faced upstream. If the stream is too deep to wade in or if addition samples must be collected at various depths, additional sampling

equipment will be required. Surface water samples should be collected about 6 inches (15 cm) below the surface, with the sample bottles being completely submerged. Taking the surface water sample at this depth eliminates the collection of floating debris in the sample container.

Surface water sample collection where the flow depth is less than 1 inch (<2.5 cm) requires the use of special equipment to eliminate sediment disturbance. Surface water sampling may be conducted with a container then transferred to the appropriate sample container, or collection may be performed using a peristaltic pump. A small excavation in the stream bed to create a sump for sample collection can also be considered but should be prepared in advance to allow all the sediment to settle prior to surface water sampling activities.

Teflon™ bailers can be used for surface water sampling if it is not necessary to collect surface water samples at specific depths. A bottom loading bailer with a check ball is sufficient. When the bailer is lowered through the water, the water is continually displaced through the bailer until the desired depth is reached. The bailer is retrieved and the check ball prohibits the release of the collected surface water sample. Bailers are not suitable in surface water bodies with strong currents, or where depth specific sampling is required.

In all instances, properly document all surface water sampling locations in a standard CRA field book. Documentation may include photographs and tie ins to known structures.

Standard Operating Procedure F-17
Vertical Aquifer Sampling Procedures

This standard operating procedure (SOP) sets forth the field procedures for the completion of vertical aquifer sampling (VAS).

Equipment

Equipment needed for installation of monitoring wells may include the following:

- Personal Protective Equipment (PPE) and safety equipment;
- Decontamination equipment;
- Sample bottles/preservatives;
- Ziploc bags;
- Ice;
- Coolers;
- Chain of Custody records, custody seals;
- Field data sheets;
- Decontamination equipment;
- Bottle labels;
- Maps, figures, or plot plans;
- SP16 Sampler Sheath sampler (other drilling method may be selected based on site geologic and hydrogeologic conditions);
- Screen, wire-wound Stainless Steel,
- Bailer or mini-bailers;
- Bentonite grout Bailer;
- Protective posts (if required);
- Camera and film; and
- Logbook.

Decontamination Procedures

Prior to use and between each borehole location, drilling and sampling equipment must be decontaminated in accordance with the Work Plan, the QAPP, or the methods presented in the following section.

The minimum wash procedures for decontamination of drilling equipment are:

- High pressure hot water detergent wash (brushing as necessary to remove particulate matter); and
- Potable, hot water, high pressure rinse.

Cover the clean augers with clean plastic sheeting to prevent contact with foreign materials. For geotechnical, geologic, or hydrogeologic studies where no contaminants are present, it is sufficient to clean the drilling or excavating equipment simply by removing the excess soils.

Sampling Procedure

1. Select the exact location of each VAS locations consistent with the site and project requirements. If the VAS location must be relocated more than 20 feet (5.7 m) from the initially identified location, confirm the new location's suitability with the Project Manager. Ensure all utilities have been cleared prior to initiating borehole advancement activities;
2. To the extent practical, VAS location should be located adjacent to permanent structures (e.g., fences, buildings) that offer some form of protection and a reference point for future identification. Field tie ins must be completed to accurately identify each location. These will ensure that the VAS locations are properly identified on plans and for future identification in the field;
3. The drill rig will be set up at the drilling location;
4. Soil borings will be advance to predetermined depths using direct push technologies;
5. Upon advancement of soil boring to predetermined interval, soil cores will be retrieved and examined for presence of visual and/or olfactory evidence of impact, and will be screened across their entire length using a PID to determine relative concentrations of undifferentiated volatile organic vapors. At each soil boring, soil samples will be collected on a continuous basis as described in SOP F-5;
6. Geoprobe® Screen Point 16 Groundwater Sampler (1.6 in. outer diameter screen sheath) will be driven to depth within a sealed, steel sheath. Once the sampling interval is reached, an extension rod equipped with an insert tool will be used to hold the screen in place at the base of the cutting shoe. The outer sheath then will be retracted as the screen is held in position with the extension rods. As the rod is retracted, the screen will be exposed to the formation and groundwater will be collected using a bailer. Purging of the groundwater is not required prior to sample collection;
7. Measurement of water levels before retracting sheath and after retracting sheath to ensure that only formation water is present. Water levels will be recorded the field notes;
8. Groundwater sample will be placed in Laboratory supplied containers, packed in coolers supplied with ice, and will be shipped to laboratory under chain of custody protocols; and
9. Sample information will be documented in field notebook and field sample key; and
10. Equipment will be decontaminated for re-use.

It is noted that the Project Manager or Project Coordinator should be notify of any improprieties or failures during the field activities.

Surveying Activities

Geodetic benchmark elevations are established relative to a vertical datum such as Mean Sea Level. Benchmarks (BM), at the national level, are precisely established by federal agencies utilizing first order survey methods and first order instruments. The same high requirements are also specified for state and provincial networks. Wherever possible, the use of geodetic benchmarks is recommended. Please refer to SOP F-5 for more information on surveying activities.

References

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U.S. EPA, 2005, Groundwater Sampling and Monitoring with Direct Push Technologies, U.S. EPA Office of Solid Waste and Emergency Response, Washington, DC., August 2005,

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ATTACHMENT B

EXAMPLE FORMS/ LOGS

Date: _____ Reference No.: _____

PROJECT PLANNING COMPLETION AND FOLLOW-UP CHECKLIST

PRIOR PLANNING AND COORDINATION:

- ☐ Confirm well numbers, location and accessibility
- ☐ Review of project documents, Health and Safety Plan (HASP), sampling Quality Assurance/Quality Control (QA/QC) and site-specific sampling requirements
- ☐ Historical well data; depth, pH, performance and disposition of purge water
- ☐ Site access notification and coordination
- ☐ Coordination with laboratory through CRA Chemistry Group
- ☐ Procurement, inventory and inspection of all equipment and supplies
- ☐ Prior equipment preparation, calibration or maintenance
- ☐ All utilities located and approved

FIELD PROCEDURE:

- ☐ Instruments calibrated daily
- ☐ Sampling equipment decontaminated in accordance with the QAPP
- ☐ Field measurements and sampling details logged in appropriate field books or an appropriate field form
- ☐ Well volume calculated and specified volumes removed
- ☐ Specified samples, and QA/QC samples taken per Quality Assurance Project Plan (QAPP)
- ☐ Samples properly labeled, preserved and packed
- ☐ Sampling locations secured or completed according to Work Plan
- ☐ Sample date times, locations and sample numbers have all been recorded in applicable log(s)
- ☐ Samples have been properly stored if not shipped/delivered to lab same day
- ☐ Samples were shipped with complete and accurate Chain of Custody Record

FOLLOW-UP ACTIVITIES:

- ☐ Questionable measurements field verified
- ☐ Confirm all samples collected
- ☐ All equipment has been maintained and returned
- ☐ Sampling information reduced and required sample keys and field data distributed
- ☐ Chain of Custody Records filed
- ☐ Expendable stock supplies replaced
- ☐ CRA and client-controlled items returned (i.e., keys)
- ☐ Arrange disposal of investigation generated wastes with client
- ☐ Confirm all samples collected

Completed by: _____ Date: _____

CRA

WELL PURGING FIELD INFORMATION FORM

JOB# _____ - _____

SITE/PROJECT NAME: _____ WELL# _____

WELL PURGING INFORMATION

PURGE DATE (MM DD YY)	SAMPLE DATE (MM DD YY)	WATER VOL. IN CASING (LITRES/GALLONS)	ACTUAL VOLUME PURGED (LITRES/GALLONS)

PURGING AND SAMPLING EQUIPMENT

PURGING EQUIPMENT.....DEDICATED Y N (CIRCLE ONE)

SAMPLING EQUIPMENT.....DEDICATED Y N (CIRCLE ONE)

PURGING DEVICE [ ] A - SUBMERSIBLE PUMP B - PERISTALTIC PUMP D - GAS LIFT PUMP E - PURGE PUMP G - BAILER H - WATERRA® x- _____ PURGING OTHER (SPECIFY)

SAMPLING DEVICE [ ] C - BLADDER PUMP F - DIPPER BOTTLE x- _____ SAMPLING OTHER (SPECIFY)

PURGING MATERIAL [ ] A - TEFLON B - STAINLESS STEEL D - PVC E - POLYETHYLENE x- _____ PURGING OTHER (SPECIFY)

SAMPLING MATERIAL [ ] C - POLYPROPYLENE x- _____ SAMPLING OTHER (SPECIFY)

TUBING PURGING [ ] A - TEFLON B - TYGON D - POLYPROPYLENE E - POLYETHYLENE F - SILICONE G - COMBINATION TEFLON/POLYPROPYLENE x- _____ PURGING OTHER (SPECIFY)

TUBING SAMPLING [ ] C - ROPE x- _____ (SPECIFY) x- _____ SAMPLING OTHER (SPECIFY)

FILTERING DEVICES 0.45 [ ] A - IN-LINE DISPOSABLE B - PRESSURE C - VACUUM

FIELD MEASUREMENTS

WELL ELEVATION _____ (m/ft) GROUNDWATER ELEVATION _____ (m/ft)

DEPTH TO WATER _____ (m/ft) WELL DEPTH _____ (m/ft)

pH	TURBIDITY	CONDUCTIVITY	SAMPLE TEMPERATURE
(std)	(ntu)	(µm/cm) AT 25°C	(°C)
(std)	(ntu)	(µm/cm) AT 25°C	(°C)
(std)	(ntu)	(µm/cm) AT 25°C	(°C)
(std)	(ntu)	(µm/cm) AT 25°C	(°C)
(std)	(ntu)	(µm/cm) AT 25°C	(°C)

FIELD COMMENTS

SAMPLE APPEARANCE: _____ ODOR: _____ COLOR: _____ TURBIDITY: _____

WEATHER CONDITIONS: WIND SPEED _____ DIRECTION _____ PRECIPITATION Y/N OUTLOOK _____

SPECIFIC COMMENTS _____

I CERTIFY THAT SAMPLING PROCEDURES WERE IN ACCORDANCE WITH APPLICABLE CRA PROTOCOLS

CRA

DATE _____ PRINT _____ SIGNATURE _____

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME _____ PROJECT NO. _____

SAMPLING CREW MEMBERS _____ SUPERVISOR _____

DATE OF SAMPLE COLLECTION _____

[Note: For 2" dia. well, 1 ft. = 0.14 gal (imp) or 0.16 gal (us)]

Sample I.D. Number	Well Number	Measuring Point Elev. (ft. AMSL)	Bottom Depth (ft. btoc)	Water Depth (ft. btoc)	Water Elevation (ft. AMSL)	Well Volume (gallons)	Bailer Volume No. Bails	Volume Purged (gallons)	Field pH	Field Temp.	Field Cond.	Time	Sample Description & Analysis

Additional Comments: _____

Copies to: _____

CRA

MONITORING WELL RECORD FOR LOW-FLOW PURGING

Project Data:

Project Name: _____ Date: _____

Ref. No.: _____ Personnel: _____

_____

Monitoring Well Data:

Well No.: _____

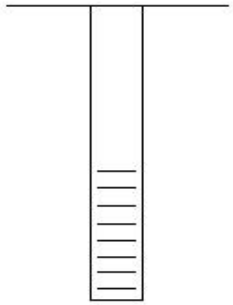
Vapour PID (ppm): _____ Saturated Screen Length (m/ft): _____

Measurement Point: _____ Depth to Pump Intake (m/ft)[1]: _____

Constructed Well Depth (m/ft): _____ Well Diameter, D (cm/in): _____

Measured Well Depth (m/ft): _____ Well Screen Volume, V_s (L)[2]: _____

Depth of Sediment (m/ft): _____ Initial Depth to Water (m/ft): _____



Time	*Pumping Rate (mL/min)*	*Depth to Water (m/ft)*	*Drawdown from Initial Water Level (3) (m/ft)*	*Temperature ° C*	*Conductivity (mS/cm)*	*Turbidity NTU*	*DO (mg/L)*	*pH*	*ORP (mV)*	*Volume Purged, Vp (L)*	*No. of Well Screen Volumes Purged (4)*
			Precision Required (5) :	*±3 %*	*±0.005 or 0.01 (6)*	*±10 %*	*±10 %*	*±0.1 Units*	*±10 mV*		

Notes:

(1) The pump intake will be placed at the well screen mid-point or at a minimum of 0.6 m (2 ft) above any sediment accumulated at the well bottom.

(2) The well screen volume will be based on a 1.52 metres (5-foot) screen length (L). For metric units, $V_s=\pi*(r^2)*L$ in mL, where r (r=D/2) and L are in cm. For Imperial units, $V_s=\pi*(r^2)*L*(2.54)^3$, where r and L are in inches

(3) The drawdown from the initial water level should not exceed 0.1 m (0.3 ft). The pumping rate should not exceed 600 mL/min.

(4) Purging will continue until stabilization is achieved or until 20 well screen volumes have been purged (unless purge water remains visually turbid and appears to be clearing, or unless stabilization parameters are varying slightly outside of the stabilization criteria and appear to be stabilizing), No. of Well Screen Volumes Purged= Vp/Vs.

(5) For conductivity, the average value of three readings <1 mS/cm ±0.005 mS/cm or where conductivity >1 mS/cm ±0.01 mS/cm.

WATER LEVEL RECORD

PROJECT NAME: _____ LOCATION: _____

JOB NO. : _____ DATE: _____

CLIENT: _____ ENGINEER/GEOLOGIST: _____

OBSERVATION WELL	TOP OF CASING ELEVATION A		DEPTH TO WATER B		WATER LEVEL ELEVATION A-B	
	feet	metres	feet	metres	feet	metres

CRA

Date: _____ *Reference No.* _____

BOREHOLE INSTALLATION/SOIL SAMPLING EQUIPMENT AND SUPPLY CHECKLIST

INSTRUMENTS

- ☐ Steel Tape (50 foot)
- ☐ Air Monitoring Equipment
- ☐ Water Level Meter
- ☐ Pocket Penetrometer

SUPPLIES

- ☐ Foil
- ☐ Plastic Sample Bags
- ☐ Paper towels
- ☐ Decontamination Fluids (as required by QAPP)
- ☐ Deionized water
- ☐ Labels
- ☐ Sample knives
- ☐ Trash bags
- ☐ Plastic spray bottles
- ☐ Sampling Glassware
- ☐ Coolers

PERSONAL PROTECTIVE EQUIPMENT

- ☐ Tyveks (assorted sizes and types)
- ☐ Protective gloves
- ☐ Hard hats/liner(s)
- ☐ Field overboots
- ☐ Work gloves (cotton and chemical resistant)
- ☐ Safety glasses or OSHA-approved prescription lenses
- ☐ First Aid Kit
- ☐ Respirators and Cartridges
- ☐ Check Health and Safety Plan

DOCUMENTATION

- ☐ Notebook/Field book
- ☐ Photolog
- ☐ Site pass/badge
- ☐ Previous well logs/previous historical well data
- ☐ Site map
- ☐ Access Agreement Documentation
- ☐ Utility Clearance Documentation
- ☐ Stratigraphic Log (Overburden) - at least one for each 20 feet of drilling
- ☐ Chain-of-Custody Forms

MISCELLANEOUS

- ☐ Camera/film
- ☐ Spare batteries for instruments
- ☐ Carpenters Rule (6 foot)
- ☐ Clipboard
- ☐ Indelible Pen/pencil/indelible marking pen
- ☐ Tool box
- ☐ Spare locks/keys
- ☐ On Site Transportation (all Terrain Vehicle/Snowmobiles)

* Do not use pen with water soluble ink

Completed by: _____ *Date:* _____

CRA

STRATIGRAPHY LOG (OVERBURDEN)

PAGE ____ OF ____

PROJECT NAME _____
PROJECT NUMBER _____
CLIENT _____
LOCATION _____

DRILLING CONTRACTOR _____
DRILLER _____
SURFACE ELEVATION _____
WEATHER (A.M.) _____
(P.M.) _____

HOLE DESIGNATION _____
DATE/TIME STARTED _____
DATE/TIME COMPLETED _____
DRILLING METHOD _____
CRA SUPERVISOR _____

STRATIGRAPHIC INTERVALS (DEPTHS IN ft/m BGS)			SAMPLE DESCRIPTION	SAMPLE DETAILS											
FROM	AT	TO	ORDER OF DESCRIPTORS: SOIL TYPE SYMBOL(S) – PRIMARY COMPONENT(S), (NATURE OF DEPOSIT), SECONDARY COMPONENTS, RELATIVE DENSITY/CONSISTENCY, GRAIN SIZE/PLASTICITY, GRADATION/STRUCTURE, COLOUR, MOISTURE CONTENT, SUPPLEMENTARY DESCRIPTORS NOTE: PLASTICITY DETERMINATION REQUIRES THE ADDITION OF MOISTURE IF THE SAMPLE IS TOO DRY TO ROLL (INDICATE IF MOISTURE WAS ADDED OR NOT).	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS (RECORD N-VALUES & RECOVERIES) 6"	6"	6"	6"	N	R	SAMPLE INTERVAL	PID / FID (ppm)	CHEMICAL ANALYSIS	GRAIN SIZE

NOTES AND COMMENTS

DEPTH OF BOREHOLE CAVING _____ DEPTH OF FIRST GROUNDWATER ENCOUNTER _____ TOPSOIL THICKNESS _____

WATER LEVEL IN OPEN BOREHOLE ON COMPLETION _____, AFTER _____ HOURS _____

COMPLETION DETAILS: _____

NOTE: FOR EACH SPLIT–SPOON SAMPLE, RECORD BLOW COUNTS, N–VALUE, SAMPLE RECOVERY LENGTH, AND SAMPLE INTERVAL.

NOTES:

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.S.)

MAJOR DIVISIONS			GROUP SYMBOL	TYPICAL DESCRIPTION
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS MORE THAN HALF OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES, < 5 % FINES
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, < 5 % FINES
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, > 12 % FINES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, > 12 % FINES
	SANDS MORE THAN HALF OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SW	WELL GRADED SANDS, GRAVELLY SANDS, < 5 % FINES
			SP	POORLY GRADED SANDS, OR GRAVELLY SAND, < 5 % FINES
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES > 12 % FINES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES > 12 % FINES
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		ML	INORGANIC SILTS AND VERY FINE SAND, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
			OH	ORGANIC CLAYS OF HIGH PLASTICITY

CONVENTIONAL SOIL DESCRIPTIONS

NON-COHESIVE (GRANULAR) SOIL

RELATIVE DENSITY	BLOWS PER FOOT (N-VALUE)
Very loose	less than 5
Loose	5 to 9
Compact	10 to 29
Dense	30 to 50
Very Dense	greater than 50

COHESIVE (CLAYEY) SOIL

CONSISTENCY	BLOWS PER FOOT (N-VALUE)
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	greater than 30

GRAIN SIZE CLASSIFICATION

COBBLES	Greater than 3 inches (76 mm)
GRAVEL	3 in. to No. 4 (4.76 mm)
Coarse Gravel	3 in. to 3/4 in.
Fine Gravel	3/4 in. to No. 4 (4.76 mm)
SAND	No. 4 (4.76 mm) to No. 200 (0.074 mm)
Coarse Sand	No. 4 (4.76 mm) to No. 10 (2.0 mm)
Medium Sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine Sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
SILT	No. 200 (0.074 mm) to 0.002 mm
CLAY	Less than 0.002 mm

NOTE: The "No. __ " refers to the standard sieve sizes.

COMPONENT PERCENTAGE DESCRIPTORS

Noun(s) (e.g. SAND and GRAVEL)	35 to 50 %
Adjective (e.g. SANDY)	20 to 35 %
With	10 to 20 %
Trace	Less than 10 %

SOIL STRUCTURE TERMS

Stratified	Blocky
Laminated	Lenses/Seams
Fissured	Homogeneous

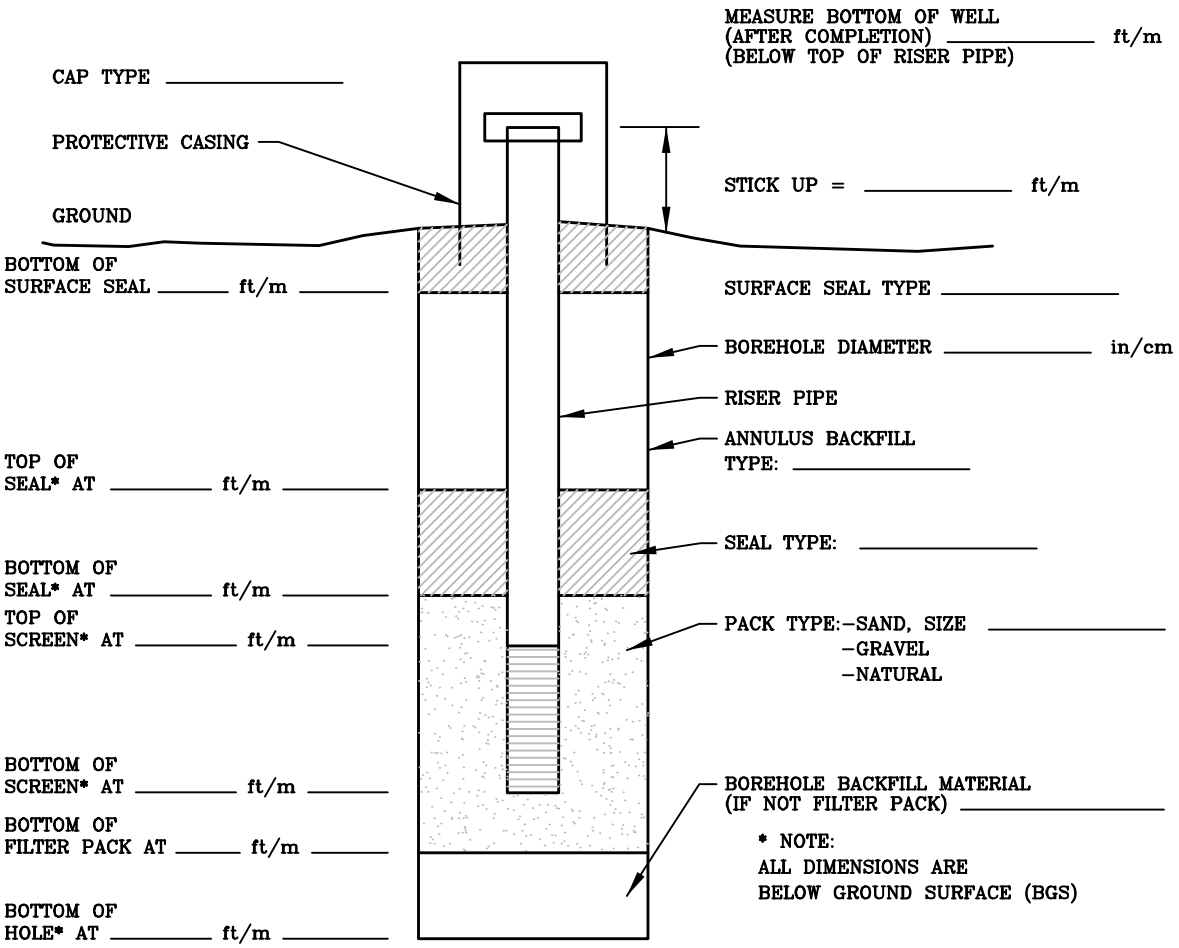
WELL INSTRUMENTATION LOG

PROJECT NAME _____ WELL DESIGNATION _____

PROJECT NUMBER _____ DATE COMPLETED _____

CLIENT _____ DRILLING METHOD _____

LOCATION _____ CRA SUPERVISOR _____



SCREEN TYPE: ☐ continuous slot ☐ wire wrapped ☐ louvre ☐ other: _____

SCREEN MATERIAL: ☐ stainless steel ☐ pvc ☐ other: _____

SCREEN LENGTH: _____ ft/m SCREEN DIAMETER: _____ in/cm SCREEN SLOT SIZE: _____

RISER PIPE MATERIAL: _____ RISER PIPE DIAMETER: _____ in/cm

SURFACE CASING (Y/N) _____ MATERIAL _____ DEPTH _____ ft/m

DIAMETER _____ in/cm SEALANT _____

DEVELOPMENT: METHOD: _____ DURATION: _____

DESCRIPTION OF PURGED WATER: _____

_____

Date: _____ *Reference No.* _____

EQUIPMENT AND SUPPLY CHECKLIST
SURFACE WATER SAMPLING, SEDIMENT SAMPLING, AND FLOW MEASUREMENT

INSTRUMENTS:

- ☐ Measuring tape
- ☐ Steel tape (100 ft)
- ☐ Air monitoring equipment
- ☐ Velocity meter
- ☐ Flow meter
- ☐ Depth recorder/data logger
- ☐ Calculator
- ☐ Laptop computer with communication cable
- ☐ Stop watch
- ☐ Camera

EQUIPMENT:

- ☐ Sampling telescopic pole
- ☐ Sampling scoop/bucket
- ☐ Boat/motor (if required)
- ☐ Bailers
- ☐ Kemmerer/Van Dorn sampler
- ☐ Peterson/Ponar Dredge
- ☐ Core sampler/split spoon sampler
- ☐ Stainless steel mix bowl
- ☐ Hand tools
- ☐ Other _____

SUPPLIES

- ☐ Foil
- ☐ Paper towels
- ☐ Decontamination Fluids (as required by Work Plan)
- ☐ Deionized Water
- ☐ Labels
- ☐ Sample knives
- ☐ Trash bags
- ☐ Sample Glassware
- ☐ T-bars/stakes
- ☐ Duct tape
- ☐ Markers
- ☐ Film
- ☐ Paint
- ☐ Thumbtacks

DOCUMENTATION

- ☐ Topographic Maps
- ☐ Notebook/Field book
- ☐ Photolog
- ☐ Site pass/badge
- ☐ Site Map
- ☐ Work Plan

PERSONAL PROTECTIVE EQUIPMENT:

- ☐ Waders/overboots
- ☐ Tyveks (if required)
- ☐ Life vest
- ☐ Safety line
- ☐ Protective gloves
- ☐ Hardhat
- ☐ Safety glasses
- ☐ First Aid Kit
- ☐ Check Health and Safety Plan

Completed by: _____ *Date:* _____

Date: _____ *Reference No.* _____

LANDFILL GAS MONITORING EQUIPMENT AND SUPPLY CHECKLIST

INSTRUMENTS:

- o Water level indicator (Narrow Diameter) with measuring tape
- o Steel Tape
- o Plopper
- o Air Monitoring Equipment
- o Combustible Gas Instrument
- o Pressure Measuring Instrument
- o Digital Thermometer

SUPPLIES:

- o Foil
- o Paper towels
- o Decontamination Fluids (as required by Work Plan)
  - o 2 - Propanol
  - o Deionized water
  - o Hexane (pesticide grade)
  - o Methanol (pesticide grade)
  - o Other
- o Trash bags
- o Plastic spray bottles
- o Tubing (Tygon or teflon)
- o Assorted adaptors and connectors (to connect instrument to probe)

PERSONAL PROTECTIVE EQUIPMENT:

- o Tyveks (assorted sizes and types)
- o Latex gloves
- o Hard hats/liner(s)
- o Field overboots
- o Work gloves (cotton and chemical resistant)
- o Safety glasses/or side shields on OSHA-approved prescription lenses
- o First Aid Kit
- o Respirators
- o Check Health and Safety Plan
- o Confined Space Entry equipment

DOCUMENTATION

- o Notebook/field book
- o Site pass/badge
- o Previous well logs/previous historical well data
- o Site map
- o Blank landfill gas monitoring data forms
- o Property access/utility clearance
- o Confined Space Entry Permit

MISCELLANEOUS

- o Well Cap Keys
- o Bolt cutters
- o Camera/film
- o Knife
- o Spare batteries for instruments
- o Lock deicer (winter)
- o Measuring Tape
- o Pen/pencil/indelible marking pen
- o Tool box
- o Spare locks/keys
- o On site transportation (all Terrain Vehicle/Snowmobiles)

*Completed by:*_____ *Date:* _____

CRA

FIELD DATA RECORD FORM **(QSF-295D)**
MONITOR, PID, MINIRAE 2000

Control No.: _____ **Project No.:** _____
Date: _____ **Project Name:** _____
User: _____ _____
Location: _____
Additional Equipment Control Numbers and Descriptions: _____

_____

_____

FIELD PROCEDURE BEFORE USE:

	Check when completed
• Gently unscrew the lamp housing cap.	
• Remove the sensor adaptor with the gas inlet probe, and remove the metal and dust filters from the probe using tweezers.	
• Check to ensure the probe is clean.	☐
• Replace the filters back into the probe cavity and replace the probe assembly.	
• Turn the PID on by pressing the (Mode) key.	
• During the warm-up period, check the pump inlet flow using your finger to detect suction. The warm-up ends when "Ready" is displayed.	☐
• Press the (Mode) key several times until the battery voltage is displayed.	
• Check battery level and record on the space provided. Recharge if below 4.4 V.	_____ V
• Press the (Mode) key several times until "Survey/Ready" is displayed.	
• Press and hold both the (Mode) and the (N/-) keys for 3 seconds.	
• At the prompt "Calibrate/select Gas?", press the (Y/+) key.	
• If calibrating in unclean air, attach the charcoal filter to the PID probe.	☐
• At the prompt "Fresh air cal?", press the (Y/+) key to begin the zero calibration. The display will indicate "zero in progress" followed by a 15 second waiting period. At the end of the calibration, "zeroed!" will be displayed followed by the zero reading.	
• Ensure that the instrument is properly zeroed.	☐
• Press any key to continue. Remove the charcoal filter from the PID probe.	
• At the prompt "Fresh air cal?", press the (N/-) key.	
• Place the regulator onto the calibration gas and connect to the PID probe.	☐
• At the prompt "Span cal?", press the (Y/+) key.	
• At the prompt "Apply gas now!", quickly turn on the calibration gas valve. The calibration takes 30 seconds after which the display will indicate "cal'ed!" followed by the calibration reading.	
• Ensure that the calibration reading is +/- 2 ppm of the calibration gas value.	☐
• Press any key to continue.	
• Turn off the valve of the calibration gas and disconnect from the PID.	
• Press the (Mode) key several times until the "Ready" prompt is displayed.	
• Press the (Y/+) key to start the measurement.	
• To end the measurements, press the (Mode) key followed by the (Y/+) key.	
• Press and hold the (Mode) key for 5 seconds to turn off the PID.	

Filing: Field File

Signature: _____

FIELD DATA: **(QSF-295D)**

Sample No.	*Time*	*Location*	*Reading*	*Comments*

Filing: Field File

Project No: _____ **Name (please print):** _____

Date: _____ **Signature:** _____

PUMPED WELL - DRAWDOWN DATA

Project No.: _____ Project Name: _____

Date: _____ Project Location: _____

Pumped Well No.: _____ Type of Test: _____

CRA Supervisor: _____ W/L Before Pumping Ceased: _____

Screened Interval: _____ to _____ Pumping Rate (Q): _____

Aquifer Thickness: _____ Datum Point: _____ Datum Point Elevation _____ amsl

Static Water Level: _____ ☐ Confined ☐ Unconfined

Time			***Time (t) Since Pumping Stopped (min.)***	***Ratio t/t'***	***Water Level***	***Residual Drawdown***	***Remarks***
Day	***Hr.***	***Min.***					

TABLE 1
SAMPLE KEY

Project Number - 056427-10	Template Ver: FSK v3.1 8/31/2005	*Blue*	*Required for all samples*
Site Code -		*Yellow*	*Required for aqueous and solid samples*
Event Description - Work Plan IV	**Sample Batching** daily	*Green*	*Required for solid samples*
Laboratory - TestAmerica North Canton	**SSOW Ref. Code** 056427-10-001	*Light Green*	*Required for aqueous samples*

Sample ID	*Location Code*	*Location is already in the database Y/N*	*Sample Date (mm/dd/yyyy)*	*Sample Time (hh:mm)*	*Sent to Lab Date (mm/dd/yyyy)*	*Chain of Custody Number*	*Sample Type*	*Sample Matrix*	*Start Depth (ft bgs)*	*End Depth (ft bgs)*	*Parent Sample ID (Sample ID of original sample for duplicates, etc.)*	*Analyses/Parameters*						*# Containers Collected*	*Composite (Y/N)*	*Sample Method*	*Sampler Name(s)*	*Sampling Company*	*Sampling Reason*
												Hold (Y/N/P)	*VOCs*	*SVOCs*	*Mtl 10 Metals*	*PCBs*	*Molybdenum*	*Nickel*						
S-56427-042109-DR-126	SS1-09	N	4/21/2009	14:25	4/21/2009	6153/6152	N	SO	0	1		N	X	X	X	X			6	N	Core Barrel	D. Rivers	CRA	Stockpiled Soil and Surficial Debris
S-56427-042109-DR-127	SS2-09	N	4/21/2009	14:40	4/21/2009	6153/6152	N	SO	0	1		N	X	X	X	X			6	N	Core Barrel	D. Rivers	CRA	Stockpiled Soil and Surficial Debris
S-56427-042109-DR-128	SS3-09	N	4/21/2009	15:00	4/21/2009	6153/6152	N	SO	0	1		N	X	X	X	X			6	N	Core Barrel	D. Rivers	CRA	Stockpiled Soil and Surficial Debris
S-56427-042109-DR-129	SS4-09	N	4/21/2009	15:15	4/21/2009	6153/6152	N	SO	0	1		N	X	X	X	X			6	N	Core Barrel	D. Rivers	CRA	Stockpiled Soil and Surficial Debris
S-56427-042109-DR-130	SS5-09	N	4/21/2009	16:00	4/21/2009	6153/6152	N	SO	0	1		N	X	X	X	X			6	N	Core Barrel	D. Rivers	CRA	Stockpiled Soil and Surficial Debris
S-56427-042109-DR-122	SB48-09	N	4/21/2009	13:40	4/21/2009	6668/6667	N	SO	8	10		N	X	X	X	X	X	X	6	N	Core Barrel	E. Mickelson	CRA	Potential On-Site Fill Activities
S-56427-042109-DR-123	SB49-09	N	4/21/2009	15:20	4/21/2009	6668/6667	N	SO	5	7		N	X	X	X	X	X	X	6	N	Core Barrel	E. Mickelson	CRA	Potential On-Site Fill Activities
S-56427-042109-DR-124	SB50-09	N	4/21/2009	17:30	4/21/2009	6668/6667	N	SO	12.5	14.5		N	X	X	X	X	X	X	6	N	Core Barrel	E. Mickelson	CRA	Potential On-Site Fill Activities
S-56427-042209-EM-132	SB56-09	N	4/22/2009	8:45	4/22/2009	5503	N	SO	16.5	18.5		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-EM-133	SB56-09	N	4/22/2009	8:50	4/22/2009	5503	FD	SO	16.5	18.5	S-56427-042209-EM-132	N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-EM-134	SB58-09	N	4/22/2009	11:00	4/22/2009	5503	N	SO	5	7		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-EM-135	SB57-09	N	4/22/2009	13:30	4/22/2009	5503	N	SO	6.6	8.6		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-EM-136	SB54-09	N	4/22/2009	15:45	4/22/2009	5503	N	SO	3	5		N	X	X					13	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-EM-137	SB52-09	N	4/22/2009	17:30	4/22/2009	5503	N	SO	13	15		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042209-DR-140	SB61-09	N	4/22/2009	12:30	4/22/2009	5503	N	SO	14	15		N	X						5	N	Core Barrel	D. Rivers	CRA	VOC-Impacted Soil and Groundwater
S-56427-042209-JY-141	SS6-09	N	4/22/2009	13:22	4/22/2009	5503/5502	N	SO	0	1		N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-JY-142	SS7-09	N	4/22/2009	13:49	4/22/2009	5503/5502	N	SO	0	1		N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-JY-143	SS7-09	N	4/22/2009	13:55	4/22/2009	5503/5502	FD	SO	0	1	S-56427-042209-JY-142	N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-JY-144	SS8-09	N	4/22/2009	14:20	4/22/2009	5503/5502	N	SO	0	1		N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-JY-145	SS9-09	N	4/22/2009	14:40	4/22/2009	5503/5502	N	SO	0	1		N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-JY-146	SS10-09	N	4/22/2009	15:05	4/22/2009	5503/5502	N	SO	0	1		N	X	X	X	X	X	X	5	N	Core Barrel	J. York	CRA	Stockpiled Soil and Surficial Debris
S-56427-042209-DR-147	Trip Blank	N	4/22/2009		4/22/2009	5503	TB	SOQ				N	X						3	N	Core Barrel	D. Rivers	CRA	Trip Blank
S-56427-042309-EM-138	SB53-09	N	4/23/2009	8:40	4/23/2009	6671	N	SO	7	9		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042309-EM-139	SB55-09	N	4/23/2009	10:35	4/23/2009	6671	N	SO	10.8	12.8		N	X	X					5	N	Core Barrel	E. Mickelson	CRA	Former Fuel Oil and Diesel Fuel USTs
GW-56427-042309-DR-148	SB61-09	N	4/23/2009	8:55	4/23/2009	6671	N	WG	69	74		N	X						9	N	Core Barrel	D. Rivers	CRA	VOC-Impacted Soil and Groundwater
GW-56427-042309-JY-149	TW56-09	N	4/23/2009	10:06	4/23/2009	6671	N	WG				N	X	X					5	N	Pump	J. York	CRA	Former Fuel Oil and Diesel Fuel USTs
GW-56427-042309-JY-150	TW56-09	N	4/23/2009	10:10	4/23/2009	6671	N	WG			GW-56427-042309-JY-149	N	X	X					5	N	Pump	J. York	CRA	Former Fuel Oil and Diesel Fuel USTs
S-56427-042309-EM-152	SB51-09	N	4/23/2009	14:30	4/23/2009	6670/5504	N	SO	11.8	13.8		N	X	X	X	X	X	X	5	N	Core Barrel	E. Mickelson	CRA	Potential On-Site Fill Activities
S-56427-042309-EM-153	SB51-09	N	4/23/2009	12:00	4/23/2009	6670/5504	FD	SO	11.8	13.8	S-56427-042309-EM-152	N	X	X	X	X	X	X	5	N	Core Barrel	E. Mickelson	CRA	Potential On-Site Fill Activities
S-56427-042309-DR-154	SB60-09	N	4/23/2009	14:20	4/23/2009	6671	N	SO	13.5	14.5		N	X						4	N	Core Barrel	D. Rivers	CRA	VOC-Impacted Soil and Groundwater
S-56427-042309-DR-155	SB60-09	N	4/23/2009	14:25	4/23/2009	6671	FD	SO	13.5	14.5	S-56427-042309-DR-154	N	X						4	N	Core Barrel	D. Rivers	CRA	VOC-Impacted Soil and Groundwater
GW-56427-042309-DR-156	TW60-09	N	4/23/2009	15:00	4/23/2009	6671	N	WG	9	17		N	X						3	N	Pump	D. Rivers	CRA	VOC-Impacted Soil and Groundwater
S-56427-042309-EM-157	SB62-09	N	4/23/2009	17:45	4/23/2009	6671	N	SO	4.6	6.6		N	X						4	N	Core Barrel	E. Mickelson	CRA	VOC-Impacted Soil and Groundwater
TB-56427-042309-DR-158	Trip Blank	N	4/23/2009		4/23/2009	6671	TB	SOQ				N	X						3	N	Direct Fill	D. Rivers	CRA	Trip Blank
TB-56427-042309-DR-159	Trip Blank	N	4/23/2009		4/23/2009	6671	TB	WGQ				N	X						1	N	Direct Fill	D. Rivers	CRA	Trip Blank

ATTACHMENT C

RRD OPERATIONAL MEMORANDUM NO. 2