Woodward-Clyde Consultants

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FINAL

REMEDIAL INVESTIGATION REPORT FOR THE BAIER SITE & MCCARL SITE LEE COUNTY, IOWA

E. I. DU PONT DE NEMOURS & CO.
FORT MADISON, IOWA

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WCC PROJECT 89C7583-1

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0.0 EXECUTIVE SUMMARY

A Remedial Investigation (RI) was conducted in the spring and summer of 1990 at the Baier site and the McCarl site, Lee County, Iowa (see Figure 1). The Baier site and the McCarl site are former disposal areas for wastes generated as a result of paint manufacturing by a Du Pont facility located in Fort Madison, Iowa. The Baier site was reportedly used between April 1949 and November 1953 and the McCarl site was reportedly used between November 1952 and November 1953 when access to the Baier site was prohibited by weather related conditions.

The RI was conducted by Woodward-Clyde Consultants (WCC) on behalf of E. I. du Pont de Nemours and Company (Du Pont) under a CERCLA 106(a) order, dated July 5, 1989, and a subsequent amendment revising terms, dated February 7, 1990. The primary objective of the RI was to gather the additional data necessary to supplement existing data in order to evaluate the nature and extent of potential contamination at the sites and support the preparation of a feasibility study (FS) and risk assessment (human health and ecological).

Field activities included x-ray fluorescence (XRF) screening of soil samples for lead as an indicator metal (a potential contaminant of concern); soil gas analysis for toluene, ethylbenzene, and xylene; soil boring installation, sampling, and analysis to a depth of 6 feet; sediment sampling and analysis in drainage ditches near each site; and monitoring well installation, development, and sampling. Monitoring well installation included shallow wells installed in the weathered till and deep wells installed in the unweathered till to assess potential vertical migration of contaminants.

Stratigraphy of the sites was identified through the installation of geotechnical borings. One boring at monitoring well location MC-4C (McCarl site) was installed to a depth of 225 feet below ground surface where limestone bedrock was encountered. In general, the site stratigraphy is characterized by approximately 0 to 5 feet of loess, approximately 55 feet of weathered glacial till, and approximately 150 feet of unweathered glacial till on the average. The weathered and unweathered tills contain discontinuous sand lenses and clay. The weathered till is fractured in places, while the unweathered till appears to be free of fractures. Glacial tills at the sites exhibit permeabilities ranging from 10^{-3} to 10^{-9} cm/sec.

In general, the hydrogeologic investigations conducted during the RI indicated that ground water in the shallow water bearing zone is directed laterally towards drainage ditches adjacent to the sites. The underlying unweathered till serves as a confining layer which, in combination with the proximity of the adjacent discharge areas for ground water in the shallow water bearing zone, prevents deeper percolation of ground water from the shallow zone (weathered till) to the deeper zone (unweathered till).

Analytical data indicated the presence of elevated levels of metals in soils. Metals identified to be of potential concern include lead (the primary contaminant of concern), cadmium, chromium, selenium, and zinc. Several volatile organics were also identified in site soils and waste samples with toluene, xylene, and ethylbenzene being the organics of interest. A sample of waste-like material collected from each site and subjected to the toxicity characteristic leaching procedure (TCLP) indicated site wastes can be classified as hazardous because the extractable concentrations of lead in excess of 5 mg/L at both sites and cadmium in excess of 1.0 mg/L at the Baier site only.

Ground water analytical data collected at the sites identified several metals of potential concern in the shallow water bearing unit at each site. Deep monitoring wells at each site appear to be free of metals contamination and are not impacted by site related activities. Volatile organics of concern were only detected in two shallow monitoring wells located at the Baier site (MW-F and MW-J). Organics of concern were not detected in the deep wells at the Baier site or the shallow or deep wells at the McCarl site (see Section 7.0).

In summary, the deep water bearing unit at each site has not been impacted by site-related contaminants. Potential shallow water bearing unit contamination at the Baier site is defined by an isolated area of volatile organic contamination and an isolated area of dissolved selenium concentrations above the maximum contaminant level (MCL). Shallow water bearing unit contamination at the McCarl site is defined by levels of dissolved selenium above the MCL.

A baseline risk assessment (RA) was performed to evaluate the potential risks to human health posed by soil and ground water contamination at the Baier site and McCarl site in the absence of remedial action. Similarly, an ecological assessment was performed to evaluate the potential effects of site contaminants on environmental receptors.

The RA focused on potential health risks associated with exposures to surface soils at the site. As stated above, the surface soils contain several contaminant metals that may have been introduced at the sites as a result of past disposal of paint wastes. Specifically, metals evaluated in the RA included barium, cadmium, chromium, copper, lead, manganese, selenium, and zinc. Arsenic was also evaluated although the concentrations of this metal found on the sites were within its background range (i.e., naturally occurring). Potential health risks due to soil ingestion and dermal contact with soil were evaluated for several groups of populations that may be on-site primarily as a result of recreational activities (e.g., hunting and hiking).

Potential cancer risks were estimated to be on the order of 10^{-9} to 10^{-6} for the various populations considered in the RA and this range reflects both representative and maximum exposures. This range of potential risks is below or at the low end of EPA's advisory range of 10^{-6} to 10^{-4}. Therefore, potential cancer risks estimated for the sites are not excessive.

The potential for non-carcinogenic health hazards (i.e., toxic effects) does not exist at either site. However, potential exposures to lead wastes at the Baier site may pose a health concern for young children (i.e., children age six and younger). Potential health hazards due to lead were evaluated by estimating blood lead levels that may result from exposure to lead in soils. The estimated blood lead levels were compared to an EPA advisory range of blood lead levels thought to be associated with harmful effects.

Hypothetical ground water ingestion was evaluated as a possible future use adjacent to each site. Potential cancer risks were estimated to be on the order of 10^{-5} and were attributed to background levels of arsenic present in the ground water. A non-carcinogenic health hazard was not found to exist under this scenario.

The results of the ecological assessment indicated that no threatened or endangered species are present at either the Baier site or McCarl site. Potential impacts on the flora and fauna found at the sites were evaluated for a broad or group of contaminants, including metals, volatile organic compounds (VOCs), and semi-volatile organic compounds. Both vertebrate (e.g., small mammals and birds) and invertebrate (e.g., earthworms) species were included in the ecological assessment. Thus, species at various levels in the food web at the Baier site and McCarl site were represented.

The results of the ecological assessment further indicated that the sites possess little potential for impacting the local environment. This conclusion is primarily based on the finding that contaminant concentrations at points where environmental receptors may be exposed are less than those documented in the literature to be without harmful effects.

Based on the RI activities conducted at the Baier site and McCarl site and summarized above, the following conclusions were reached.

BAIER SITE

- Waste material generated as a result of the paint manufacturing process was disposed and is evident at the site.
- The waste material and surrounding soils contain a variety of organic and inorganic chemicals with total xylenes, toluene,

ethylbenzene, arsenic, barium, cadmium, chromium, lead, selenium, and zinc being the primary constituents.

- The primary contaminants of concern are lead (soils) and toluene, xylene, ethylbenzene, and dissolved selenium (ground water). Secondary contaminants of concern in ground water include acetone, 2-butanone, and 4-methyl-2-pentanone.
- The areal extent of lead contamination defines the surface area of contamination at the site.
- In general, metals contamination rapidly attenuates with depth and has dropped to a level of 350 ppm lead or background by four feet below ground surface or the waste/soil interface.
- Isolated areas of the upper water bearing unit beneath the site have been impacted by site-related contaminants. One isolated area has been impacted by volatile organics (primarily toluene, ethylbenzene, xylene and secondarily acetone, 2-butanone, and 4-methyl-2-pentanone) and a second isolated area has been impacted by dissolved selenium.
- There is no evidence that the deeper water bearing unit beneath the site (waters contained in the unweathered till) has been impacted by site activities.
- High concentrations of lead appear to be the primary hazard to human health at the site. The other contaminants of concern do not pose public health concerns based on their concentrations at the site.
- There has been no documented impact to the environment or ecology related to the contaminants of concern at the site.
- There are approximately 8800 cy of contaminated soil at the Baier site based on a level of 350 ppm lead.

MCCARL SITE

- Waste material generated as a result of the paint manufacturing process was only minimally evident at the site.
- Site soils contain a variety of organics including toluene, xylene, and ethylbenzene and inorganics with metals contamination being far more widespread than organics contamination.
- The primary contaminants of concern are lead (soils) and dissolved selenium (ground water).
- The areal extent of lead contamination defines the surface area of contamination at the site.

- In general, metals contamination rapidly attenuates with depth and has dropped to a level of 350 ppm, lead or background by four feet below ground surface.
- Data generated to date indicate the upper water bearing unit beneath the McCarl site has not been impacted by organics contamination.
- The upper water bearing unit beneath the McCarl site has been impacted by and contains elevated levels of total and dissolved selenium above the current MCL.
- There is no evidence that the deeper water bearing unit beneath the McCarl site (waters contained in the unweathered till) has been impacted by site activities.
- High concentrations of lead appear to be the primary hazards to human health at the site. Other contaminants of concern do not pose public health concerns based on their concentrations at the site.
- There has been no documented impact to the environment or ecology related to the contaminants of concern at the site.
- There are approximately 2100 cy of contaminated soils at the McCarl site based on a level of 350 ppm lead.

1.0 INTRODUCTION

This document presents the results of the remedial investigation conducted during the spring and summer of 1990 at the Baier site and McCarl site, Lee County, Iowa. The report discusses the data collection program and analytical results, presents the results of the risk assessment, discusses possible remedial alternatives, and presents remedial action objectives. It is assumed that the reader is familiar with the history of negotiations on the sites, as well as the work plan (WCC, 1990a), the quality assurance project plan (QAPP) (WCC, 1990b), and the health and safety plan (HSP) (WCC, 1990c) prepared by WCC and approved by the USEPA prior to the implementation of field work.

This report also includes data generated by the USEPA on the Fedler property, which is adjacent to and contiguous with the Baier site. The scope of the activities proposed in the RI/FS Work Plan to be under-taken on the Fedler property were implemented by Jacobs Engineering Group on behalf of USEPA in general accordance with the approved work plan when access to the property was denied to Du Pont.

1.1 PURPOSE OF REPORT

The U.S. Environmental Protection Agency (USEPA), under an order dated July 5, 1989 (USEPA, 1989), issued pursuant to Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Acts directed E.I. du Pont de Nemours & Company (Du Pont) to:

1. perform a removal action at the Baier site; and
2. perform a remedial investigation/feasibility study (RI/FS) of the entire area known as the County Road X-23 site, which consists of both the Baier site and the McCarl site.

A subsequent Amendment Revising Terms, dated February 7, 1990 (USEPA, 1990), deferred the obligation to perform the removal action, but maintained the requirement (with certain revisions) to perform the RI/FS activities.

As a result, Woodward-Clyde Consultants (WCC), on behalf of Du Pont, prepared and submitted an RI/FS work plan to USEPA on March 19, 1990. The purpose of the work plan (and supporting documentation) was to guide the activities associated with the performance of the RI/FS. The primary objective of the remedial investigation was to gather the additional data necessary to supplement the existing data in order to evaluate the nature and extent of potential contamination at the Baier site and McCarl site. Another objective was to gather the necessary data to support the preparation of a feasibility study and risk assessment (human health and ecological).

The objective of the feasibility study was to develop and evaluate potential remedial alternatives for the site.

1.2 SITE BACKGROUND

The following sections provide a brief historical background and a chronological summary of the activities associated with the Baier site and the McCarl site, Lee County, Iowa. Site chronologies are presented in Table 1-1.

1.2.1 BAIER SITE

The Baier site is located in a rural area of Lee County, Iowa, approximately 3.5 miles south of West Point, Iowa, and approximately 5 miles west-northwest of Fort Madison, Iowa. The Baier site is more precisely described as being located in the NE¼ of the SW¼ of Section 28, Township 68 North, Range 5 West (Figure 1). The site is accessible via County Road X-23 and a farm lane traversing the Richard Fedler property immediately northeast and contiguous to the site. For the purpose of the RI/FS field activities the site was accessed the "backway" via a secondary county road and approximately 2.5 miles of unimproved roadway. Entrance to the site via this route became necessary when direct access to the Richard Fedler property was denied Du Pont by the property owner.

The Baier site is a former disposal area for wastes generated as a result of paint manufacturing by a Du Pont facility located in Fort Madison, Iowa. The manufacture of paint generates a variety of waste products which are, by present day standards, considered to be of potential environmental concern. Among these waste products are heavy metals, base solutions, and organic compounds, including solvents and resins.

Du Pont contracted with Mr. Charles Knoch for paint waste disposal at the Baier site during the period April 1949 to November 1953. It is reported that Mr. Knoch transported the waste material to the Baier site for both burial and burning. At the time of the disposal activities, the site was owned by Mr. Knoch's sister, Ella Livingston.

1.2.2 MCCARL SITE

The McCarl site is also located in a rural area of Lee County, Iowa, approximately 1.5 miles northeast of the Baier site. The McCarl site is located on Chalkridge Road, which is accessible via County Road X-23. A more precise description of the location of the McCarl site is the SE¼, SW¼ of Section 22, Township ~~26~~ 68 North, Range 5 West (Figure 1).

The McCarl site was reportedly used by Charles Knoch between November 1952 and November 1953 for the disposal of paint waste generated by Du Pont when muddy roads limited the accessibility of the Baier site. During the period of waste disposal, the area now referred to as the McCarl site was purchased by Mr. Knoch. The McCarl site derives its name from the former owners, Ray and Olive McCarl, who owned the site when it was first identified in 1984. The property was subsequently sold to Du Pont in 1986.

1.3 PREVIOUS INVESTIGATIONS

The following sections briefly describe the history of the previous investigations conducted at the sites by the USEPA. WCC, on behalf of Du Pont, in addition to the remedial investigation activities conducted in the spring and summer of 1990, also conducted investigations at the sites in May and July/August 1989 and conducted quarterly ground water sampling in September 1989, December 1989, March 1990, and June 1990. These activities and findings are discussed with the remedial investigation activities and findings in Sections 2.0 and 4.0 of this report.

1.3.1 SUMMARY OF USEPA INVESTIGATIONS

1.3.1.1 Baier Site

1.3.1.1.1 April 1983

The Baier site was originally identified as a potential uncontrolled hazardous waste site by Du Pont in its submittal to the Eckhardt subcommittee. Following the Eckhardt subcommittee report of November 1979, the site was selected for evaluation by USEPA. A preliminary inspection of the site was conducted by the Ecology and Environment, Inc. (E&E) Field Investigation Team (FIT) in September 1980. The results of that inspection, presented in a report dated October 10, 1980, prompted USEPA to request a field investigation. As a result of that request, a field investigation work proposal was delivered to USEPA which called for soil sampling, surface water sampling, and ground water sampling in the vicinity of the Baier site. Ground water sampling was subsequently omitted because no downgradient private water supply wells were identified in the immediate area of the Baier site. The elements of the work proposal were implemented by E&E in April 1983.

Composite soil samples collected during the April 1983 investigation reported the presence of barium, cadmium, chromium, cobalt, copper, lead, and zinc in concentrations exceeding those generally representative of background. A summary of the range of selected metals concentrations observed at the Baier site by E&E and national background values from the literature are provided below. (NOTE: E&E reported only barium, cadmium, chromium, cobalt, copper, lead and zinc concentrations in their report (Ecology and Environment, 1983). However, the report also stated that with the exception of selenium and thallium, all Task 1 and Task 2 metals were detected in at least one sample.

Analyte	Range in Concentrations (mg/kg)	Background Range[1] (mg/kg)	Background Average[1] (mg/kg)
Barium	1300-1700	100-3000	430
Cadmium	90-240	0.01-0.7	0.06
Chromium	430-470	1-1000	100
Cobalt	39-120	1-40	8
Copper	ND[2]-90	2-100	30
Lead	120-12000	2-200	10
Zinc	6000-18000	10-300	50

Notes: [1] National background values reported by USEPA, 1983. "Hazardous Waste Land Treatment."
[2] ND - Not detected.

Six priority pollutant organics were also detected during the field investigation in one or more of the soil samples analyzed. A summary of those compounds is provided below.

Analyte	Range in Concentrations (mg/kg)
Benzoic Acid	5.8-110
2-Methylnaphthalene	5-220
Naphthalene	0.02-0.7
Bis(2 ethyl hexyl)phthalate	0.24-2.8
Ethylbenzene	ND-0.3
O-Xylene	ND-3.6

Note: ND - Not detected.

Soil samples collected on-site consisted of aliquots of surface soil (0 to 3 inches) which were composited with aliquots obtained from 12 to 30 inches. Off-site soil samples consisted of samples collected and composited from 0 to 30 inches.

In addition to the composite soil samples, four aqueous grab samples were collected in the vicinity of the Baier site. Two samples were obtained from surface streams and two were obtained from seeps which discharged into nearby erosional ravines.

Detectable levels of aluminum, barium, iron, manganese, zinc, boron, and mercury were found in one or more of the water samples analyzed. A summary of the total metal concentrations reported for the aqueous samples collected is provided below. In addition, the currently existing or proposed primary or secondary (May 22, 1989) maximum contaminant levels (MCL) are provided for comparison purposes only as none of these water sources are utilized for domestic consumption.

Analyte	Maximum Detected Concentration (mg/l)		MCL (mg/l)	
	Stream	Seep	Current	Proposed
Aluminum	0.3	1.2	NE[1]*	0.05*
Barium	0.11	0.13	1.0	5.0
Iron	0.51	1.9	0.3*	NC[2]*
Manganese	0.25	0.06	0.05*	NC*
Zinc	0.015	0.215	5*	NC*
Boron	ND	0.180	NE	NE
Mercury	0.00022	0.00022	0.002	0.002

Notes:
[1]NE = not established
[2]NC = no change
* = represents secondary MCL (all other primary MCLs)

Only one organic constituent was detected in any of the water samples obtained. Bis (2-ethylhexyl)phthalate (an organic compound ubiquitous in the environment) was detected at 14 ug/l in one of the seep samples. USEPA ascertained that at these low levels, this compound presents no water quality concern (Ecology and Environment, 1983).

In their November 30, 1983 report, USEPA concluded that "overall, the remote location of the site and the minimal evidence of contaminant dispersion from the site combine to characterize it as a low hazard." It was further stated that additional action at the site of a low priority nature may be deemed necessary. These actions would include enhancement of the soils natural attenuating properties by liming and cultivation. USEPA further concluded that considering the quality of the spring water sampled during the investigation, the necessity for an investment to fully characterize the ground water in the vicinity of the disposal area was questionable (Ecology and Environment, 1983).

1.3.1.1.2 Other Investigations

At the direction of USEPA, E&E FIT (utilizing Nebraska Testing Laboratories, Inc.) installed three ground water monitoring wells at the Baier site in July 1985. The wells were installed to an approximate depth of 50 feet below the ground surface and arranged in a triangular fashion outside the former disposal area(s). The locations of the Baier site monitoring wells installed by E&E (MW-A, MW-B, and MW-C) are shown in Figure 2. Following installation and development of the monitoring wells, E&E sampled the wells in August 1985 and March 1986. In addition, Du Pont sampled the wells in July 1988. A summary of the total and dissolved metals analyses is presented in Table 1-2.

1.3.1.2 McCarl Site

The McCarl site was originally identified by Du Pont in a 3007 response submittal to USEPA in 1984. As a result of this submittal, which identified the site as a waste disposal area, USEPA requested that E&E conduct an initial site investigation at the McCarl site. The initial site investigation was conducted in July 1986 and included the installation and sampling of three ground water monitoring wells, the sampling of on-site soils, and the sampling of surface water in the vicinity of the site.

Prior to the E&E investigation, the Lee County Health Department had collected private well water samples from two residences located immediately west of the site. Samples were collected from a well located at the John Glascow residence which, according to E&E records, is approximately 300 feet deep and from a well located at the Sadie King residence (no depth information on this well is available in E&E records). Based upon water level information from the currently existing ground water monitoring wells, these wells are considered "generally" upgradient of the site. Samples were analyzed for volatile organics as well as arsenic, barium, cadmium, chromium, and lead. No volatile organics were detected in either private well. Barium at a concentration of 100 ug/l was detected in both wells and chromium at a concentration of 20 ug/L was detected in the Glasgow well. The levels of barium and chromium reported were below their respective drinking water standards. All other metal analytes were reported as below their limits of detection (Ecology and Environment, 1986).

During the July 1986 E&E investigation, 10 composite soil samples (consisting of 5 aliquots each) were obtained from the 0 to 2 inch depth interval within the presumed limits of the disposal area and along the presumed perimeter of the disposal area. Soil samples were analyzed for metals, base-neutral/acid extractables (BNA), and volatile organics. A summary of the range of selected metals observed at the McCarl site and national background values from the literature is provided below.

Analyte	Range in Concentrations (mg/kg)	Background Range (mg/kg)[1]	Background Average (mg/kg)[1]
Barium	200 - 3400	100 - 3000	430
Cadmium	3.2 - 79	0.01 - 0.7	0.06
Chromium	5.7 - 130	1 - 1000	100
Copper	8.6 - 2000	2 - 100	30
Lead	24 - 1900	2 - 200	10
Manganese	910 - 2900	20 - 3000	600
Selenium	ND[2] - 48	0.1 - 2	0.3
Zinc	49 - 3000	10 - 300	50

Notes: [1] National background values reported by USEPA 1983, "Hazardous Waste Land Treatment."
[2] ND = Not detected.

In addition to the metals observed, several polynuclear aromatic hydrocarbons (PAH) and one volatile organic compound, toluene at a concentration of 71.0 J ug/kg, were detected at the McCarl site. (Note: J indicates that the compound was qualitatively identified but the compound failed to meet all CLP QA criteria and therefore is only an estimated value.) A summary of the PAH compounds detected is provided below.

Analyte	Range in Concentrations (ug/kg)
Phenanthrene	180M[1] - 1300
Fluoranthene	38M - 1700
Pyrene	26M - 1200
Benzo(B)Fluoranthene	ND[2] - 840
Benzo(K)Fluoranthene	ND - 500
Benzo(A)Pyrene	ND - 730
Butyl Benzyl Phthalate	110M - 780
Chrysene	54M - 1000
Benzo(A)Anthracene	ND - 730

Notes: [1] M indicates compound was qualitatively identified; however, quantitative value is less than contract required detection limit [CRDL] or value is less than limit of quantitation [USEPA data].
[2] ND = Not detected.

Three surface water samples were also collected during the field investigation. Aside from trace levels of barium ranging from 99M to 110M ug/l and copper ranging from 5.3M to 9.6M ug/l, no other heavy metals of concern were detected. The current secondary maximum contaminant level (SMCL) for copper is 1.0 mg/l.

The final activity of the E&E FIT investigation conducted in July 1986 involved the installation, development, and sampling of three ground water monitoring wells (MC-1, MC-2, and MC-3) are shown in Figure 3. These wells were installed at an approximate depth of 50 feet below ground surface and screened through the lower 20 feet. Following development, the wells were sampled for total metals, BNAs, and volatile organics. In addition to this initial sampling event, E&E on behalf of USEPA resampled the wells in April 1987. During the April 1987 sampling event Du Pont split ground water samples with USEPA. Du Pont also conducted an independent sampling event in July 1988. A summary of the total and dissolved metals analytical results is presented in Table 1-3. Volatile organics and semi-volatile organics were not detected above their respective detection limits.

2.0 STUDY AREA INVESTIGATION

2.1 BAIER SITE

2.1.1 PRE-REMEDIAL INVESTIGATION

2.1.1.1 May 1989

Preliminary field investigation activities were conducted by WCC during late May 1989. The purpose of the field investigation activities was to provide an initial site assessment and recommendations for further action/field work. Field activities were initiated on May 20, 1989 and concluded on May 26, 1989. Activities conducted at the Baier site included intrusive probing to visually estimate the areal and vertical extent of waste material, test pit excavation, soil/waste sampling, development and sampling of USEPA installed ground water monitoring wells, and field mapping.

Source/Soil Investigations

The approximate areal and vertical extent of waste material was estimated by probing with a hand auger. The hand auger was advanced to the soil/waste contact and materials encountered were logged in a field book. A HNu photoionization detector was used to measure organic vapors from open probe holes, auger cuttings, and in the breathing zone. Probe hole locations were marked and photographically documented by the methods described in the Abbreviated Sampling and Analysis Plan (SAP) (WCC, 1989a).

Areas alleged to have been utilized as disposal/burn trenches were evaluated by excavating test pits using a tractor mounted backhoe. The test pits were generally advanced 24 inches below the soil/waste contact. The lateral extent of the test pits excavated in the suspected disposal/burn trenches was based on HNu readings recorded during excavation, the nature of the material excavated, and the physical accessibility of the terrain at the excavation site.

As with the hand auger probes, descriptions of all materials encountered were entered into a field logbook. HNu readings were taken over the open pit, in the breathing zone, and over excavation materials placed on plastic sheeting. After excavation to completion depth, excavated materials were backfilled into the test pits on a last-out, first-in basis.

Table 2-1 presents the depths to the soil/waste contact encountered in the hand auger probes and test pits excavated at the Baier site. A summary of the HNu readings is also included. Depths to the soil/waste contact ranged from approximately 2 inches below grade to greater than 36 inches below grade. HNu readings ranged from background to greater than 300 parts per million (ppm). Hand auger and test pit locations from the May 1989 field event are presented in Figure 2.

During field activities, soil/waste samples for chemical analysis were collected with the hand auger, from the backhoe bucket during test pit excavation, and from the test pit walls. Samples were collected in general accordance with the abbreviated SAP. However, due to the high levels of organic vapors observed via HNu monitoring a field decision was made to collect samples for volatile organic analysis. Collection of these samples was not detailed in the abbreviated SAP. Analytical results are presented in Section 4.0.

Ground Water Investigations

Monitoring wells installed by USEPA in July 1985 were redeveloped during the May 1989 site assessment in order to remove fine sediment from the well casing and filter pack. In addition, development activities provided a means to evaluate the recharge capabilities of each well. The monitoring wells were developed with the dedicated PVC bailers located in each well. Prior to the initiation of bailing activities the static water level was obtained and the saturated well volume calculated. The volume of water removed during redevelopment was recorded in the field log book. Because the wells were extremely turbid during development activities, field parameters were not measured.

Field Mapping

Intrusive probing locations, test pits, monitoring wells, fences, roads, drainageways, and other permanent features were located using field mapping techniques. Mapping was performed by the WCC field team using a fiberglass engineer's tape and a Brunton compass. Qualitative corrections were made in the field to account for slope distances and non-linear distances (i.e., around obstacles). All measurements made with the tape were read to the nearest foot, and angles measured with the compass were read to the nearest degree.

2.1.1.2 July 1989

A second phase of field investigation activities was initiated in July 1989.The need for this phase of work was the result of the unexpected field conditions encountered (i.e. high HNu readings indicating the presence of volatile organics) during the initial site assessment conducted in May 1989.

The purpose of this supplemental field investigation was to further define the waste/soil contact, evaluate the areal and vertical extent of soil and ground water contamination, obtain samples enabling geotechnical analysis of unconsolidated sediments, and estimate the waste volume which may require removal.

Field activities were initiated on July 21, 1989 and concluded on August 11, 1989. Activities performed at the Baier site included intrusive probing with a hand auger, shallow and deep soil borings, soil sampling, ground water monitoring well installation and development, sampling of newly installed and pre-existing ground water monitoring wells, and mapping of topographic features (surveying). Soil boring and sampling activities were conducted in general accordance with the Addendum to the Abbreviated Sampling and Analysis Plan (WCC, 1989b). Ground water investigation activities were conducted in general accordance with the Work Plan for Focused Ground Water Investigation (WCC, 1989e).

Hand Augering/Probing

Additional hand auger probing was performed to better define and confirm the areal and vertical limits of contamination. Procedures used for hand auger probing were the same as those employed in May 1989. Hand auger probes, boring locations, and monitoring wells are shown in Figure 2.

Drilling Activities

Shallow and deep borings were performed in and outside of areas of known contamination utilizing mobile drilling rigs. Soil samples were obtained from selected intervals for chemical and geotechnical testing. Drilling equipment was decontaminated in between boreholes to prevent potential cross contamination. After completion, soil borings not utilized for monitoring well installation were grouted to ground surface.

Soil samples were collected from selected intervals in the shallow and deep borings. Chemical analysis was performed on samples obtained from shallow borings (i.e. those not utilized for monitoring well installation). Parameters analyzed included total metals, VOCs, moisture content, and soil pH. Select geotechnical samples obtained from deep borings (i.e. borings converted to monitoring wells) were tested for permeability, moisture content, Atterberg limits, and grain-size/hydrometer analysis where appropriate.

Seven ground water monitoring wells were installed during the July 1989 field activities at the Baier site. The ground water investigation program was designed to provide information on the hydrogeologic properties of the upper most water bearing unit. A further objective of the investigation was to provide information on the general extent of any chemical contamination in the upper water bearing unit and to assist in the selection of remedial design alternatives should they become necessary.

All monitoring wells were constructed of two inch diameter Schedule 40 PVC casing. Filter pack sand was placed in the well annulus to a depth of two feet above the top of the screened interval. One half of one foot of fine grained buffer sand was placed on top of the filter pack. A two-feet thick bentonite seal was placed above the buffer sand by slowly pouring in bentonite pellets. The monitoring well was grouted from the top of the bentonite seal to ground surface. Concrete pads and steel protective casings were installed at each location. Following well installation, all new monitoring wells were developed according to the procedures presented in the Work Plan for Focused Ground Water Investigation (WCC, 1989e). Boring logs and monitoring well installation reports are provided in Appendix A.

Ground Water Sampling

During the July/August field activities ground water samples were obtained from 10 monitoring wells at the Baier site (7 newly installed and 3 existing). One monitoring well (MW-G) was nearly dry and adequate volume to analyze volatile organics, semi-volatile organics and dissolved metals was all that could be obtained.

Prior to sampling, all wells were purged three to five well volumes or until dry. Sampling of wells took place within 24 hours of completion of purging. Samples were obtained with stainless steel bailers. Bailers were decontaminated between monitoring wells. Well installation, purging, and sampling procedures are detailed in the Work Plan for Focused Ground Water Investigation (WCC, 1989e).

Surveying

The final activity conducted during the July investigation was topographic mapping of the Baier site. Surveying was performed by personnel from George Butler Associates, Inc. Mapping was completed by the transit and rod method. Elevations were measured to the nearest hundredth of a foot and angles to the nearest second. Intrusive probing locations, test pits, monitoring wells, fences, roads, drainage features, and other permanent features were mapped where encountered.

2.1.2 REMEDIAL INVESTIGATION - BAIER SITE

Remedial investigation (RI) field activities were initiated on April 23, 1990 in accordance with the USEPA approved Work Plan for Remedial Investigation/ Feasibility Study at the Baier Site and McCarl Site Lee County, Iowa, dated March 19, 1990 (Work Plan) and the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HSP) for Remedial Investigation/Feasibility Study at the Baier Site and McCarl Site, Lee County, Iowa, dated March 19, 1990. The activities conducted as part of the work plan implementation are discussed below.

2.1.2.1 Field Mapping

Field mapping of the surficial expression of the contact between the weathered and unweathered till deposits was attempted along the sideslopes of the drainages to the north and southwest of the site. This activity was implemented in an attempt to locate seeps for potential sample collection and provide supporting documentation consistent with the conceptual geologic model of the site presented in the work plan.

The location of the contact between the weathered and unweathered till deposits was estimated from till contact elevation data available from boring logs and ground surface elevation data available from the site topographic map. The drainage ditches were excavated by pick and shovel in selected areas until the weathered and unweathered till contact was located. Location of the till contact was generally observed in the deep cut drainages.

No active seeps were noted by field personnel during field activities, however, soils in drainage ditches just above the weathered and unweathered till contact had noticeably higher moister contents. The visually higher moisture content may be due either to surface runoff following precipitation or slow ground water discharge from areas with inadequate volumes of water to be considered flowing seeps.

2.1.2.2 Contaminant Source Investigation

As discussed above, the contaminant source investigation was initiated during field investigation activities performed in May and July, 1989. The purpose of the field investigation activities was to provide an initial assessment of the lateral and vertical extent of contamination through the completion of a series of hand auger and drill rig borings, test pit excavation, and installation, development, and sampling of ground water monitoring wells.

In accordance with the 106(a) order, the contaminant source investigation was extended to include surface soil sampling outside of the known source areas to further characterize the extent of contamination. The soil investigation program is discussed in Section 2.1.2.5.

2.1.2.3 Sediment Investigations

Sediment samples were collected in the flowlines of four ditches near the Baier site. The locations of the ditches can be generally summarized as follows:

- ditch located south of MW-I and generally southeast of MW-B (Ditch 1);
- ditch located west of MW-G (Ditch 2);
- ditch located south of MW-F (Ditch 3); and
- ditch located north of and parallel to the fence at the northern boundary of the site (Ditch 4).

The ditches and sediment sampling points are shown on Figure 2. Samples were collected at distances of 10 feet and 100 feet downstream of the head of each ditch. After reviewing preliminary analytical results, samples were also collected at 40 feet and 70 feet below the drainage ditch head in Ditch 3. *In addition*, samples were also collected from the center line of drainage Ditch 3 approximately 10 feet (B-SED-9) and 106 feet (B-SED-10) downgradient of PZ-03. These samples were collected from areas of stained soil believed to be seep locations. Sediment samples were collected because of inadequate volume to collect water samples.

Samples were collected by hand augering from 0- to 1-foot below ground surface within each drainage ditch flowline. Samples B-SED-1 through B-SED-6 were analyzed for CLP metals, CLP volatile organics, and CLP semi-volatiles in accordance with the CLP statement of work. Samples B-SED-7 and B-SED-8 were only analyzed for CLP metals. Samples B-SED-9 and B-SED-10 were analyzed for CLP volatile organics and CLP metals. Analytical results are discussed in Section 4.0.

Samples obtained from Ditch 4 were collected by personnel from Jacobs Engineering Group on behalf of USEPA. The collection of these samples by an outside organization became necessary when the adjacent property owner denied property access to DuPont. These sample locations (designated B-SED-11 and B-SED-12 by WCC) are also illustrated on Figure 2.

2.1.2.4 Geological Investigation (Geotechnical Borings)

A total of four geotechnical borings (MW-F2, MW-J, MW-K2, MW-L2) were drilled and sampled at the Baier site (see Figure 2).

Three of the geotechnical borings terminated at the first identifiable water bearing zone below the weathered/ unweathered till contact. The other geotechnical boring (MW-J) terminated near the contact between the weathered and unweathered till deposits. Boring logs are included in Appendix A.

Each geotechnical boring was continuously sampled with a 5-foot continuous core barrel sampler from the ground surface to the termination depth of the boring. Samples were classified in accordance with the Unified Soil Classification system by a WCC qualified geologist.

Borings were advanced with hollow-stem augers to the termination depth to aid in the identification of potential water bearing zones. Samples were carefully inspected for changes in relative moisture content with depth. Relative moisture content of a sample was described with reference to the plastic limit of the material. Fractures within the till deposits, when present, were inspected for evidence of iron or carbonate coatings to evaluate whether water is, or has been, present.

Borings located in areas suspected of being downgradient of potential source areas and extended below the weathered/unweathered till contact were cased with 10-inch diameter steel casing to prevent potentially contaminated ground water in the weathered till from migrating to lower depths. The bottom of the casing was set approximately 2 feet below the contact between the weathered and unweathered tills. The annular space between the borehole wall and the casing was filled with a cement/bentonite or VolClay grout from the bottom of the casing to the ground surface (by tremie pipe) to prevent potential downward migration of water along the outside of the casing.

Because of access restrictions to the property where MW-L2 was to be installed, WCC was only able to install borings MW-F2, MW-J, and MW-K2. The fourth boring (MW-L2) was installed on the Richard Fedler property by Jacobs Engineering Group on behalf of USEPA. The Jacobs Engineering Group boring logs and monitoring well installation reports are also included in Appendix A. Drilling procedures were generally the same as those utilized by WCC.

2.1.2.5 Soil Investigation

A soil sampling program was performed at the Baier site to further characterize the areas surrounding the source areas identified during the May 1989 and July 1989 field investigations. This section discusses the procedures followed for sampling at the Baier site.

Coordinate Layout

A 25-foot by 25-foot coordinate grid was established over the entire Baier site and extending west onto the adjacent and contiguous Fedler property. The grid was utilized to establish reference points for sampling operations 50 feet outside of all known areas of contamination at the Baier site. The sampling grid was surveyed and tied to benchmarks to ensure that adequate control was achieved. The grid was oriented in a north-south direction, and was labeled with row and column identifiers to allow for unique identification of each sampling node. The layout of the sampling grid at the Baier site is shown in Figure 4. Sampling from those grids which extended onto the Fedler property was performed by Jacobs Engineering Group on behalf of USEPA because of the previously described access restrictions to the Fedler property.

Sample Collection/Field Screening

After the sampling grid was established, the field screening sampling program was performed to further evaluate the potential source areas of contamination and assess the lateral extent of surficial contamination. Field screening sampling was performed at the Baier site to evaluate the presence of metals (using lead as the indicator) and volatile organic chemicals (xylene, toluene, ethylbenzene) in the soil to a depth of 3 feet. Metals screening was undertaken at 1-foot intervals to a depth of 3 feet. VOC screening (soil gas survey) was undertaken at 3 feet below ground surface. Metals screening samples were collected on 25-foot grid centers from grids which lay outside the known source areas. VOC screening samples were collected from every other grid (50-foot centers) from grids which lay outside the known source areas as shown on Figure 4.

In boundary grids where the limiting criteria were exceeded, the grid system was laterally extended. In the extended grids, samples for lead screening were collected and screened to the deepest interval in which boundary grid screening samples exceeded the limiting criteria (i.e., if the boundary grid only exceeded the 500 ppm limiting criteria in the 0 to

1 foot interval, screening samples from the extended grid were only collected from the 0 to 1 foot interval). Grid extensions are shown on Figure 4. The grid did not require extension for soil gas analyses. [Note: Grid A5 exceeded the limiting criteria in the 0 to 1 foot interval. However, Grid A'5 extended onto the Fedler property to which DuPont did not have access. Therefore, a sample from this grid was collected by Jacobs Engineering Group on behalf of USEPA and analyzed in the laboratory.]

Metals screening samples were obtained with decontaminated hand augers. Sample material from each 1-foot interval was composited in a decontaminated stainless steel bowl and placed in a prelabeled amber glass sample jar. Composited sample material from each interval was then dried by microwaving on the high setting for approximately 2 minutes. Samples were then sieved through a decontaminated stainless steel No. 10 wire mesh sieve. Appropriate amounts of the sieved material were then withdrawn and placed into small Teflon cups and covered with acetate for the analysis of lead by x-ray fluorescence (XRF). The remaining sieved samples was placed back into the same prelabeled sample jar and sent to archive at the Du Pont Fort Madison facility in case future chemical analysis was required.

VOC soil gas screening was conducted by collecting soil samples at discrete depths (approximately 3 feet below ground surface) using a one-inch sampling tube which connected to the end of a hydraulically driven probe rod. A five gram sample was then weighed to the nearest 0.1 gram and prepared for analysis.

The procedure of collecting an actual soil sample for analysis rather than soil gas was a deviation from the approved work plan. The rationale for the proposed method modification was discussed with USEPA prior to implementation. USEPA subsequently provided verbal approval of the change and formally notified Du Pont of their approval in a letter dated May 22, 1990. Section 2.4 discusses Work Plan deviations.

Because Jacobs Engineering Group did not have the field screening capabilities employed by WCC (i.e., X-ray fluorescence and mobile soil gas equipment) samples from grids extending onto the Fedler property were collected and shipped to an analytical laboratory for analysis rather than being screened in the field. Samples were collected in the same manner employed by WCC (i.e., hand augering). Samples for metals analysis were collected and composited from 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet. Discrete samples were collected from 3.0 to 3.5 feet from every other grid for volatile organic analyses.

Work plan deviations and a complete description of the modified soil gas screening procedures are discussed in Section 2.4.

Deep Boring Installation

The purpose of the field screening for metals and volatile organics was to obtain real time data to allow immediate field decisions to be made on where deep borings (to 6 feet) should be installed and to further delineate the area(s) of surficial contamination.

Therefore, upon completion of the field screening for metals and VOCs, the chemical analysis results for each location were assessed to evaluate the necessity of deep boring and sampling for laboratory chemical analysis. The following criteria were used to establish deep boring and sampling locations:

- Metals - Grid sampling locations where lead concentrations by XRF were greater than the 500 ppm exceedance criteria established in the approved work plan in the 2- to 3-foot interval were included in the deep sampling program (See Figure 4). The 500 ppm level was selected because it represents the current ATSDR residential target clean-up level for lead and would be overall conservative given the nature of the Baier site (i.e., remote location/no sensitive populations).
- VOCs - Locations with concentrations of the screening constituents (ethylbenzene, toluene, and xylene) where the sum total of the three compounds exceeded 1 mg/kg were included in the deep sampling program (See Figure 4). (Note: The original screening criteria of 5 times the signal to noise ratio for soil gas analysis was eliminated and revised to 1 mg/kg total xylene, toluene, and ethylbenzene with USEPA approval when the field screening technique was modified).

- <u>Semi-volatiles</u> - Samples were collected and analyzed at those locations where lead concentrations were found greater than 500 ppm in the 2- to 3-foot intervals because of the nature of the disposal activities and their similar behavior to metals in the environment (See Figure 4).

- In those locations where the metals criterion was exceeded, but not the VOC criteria, deep boring and sampling was performed for metals and semi-volatiles only. In those locations where the VOC criterion was exceeded, but not the metals, deep boring and sampling were performed for VOCs only.

Deep Boring and Sampling

When the limiting criteria were exceeded for a given contaminant group (metals or VOCs) at a sampling location, deep boring and sampling to a depth of 6 feet was performed at the individual sampling locations. Deep sampling was performed as follows:

- <u>Metals</u> - Samples were collected at 2-foot intervals to a depth of 6 feet. In sampling locations where a drilling rig was utilized a continuous core barrel sampler was used for the first 5 feet, and a split spoon was driven to collect the 5- to 6-foot interval. Samples were composited from each 2-foot interval, resulting in three samples from each deep sampling location. Due to inaccessibility and drill rig breakdown, some deep borings were installed with hand augering tools. Samples for analysis were collected and composited from the prescribed intervals for chemical analysis. Each sample was analyzed for the full suite of metals as per the CLP statement of work.

- <u>Semi-volatiles</u> - Samples were collected at 2-foot intervals to a depth of 6 feet as described above. Samples were composited from each 2-foot interval, resulting in three samples from each deep sampling location. Each sample was analyzed for the full suite of semi-volatiles as per the CLP statement of work.

- <u>VOCs</u> - VOC samples were collected to a total sampling depth of 6 feet as described above. Samples for VOC analysis were collected from the lower 6 inches of each 2-foot interval (i.e., 1.5 to 2 feet, 3.5 to 4 feet, and 5.5 to 6 feet) resulting in three samples from each deep sampling location. As with the metals samples some borings were installed with hand augering equipment. Each sample was analyzed for VOCs in accordance with the CLP statement of work.

2.1.2.6 Ground Water Investigation/Monitoring Well Installation and Development

A total of six additional monitoring wells (three shallow and three deep) were installed at the Baier site. WCC installed shallow wells MW-J and MW-K1, and deep wells MW-F2 and MW-K2. Because of access restrictions to the adjacent and contiguous Fedler property, Jacobs Engineering Group on behalf of USEPA installed shallow well monitoring MW-L1 and deep monitoring well MW-L2 on the Fedler property.

Two of the proposed shallow monitoring wells (MW-J, MW-K1) were located in areas suspected of being immediately downgradient of source areas identified during the May 1989 and July 1989 investigations. Monitoring well (MW-L1) was installed upgradient from surficial source areas based on preliminary evaluation of ground water flow direction in the uppermost water bearing zone in the weathered till.

The shallow monitoring wells (MW-J, MW-K1, MW-L1) were installed at the locations shown on Figure 2. These wells were screened in a similar stratigraphic position as the existing shallow monitoring wells installed by WCC during the July 1989 investigation (MW-D1, MW-E, MW-F, MW-G, MW-H, and MW-I). These existing wells are screened in the lower 15 feet of weathered till at each location (i.e., just above the weathered/unweathered contact). Monitoring well installation reports and boring logs are included in Appendix A.

The deep monitoring wells (MW-F2, MW-K2, MW-L2) were placed at the locations shown on Figure 2 to provide adequate distribution for the evaluation of ground water flow conditions beneath the site. Each of the deep monitoring wells were screened in a similar stratigraphic position as existing deep monitoring well MW-D2. All deep wells are screened approximately 60 to 75 feet below the weathered/unweathered till contact (approximately 120 feet to 135 feet below ground surface). Monitoring well installation reports and boring logs are included in Appendix A.

Five of the additional monitoring wells (MW-J, MW-K1, MW-K2, MW-F2, and MW-L1) were constructed of 2-inch diameter, flush coupled, threaded PVC. Deep monitoring well MW-L2 (installed by Jacobs Engineering Group) was constructed with 4-inch diameter flush coupled threaded PVC. The monitoring well screens consist of commercially slotted, flush coupled, and threaded PVC screen, 15 feet in length, with a slot size of 0.010 inches.

An artificial filter pack was tremied into the annular space around the well screen. The filter pack, 40-30 sand, for the shallow and deep monitoring wells extends approximately 2 feet above and 1 foot below the slotted well screen. A thick bentonite pellet seal was placed above the sand to provide a minimum 2-foot thick annular seal above the filter pack.

Volclay grout was tremied into place to fill the annular space around the well casing from the top of the bentonite seal to a depth approximately 5 feet below ground surface. A surface seal of Sakrete mix was used to seal the annular space from the top of the Volclay grout to the ground surface. The concrete surface seal and the surface pad were constructed as one continuous unit.

All monitoring wells were fitted with vented PVC caps and encased with a lockable protective steel casing. The casings were coated with a rust-preventative, yellow paint. The casings extend to a depth of approximately 2 feet below ground level. A minimum 3-foot diameter, 2-foot thick concrete surface pad was constructed immediately surrounding the protective casing of the shallow wells. Deep wells are protected by the 10-inch steel surface casing in which the lockable protective steel casing was set. Protective steel fence post barriers were installed surrounding each monitoring well.

All monitoring well installations were recorded with the Lee County Iowa Health Department as required by the State of Iowa.

Following installation and in accordance with the approved work plan, each monitoring well was developed to increase yield and to remove any materials that may have been introduced into the formation during drilling operations. Development occurred no sooner than 48 hours following completion of the grouting. Development was by bailer, B-K pump, or nitrogen driven submersible pump. Measurement of water temperature, pH, and conductivity was generally performed during development. Development continued until a minimum of 10 well volumes had been removed. Exceptions were made for wells with exceptionally slow recharge. These wells were purged dry a minimum of three times.

Water produced during the development of WCC installed wells was disposed onto the ground surface adjacent to each well. This procedure was acceptable to USEPA provided that all soil samples in the vicinity of the wells had been collected which was the case. A record of the volume of water removed from each monitoring well and the results of the periodic field measurements were kept to document that proper development was completed.

Development details for the monitoring wells installed by Jacobs Engineering Group are unavailable. However, it is known that all purge and development water was contained in 55 gallon open top drums.

Piezometer Installation and Development

A total of 5 piezometers were installed on the steep sideslope leading downward to the drainage north and south of the Baier site. These borings were installed using a hand-held auger to an estimated depth of approximately 10 feet. WCC installed piezometers PZ-01, PZ-02, PZ-03, and PZ-04. Jacobs Engineering Group on behalf of USEPA installed PZ-05 on the Fedler property. The approximate locations of the piezometers are shown on Figure 2.

The location of each piezometer was determined from field observations of the contact between the weathered and unweathered tills. The actual piezometer boring location was approximately 10 feet higher in elevation than the contact between the weathered and unweathered till immediately downslope at each location.

The piezometers were constructed of 2-inch, threaded, flush coupled PVC, with 2.5 feet of 0.010 slot size screen. Construction details for the piezometers are included in Appendix B.

Piezometers were developed by bailing dry a minimum of three times.

Ground Water Sampling and Analysis

Two rounds of ground water samples were collected from each of the newly installed monitoring wells and submitted for chemical analysis to provide information on potential extent of ground water contamination. The initial sampling round occurred immediately after installation and development of the new monitoring wells. The second, or verification round, occurred approximately two weeks after the initial round and coincided with the June 1990 quarterly ground water sampling event which included all new and existing wells. (Note: Existing wells were installed by E&E on behalf of USEPA (MW-A, MW-B, MW-C, and WCC on behalf of DuPont (MW-D1, MW-D2, MW-E, MW-F, MW-G, MW-H, MW-I). Samples obtained from MW-D1, MW-D2, MW-L1, and MW-L2 located on the Fedler property were obtained by Jacobs Engineering Group on behalf of USEPA in July 1990 and August 1990 and split by WCC on behalf of DuPont.

Samples were analyzed for CLP VOCs and CLP metals (both total and dissolved), nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. Total suspended solids were also analyzed during the June 1990 quarterly ground water sampling event. In addition to these analyses, samples from the newly installed monitoring wells were analyzed for CLP semi-volatile compounds. With the exception of monitoring well MW-F, existing monitoring wells were not sampled for semi-volatile compounds because the presence of these compounds had not been observed during the previous sampling events.

The ground water samples submitted for the analysis of total suspended solids were used to evaluate sediment loading. This analysis allowed the possible correlation between sediment loading and concentrations of selected metals in ground water samples.

Slug Testing

Following the installation, development, initial and verification ground water sampling, slug tests were performed on MW-K1, MW-J, MW-K2 and MW-F2. These slug tests were conducted to aid in the estimation of the hydraulic conductivity of the formation material in the vicinity of the well screen and supplement the slug test data generated in August 1989.

Rising and falling head slug tests were performed on each of the four monitoring wells by introducing, and subsequently removing, a slug of known volume. Slug test data was collected with In-Situ, Inc., Hermit Model 2000B Hydrologic Monitors and In-Situ 10 psi pressure transducers. Following each test, the data was downloaded onto a Zenith Supersport 286 laptop computer using the In-Situ, Inc., Data Transfer Utility Software Version 1.2. The ASCII formatted information was then transferred into Lotus 1-2-3 for visual inspection using the graph mode of the program. This process was used as a quality assurance check to determine that data collection had been successful at each well location subsequent to each falling/rising head test.

2.2 MCCARL SITE

2.2.1 PRE-REMEDIAL INVESTIGATION

2.2.1.1 May 1989

Concurrent with the preliminary field investigation activities at the Baier site, WCC also conducted initial field activities at the McCarl site. The purpose of these field activities was to provide an initial site assessment and recommendations for further action/field work.

Source/Soil Investigations

Field activities conducted at the McCarl site were generally consistent with those conducted at the Baier site and included intrusive probing to visually estimate the areal and vertical extent of waste material, test pit excavation, soil/waste sampling, development and sampling of USEPA installed ground water monitoring wells, and field mapping of the site.

The approximate areal and vertical extent of waste material was investigated using intrusive hand probing techniques. General methods and procedures followed during intrusive probing activities conducted at the McCarl site were analogous to those employed at the Baier site and discussed in Section 2.1.1.1. Intrusive probing locations were labeled MA-01 through MA-04 and are illustrated on Figure 3. Table 2-2 lists the depth to the soil/waste contact for each probe hole along with the HNu readings obtained in the hole.

An attempt was also made to estimate the vertical and horizontal nature of the alleged disposal burn areas by excavating test pits with a tractor mounted backhoe. The rationale for advancing the horizontal and vertical extent of the pits, as well as the general excavation procedures are described in Section 2.1.1.1. Test pits were labeled TP-05 through TP-10 are illustrated on Figure 5. The depth to the soil/waste contact for each test pit excavated and the associated HNu readings in each test pit is presented in Table 2-2.

As with the activities conducted at the Baier site, all materials encountered in the hand auger probes or excavated test pits were logged in a field book. Excavated materials from the hand auger probes and test pits were temporarily stored on plastic sheeting next to the probe hole or test pit and ultimately backfilled into the excavation.

Soil/waste samples were collected for chemical analysis with the hand auger, from the backhoe bucket during test pit excavation, and from the test pit walls. Samples were collected in general accordance with the abbreviated SAP (WCC, 1989a). However, a field decision was made to collect samples for volatile organic analysis because of the HNu readings recorded and the conditions previously encountered at the Baier site. Collection of the volatile organic samples was not detailed in the abbreviated SAP.

Ground Water Investigations

The existing USEPA monitoring wells were redeveloped during the May 1989 site assessment at the McCarl site in order to remove fines from the well casing and filter pack. In addition, development activities provided a means to evaluate the recharge capabilities of each well. The monitoring wells were developed with the dedicated PVC bailers located in each well. The final activity conducted at the McCarl site, field mapping, was conducted as described for the Baier site in Section 2.1.1.1.

2.2.1.2 July 1989

During the July 1989 supplemental field investigation at the Baier site, four ground water monitoring wells (MC-4A, MC-4B, MC-5, and MC-6) were installed at the McCarl site and topographic mapping of the site performed. No additional intrusive hand augering or machine drilled borings were installed and no additional soil samples were collected at the McCarl site.

The four monitoring wells were installed to provide additional information on the hydrogeologic properties of the upper most water bearing unit beneath the site. A second objective of the investigation was to provide information on the general extent of potential chemical contamination in the upper most water bearing unit and to assist in the evaluation and selection of remedial design alternatives should they become necessary.

All monitoring wells were constructed of two inch diameter Schedule 40 PVC casing and well screen. Construction details were the same as for those wells installed at the Baier site and described in Section 2.1.1.2.

Following installation and development three of the four new wells and the three existing USEPA wells were sampled. Monitoring well MC-4B was dry (and remains dry) and was not sampled. The wells are shown on Figure 3. Boring logs and monitoring well installation reports are included in Appendix C.

2.2.2 REMEDIAL INVESTIGATION - MCCARL SITE

Concurrent with the RI activities conducted at the Baier site beginning April 23, 1990, RI activities were implemented at the McCarl site. These investigations were also conducted in accordance with the USEPA approved Work Plan, QAPP, and HSP prepared by WCC and dated March 19, 1990.

2.2.2.1 Field Mapping

Field mapping of the surficial expression of the contact between the weathered and unweathered till was attempted along the sideslopes of the drainages to the north of the site.

An attempt was made to locate the contact between the weathered and unweathered till deposits based on till contact elevation data available from borings logs and ground surface elevation data available from the site topographic map. This information indicated that the relief of the sideslopes was not great enough to intersect the till contact. Reconnaissance performed by a qualified geologist in the drainage ditches did not reveal the presence of the weathered unweathered till contact.

Reconnaissance of the drainage ditches also indicated that no active seeps were present. Moisture content of the soil material in the drainage ditches was not substantially higher than that of surrounding surficial material.

2.2.2.2 Contaminant Source Investigation/Soil Investigation

As previously discussed, the contaminant source investigation was initiated during field investigation activities performed in May, 1989. The purpose of those initial field investigation activities was to provide an initial assessment of the lateral and vertical extent of contamination through the completion of hand auger borings, test pit excavation, and installation, development, and sampling of ground water monitoring wells.

The contaminant source investigation was expanded during RI field activities because the initial activities of May 1989 did not reveal any discrete source areas. As a result, a sampling program was designed for the McCarl site to provide a characterization of potential source areas and surrounding soils. The investigation procedures are described below.

Coordinate Layout

A 25-foot by 25-foot coordinate grid was established over the entire McCarl site. The grid was utilized to establish reference points for sampling operations on a 25-foot center across the site. The sampling grid was surveyed and tied to benchmarks to ensure that adequate control was achieved. The grid was oriented in a north-south direction, and was completely labeled with row and column identifiers to allow for unique identification of each sampling node. The layout of the sampling grid at the McCarl site is shown in Figure 6.

Sample Collection/Field Screening

After the sampling grid was established, the field screening sampling program was performed to further evaluate the potential source areas of contamination and assess the lateral extent of surficial contamination. Field screening sampling was performed at the McCarl site to evaluate the presence of metals (using lead as the indicator) and volatile organic chemicals (xylene, toluene, ethylbenzene) in the soil at a depth of 3 feet.

Metals screening was undertaken at 1-foot intervals to a depth of 3 feet in every grid across the site. VOC screening (soil gas survey) was undertaken at 3 feet below ground surface in every other grid across the site (i.e., 50-foot centers).

In boundary grids where the limiting criteria were exceeded, the grid system was laterally extended. In the extended grids, samples for lead screening were collected and screened to the deepest interval in which boundary grid screening samples exceeded the limiting criteria (i.e., if the boundary grid only exceeded the 500 ppm limiting criteria in the 0 to 1 foot interval, screening samples from the extended grid were only collected from the 0 to 1 foot interval). Grid extensions are shown on Figure 6.

Metals screening samples were obtained with decontaminated hand augers. Sample material from each 1-foot interval was composited in a decontaminated stainless steel bowl and mixed with a decontaminated stainless steel spoon and placed in a prelabeled amber glass sample jar. Composited sample material from each interval was then dried by microwaving on the high setting for approximately 2 minutes. Samples were then sieved through a decontaminated stainless steel No. 10 wire mesh sieve. Appropriate amounts of the sieved material was withdrawn and placed into a small Teflon cups and covered with acetate for the analysis of lead by x-ray fluorescence (XRF).

VOC soil gas screening was conducted by collecting soil samples at discrete depths (approximately 3 feet below ground surface) using a one-inch sampling tube which connected to the end of a hydraulically driven probe rod. A five gram sample was then weighed to the nearest 0.1 gram and prepared for analysis.

The procedure of collecting an actual soil sample for analysis rather than soil gas was a deviation from the approved work plan. The rationale for and proposed method modification was discussed with USEPA prior to implementation. USEPA subsequently provided verbal approval of the change and formally notified Du Pont of their approval in a letter dated May 22, 1990.

Work plan deviations and a complete description of the modified soil gas screening procedures are discussed in Section 2.4.

Deep Boring Installation

The purpose of the field screening for metals and volatile organics was to obtain real time data to allow immediate decisions to be made on where deep borings (to six feet) should be installed and to further delineate the area(s) of surficial contamination. Therefore, upon completion of the field screening for metals and VOCs, the chemical analysis results for each location were assessed to evaluate the necessity of deep boring and sampling for laboratory chemical analysis. The following criteria were used to establish deep boring and sampling locations:

- o Metals - Grid sampling locations where lead concentrations by XRF were greater than 500 ppm exceedance criteria established in the approved work plan in the 2- to 3-foot interval were included in the deep sampling program (see Figure 6). The 500 ppm level was selected because it represents the current ATSDR residential target clean-up level for lead and would be overall conservative given the fact that Du Pont owns the McCarl site and residential development is restricted.
- o VOCs - Locations with concentrations of the screening constituents (ethylbenzene, toluene, or xylene) where the sum total of the three compounds exceeded 1 mg/kg were included in the deep sampling program (See Figure 6). (Note: The original screening criteria of 5 times the signal to noise ratio for soil gas analysis was eliminated and revised to 1 mg/kg total xylene, toluene, and ethylbenzene with USEPA approval when the field screening technique was modified).
- o Semi-volatiles - Samples were collected and analyzed at those locations where lead concentrations were found greater than 500 ppm in the 2- to 3-foot interval because of the nature of the disposal activities and their similar behavior to metals in the environment (see Figure 6).
- o In those locations where the metals criterion was exceeded, but not the VOC criteria, deep boring and sampling was performed for metals and semi-volatiles only. In those locations where the VOC

criterion was exceeded, but not the metals, deep boring and sampling were performed for VOCs only.

Deep Boring and Sampling

When the limiting criteria were exceeded for a given contaminant group (metals or VOCs) at a sampling location, deep boring and sampling was performed at the individual sampling location. Deep sampling was performed as follows:

- **Metals** - Samples were collected at 2-foot intervals to a depth of 6 feet. In sampling locations where a drilling rig was utilized, a continuous core barrel sampler was used for the first 5 feet, and a split spoon was driven to collect the 5- to 6-foot interval. Samples were composited from each 2-foot interval, resulting in three samples from each deep sampling location. Due to inaccessibility and drill rig breakdown, some deep borings were installed with hand augering equipment. Samples for analysis were collected and composited from the prescribed intervals for chemical analysis. Each sample was analyzed for the full suite of metals as per the CLP statement of work.
- **Semi-volatiles** - Samples were collected at 2-foot intervals to a depth of 6 feet as described above. Samples were composited from each 2-foot interval, resulting in three samples from each deep sampling location. Each sample was analyzed for the full suite of semi-volatiles as per the CLP statement of work.
- **VOCs** - VOC samples were collected to a total sampling depth of 6 feet as described above. Samples for VOC were collected from the lower 6 inches of each 2-foot interval (i.e., 1.5 to 2 feet, 3.5 to 4 feet, and 5.5 to 6 feet) resulting in three samples from each deep sampling location. As with the metals samples, some borings were installed with hand augering tools. Each sample was analyzed for VOCs in accordance with the CLP statement of work.

Risk Assessment Sampling

In grid locations where lead concentrations by XRF exceed the 500 ppm criterion in the 0- to 1-foot interval, samples were shipped to the laboratory for CLP metals analysis to provide data for use in the risk assessment. Therefore, to provide input for the risk assessment, all 0- to 1-foot grid locations exhibiting an XRF value of lead in excess of 500 ppm were shipped and analyzed for the full suite of CLP metals. The 500 ppm criterion was again utilized to provide overall conservative data. Grids requiring 0- to 1-foot metals analysis are shown on Figure 7.

2.2.2.3 Sediment Investigation

Sediment samples were collected in the flowline of the ditch north of the McCarl site (see Figure 3). Samples were collected downgradient from location of MA-5, a sediment sample which was collected in May 1989. Samples were collected by hand augering from 0- to 1-foot below ground surface within the drainage ditch flowline. Samples were analyzed for CLP metals, CLP volatile organics, and CLP semi-volatiles in accordance with the CLP statement of work.

2.2.2.4 Geological Investigations/(Geotechnical Boring)

A total of three geotechnical borings were drilled and sampled at the McCarl site. One geotechnical boring (MC-4C), terminated a short distance into bedrock (approximately 225 feet below ground surface) while the other two geotechnical borings (MC-3C, MC-6C) were terminated at the first identifiable water bearing unit in the unweathered till below the weathered/unweathered till interface.

Geotechnical borings (MW-3C and MW-6C) were continuously sampled with a 5-foot core barrel sampler from the ground surface to the termination depth of the boring. Samples were classified in accordance with the Unified Soil Classification system by a WCC qualified geologist. MC-4C was continuously sampled with a 5-foot core barrel until the drilling rig was unable to drill any deeper utilizing this method (approximately 198 feet below ground surface). At that point, the sampling was continued by driving standard split spoon samplers to the completion depth.

Borings were advanced with hollow-stem augers to the maximum depth possible to aid in the identification of potential water bearing zones. It was necessary to switch to mud-rotary drilling techniques at MW-4C as depths were reached which exceeded the capability of auger drilling techniques.

Samples were carefully inspected for changes in relative moisture content with depth. Relative moisture content of a sample were described with reference to the plastic limit of the material. Fractures within the till deposits, if present, were inspected for evidence of iron or carbonate coatings to evaluate whether water is, or has been, present.

Deep borings extended below the weathered/unweathered till contact were cased with 10-inch diameter steel casing to prevent potentially contaminated ground water in the weathered till from migrating to lower depths. The bottom of the casing was set approximately 2 feet below the contact between the weathered and unweathered tills. The annular space between the borehole wall and the casing were filled with a cement/bentonite or Volclay grout from the bottom of the casing to the ground surface to prevent potential downward migration of water along the outside of the casing. Boring logs are provided in Appendix C.

2.2.2.5 Open Borehole Test

An open borehole test was conducted during the installation of geotechnical boring MC-4C. The purpose of this test was to evaluate hydraulic conductivity of the unweathered till between the upper water bearing zone (weathered till) and first identifiable lower water bearing zone (unweathered till).

The test was initiated by determining the depth to the bottom of the open borehole and establishing the static water level. Following the establishment of these parameters, the borehole was filled with potable water from the driller's water tank to bring the water level in the borehole up approximately 7 feet above static. This soak period of the test was conducted for approximately 100 minutes during which additional water would be added to maintain the water level. The addition of water was not necessary.

Following the soak period, the falling head test was started by collecting water level measurements every 30 seconds for the first 5 minutes, then every minute for the next 20 minutes, then every ten minutes for the next 60 minutes. The final water level measurement was obtained approximately 150 minutes after the beginning of the soak period.

2.2.2.6 Ground Water Investigation/Monitoring Well Installation and Development

A total of four additional monitoring wells (one shallow and three deep) were installed at the McCarl site (see Figure 3).

The shallow monitoring well, MC-7 was installed and screened in the lower 2 feet of weathered till immediately above the contact of the underlying unweathered till. Monitoring well MC-7 was located in an area suspected of being downgradient from a potential surficial source area based on preliminary evaluation of ground water flow direction in the uppermost water bearing zone.

The deep monitoring wells MC-3C, MC-4C, MC-6C were installed to provide adequate distribution for the evaluation of deep ground water flow conditions beneath the site. Deep monitoring wells were paired with existing shallow wells at MC-3, MC-4A, and MC-6. The deep monitoring wells were screened in the first identifiable water bearing unit beneath the weathered and unweathered till contact. These wells were installed in the deep geotechnical borings described in Section 2.2.2.4.

All of the monitoring wells installed at the McCarl site were constructed of 2-inch diameter, flush coupled, threaded PVC. To be consistent with existing well construction details, the proposed deep monitoring well screens consist of commercially slotted, flush coupled, and threaded PVC screen, 15 feet in length, with a slot size of 0.010 inches.

An artificial filter pack was tremied into the annular space around the well screen utilizing a tremie pipe. The filter pack for the shallow and deep monitoring wells extends approximately 2 feet above and 1 feet below the slotted well screen. A thick bentonite pellet seal was placed to provide a minimum 2-foot thick annular seal above the filter pack.

Volclay grout was tremied into place to fill the annular space around the well casing from the top of the bentonite seal to a depth of approximately 5 feet below ground surface. A surface seal of Sakrete mix was used to seal the annular space from the top of the Volclay grout to the ground surface. The concrete surface seal and the surface pad were constructed as one continuous unit.

All monitoring wells were fitted with vented PVC caps and encased with a lockable protective steel casing. The casings were coated with a rust-preventative yellow paint. The casings extend to a depth of approximately ? feet below ground level.Protective steel fence post barriers were installed surrounding each monitoring well.

Construction of the monitoring wells was observed and documented by a WCC qualified geologist. Ground water monitoring well installation reports are included in Appendix C. All monitoring well installations were recorded with the Lee County Iowa Health Department as required by the State of Iowa.

Each completed monitoring well was developed to increase yield and to remove any materials that may have been introduced into the formation during drilling operations. Development occurred no sooner than 48 hours following completion of the grouting. Development was by bailer, B-K pump, or submersible nitrogen driven pump. Measurement of water temperature, pH, and conductivity was performed periodically during development. Development continued until a minimum of 10 well volumes have been removed. Exceptions were made for wells with exceptionally slow recharge. These wells were purged dry a minimum of three times. Water produced during the development of each well was disposed of onto the ground surface adjacent to the well. A record of the volume of water removed from each monitoring well and the results of the periodic field measurements were kept in dedicated field books to document that proper development has been completed.

Ground Water Sampling and Analysis

Two rounds of ground water samples were collected from each of the newly installed monitoring wells (except MC-7, see below) and submitted for chemical analysis to provide information on the potential extent of ground water contamination. The initial round occurred immediately after installation and development of the new monitoring wells. The second, or verification round, occurred approximately two weeks after the initial round in conjunction with the June 1990 quarterly ground water sampling event which included all wells at the McCarl site. Samples were analyzed for CLP VOCs and CLP metals (both total and dissolved), nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. In addition to these analyses, samples from the newly installed monitoring wells MC-3C, MC-4C, and MC-6C were analyzed for CLP semi-volatile compounds during both sampling events. The existing monitoring wells were not sampled for semi-volatile compounds because the presence of these compounds has not been observed during the previous sampling events.

Ground water samples collected during the June 1990 quarterly sampling event were also submitted for laboratory analysis of total suspended solids to evaluate sediment loading. This analysis allowed the possible correlation between sediment loading and concentrations of selected metals in ground water samples.

Monitoring well MC-7 was dry during initial and June 1990 quarterly sampling. The well began to make small amounts of water in July 1990 and was developed and sampled at that time. To date, MC-7 has been sampled one time. Because of its low water yield, samples were collected for volatile organics and total and dissolved metals only.

Slug Testing

Following installation, development, initial and verification ground water sampling slug tests were performed on MC-3, MC-3C, MC-4A, MC-4C, MC-6C. These slug tests were conducted to aid in the estimation of the hydraulic conductivity of the formation material in the vicinity of the well screen and supplement the slug test data generated in August 1989.

Rising and falling head slug tests were performed on wells MC-3C, MC-4C and MC-6C by introducing, and subsequently removing, a slug of known volume. Rising head slug tests only were performed in wells MC-3 and MC-4A because the static water level was below the top of the screen. Slug test data was collected with In-Situ, Inc., Hermit Model 2000B Hydrologic Monitors and In-Situ 10 psi pressure transducers. Following each test, the data was downloaded onto a Zenith Supersport 286 laptop computer using the In-Situ, Inc., Data Transfer Utility Software Version 1.2. The ASCII formatted information was then transferred into Lotus 1-2-3 for visual inspection using the graph mode of the program. This process was used as a quality assurance check to determine that data collection had been successful at each well location subsequent to each falling/rising head test.

2.3 FEDLER PROPERTY

An investigation of the alleged "farm dump" and five drainage ditch heads was conducted on the Fedler property by Jacobs Engineering Group on behalf of USEPA. The investigation was conducted in general accordance with the USEPA approved work plan dated March 19, 1990 prepared by WCC on behalf of DuPont.

In general, in the area of the alleged farm dump (see Figure 8) an origin was established in the southeast corner of the area in question. From this point of origin an X-Y coordinate system was established. A series of random numbers less than one were then generated. The first random number was then multiplied by the total number of feet in the X direction (22 feet) and the second random number was then multiplied by the total number of feet in the Y direction (86 feet). The sample point was then located by taping the given number of feet in the X direction, pivoting 90 degrees and taping the given number of feet in the Y direction. This procedure was conducted five times to locate five randomly generated sampling points.

The five random sampling points are shown on the Jacobs Engineering Group drawing included herein as Figure 8.

Samples were collected with hand augering equipment from ground surface to a depth of 3.5 feet below ground surface. Samples from the 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot intervals were individually composited and submitted to the lab for the analysis of CLP metals. A discrete sample from 3.0 to 3.5 feet below ground surface was submitted for the analysis of CLP volatile organics.

In conjunction with the investigation on the alleged "farm dump" Jacobs Engineering Group also investigated the heads of the 5 ditches shown on Figure 9. The investigation of these ditch heads was in response to allegations that dumping occurred at or near these ditches when the Fedler access road was muddy and access to the Baier site not possible. The ditches selected for sampling by Jacobs Engineering Group were identified as being the most likely locations for disposal because of their proximity to the access road.

Hand augers were utilized to collect samples from ground surface to 5 feet below ground surface in the areas identified on the Jacobs Engineering Group drawing included herein as Figure 9. Samples for metals analysis were collected from the 0- to 1-foot, 1- to 2-foot, 2- to 3-foot, and 3.5- to 5-foot intervals below ground surface from Ditch 2, Ditch 3, Ditch 4, and Ditch 5. Samples for metals analyses were collected from two locations in the 0- to 1-foot interval only in Ditch 1.

Samples for VOC analysis were collected from Ditch 2, Ditch 3, Ditch 4, and Ditch 5 from the 3.0- to 3.5-foot interval. No VOC samples were collected from either location in Ditch 1.

Splits of all samples obtained by Jacobs Engineering Group were provided to WCC for analysis. DuPont elected to analyze 100 percent of the split samples obtained. Results are discussed in Section 4.0.

2.4 WORK PLAN DEVIATIONS

2.4.1 GEOLOGICAL INVESTIGATIONS

Deep geotechnical borings at both the Baier site, (MW-F2, MW-K2) and the McCarl site (MC-3C, MC-4C, MC-6C) were to be terminated a short distance into the first bedrock unit encountered. The first geotechnical borehole (MC-4C) was drilled to depths that required the drilling method to be changed from hollow-stem augering to mud rotary as the material encountered in the borehole became very dense and hard. The change to mud rotary drilling while continuously sampling caused the rate of drilling to decrease greatly. As a result of the lack of progress during the completion of the geotechnical boring MC-4C, all further geotechnical borings were taken to the depth required to screen the water bearing unit in the unweathered till and not bedrock. This change was approved by USEPA prior to implementation.

In addition, the work plan stated that representative samples of cohesive materials would be collected and tested for moisture content by laboratory analysis. No samples were collected for laboratory analysis of moisture content.

2.4.2 SOIL INVESTIGATION

2.4.2.1 Soil Gas Survey

As part of the soil investigation, a soil gas survey was performed at alternating grid points on both the Baier and McCarl sites. The initial work plan design was altered after it became apparent that the subsurface material, a silty clay, was causing excessive soil vapor purge times.

Due to the shallow sampling depths (3 feet) and long purge times (>3 minutes), a concern regarding the integrity of the vapor samples was raised by Plains Environmental Services (PES) (subcontractor for the soil gas survey). The concern centered around the potential of surface air being drawn down around the probe annulus during the vacuum purge, and therefore, diluting the sampled vapors.

The alternate technique consisted of collecting soil samples followed by headspace analysis. An area of known contamination (H9) was sampled using both soil gas and soil headspace techniques. Only the soil headspace technique resulted in significant detection from the analysis.

Following is a presentation of the method used by PES to analyze soil samples by the headspace technique:

HEADSPACE ANALYSIS OF SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY

1. Soil samples are collected at a discrete depth using a one-inch sampling tube which connects to the end of the probe rod.
2. A five-gram sample (4.9 - 5.1 gram) was quickly transferred to a 40 ml VOA vial and accurately weighed to the nearest 0.1 gram.
3. Deionized water was added to the vial to a pre-marked line so that one-half of the vial contents consisted of headspace. The vial was immediately capped to minimize loss of volatile components. (The use of water helps to control the headspace volume and also to increase soil surface exposure for desorbing volatile components.)
4. The vial was shaken vigorously and placed in an oven at 60C for 30 minutes.
5. A 1cc aliquot was withdrawn from the vial by inserting the needle of a 1cc syringe through the vial septum.
6. The sample was injected directly into the gas chromatograph for analysis.
7. The final concentration (ug/g or mg/kg) in the soil was calculated for analysis.

$$\frac{\text{Headspace conc. (ug/L) x 0.021 L (headspace vol.)}}{\text{5.0g (used actual wt. of soil sample)}}$$

Note: This method only measures the amount of volatile compounds that are thermally desorbed from the soil and aqueous mixture/solution at 60C.

2.4.2.2 Soil Screening

As briefly described in Section 2.1.2.5 samples obtained from grid locations on the Fedler property were not screened in the field using soil gas techniques or X-ray fluorescence. These samples were collected by Jacobs Engineering Group in general accordance with the protocol described in the approved work plan (i.e., hand augering). However, all samples collected were submitted for laboratory analysis because Jacobs Engineering Group did not have field screening capabilities.

2.4.3 OPEN BOREHOLE TESTING

Open borehole testing was scheduled to be completed in each deep geotechnical boring at the McCarl site. The tests were also to be conducted over a period of approximately 4 hours. However, because of the documented lack of response during testing at MC-4C (i.e., no change in water level) the test was terminated after 150 minutes and the two remaining tests were canceled.

2.4.4 FEDLER PROPERTY

Jacobs Engineering Group on behalf of USEPA conducted the investigation of the alleged Fedler "farm dump" and the drainage ditch heads. The ditches selected for sampling and analysis by Jacobs Engineering were slightly different than those proposed in the approved March 19, 1990 work plan prepared by WCC on behalf of DuPont. No rationale for the modification was provided by Jacobs or USEPA.

In addition, field screening was not collected. All samples obtained were analyzed in the laboratory as discussed above.

3.0 PHYSICAL CHARACTERIZATION OF THE STUDY AREA

3.1 SURFACE FEATURES

3.1.1 BAIER SITE

The Baier site is located in a rural area of Lee County, Iowa approximately 3.5 miles south of West Point, Iowa and approximately 5 miles west-northwest of Fort Madison, Iowa. The Baier site is more precisely described as being located in the NE ¼ of the SW ¼ of Section 28, Township 68 North, Range 5 West (Figure 1). The site is accessible via County Road X-23 and a farm lane traversing the Richard Fedler property immediately northeast and contiguous to the site.

The Baier site is separated into two roughly triangular sections by a road trending in a northeasterly direction through the site (Figure 2). The southeastern portion of the site is generally flat and moderately wooded, with mounded areas of waste material up to several feet high. The northwestern portion of the site has gentle to steep slopes and is moderately to heavily wooded with mounded areas of waste material. The steepest slopes generally occur near the northern and western boundaries of the site.

The Baier site is bounded to the south and east by flat to gently sloping farmland and to the north and west by steep sloping forested land. Currently, the surface of the site is littered with paint cans, ceramic grinding balls, and white drum castings as well as paint, sludge and paint filters. Areas of stressed vegetation are evident in places across the site. The site was recently encircled with a barbed wire fence.

3.1.2 MCCARL SITE

The McCarl site is also located in rural Lee County, Iowa, approximately 1.5 miles northeast of the Baier site. The McCarl site is located on Chalkridge Road which is accessible via County Road X-23. A more precise description of the location of the McCarl site is the SE ¼, SW ¼ of Section 22, Township 68 North, Range 5 West (Figure 1).

The McCarl site is flat to gently sloping cleared land; however, the northern and eastern boundary areas are heavily wooded. The northern boundary area is bordered by moderate to steep drainage slopes (Figure 3).

The site is bounded to the north by an easterly flowing ephemeral drainage to Devils Creek, to the east by wooded lands, to the west by a private residence, and to the south by Chalkridge Road. Currently, access to the site is controlled by a locked gate. The site has been graded relatively flat and was cleared of surface debris by DuPont after purchase. Limited evidence of white drum castings, paint cans, and paint sludges can be seen along a steep ravine that traverses the site east and west. Small areas of stressed vegetation are also evident.

3.2 METEOROLOGY AND CLIMATOLOGY

The Baier and McCarl sites are located in a climatic region classified as humid continental. Historically, southeast Iowa undergoes warm rainy summers contrasting with cold drier winters.

The nearest meteorological information to the sites was only available at two stations (Keokuk, Iowa and Moline, Illinois) on the Mississippi River (United States Department of Commerce, 1989). Keokuk is at Lock and Dam 19, about 25 miles downstream of Fort Madison. Moline, on the other hand, is nearly 100 miles upstream in Rock Island County, Illinois.

Similarities in yearly distribution of precipitation and temperature were observed at both stations. The average annual precipitation at Keokuk from 1951 to 1988 was 36.2 inches. At Moline, average annual precipitation from 1960 to 1989 was 35.8 inches (Figure 10). The average annual temperatures were 53 degrees Fahrenheit (F) for Keokuk and 50 degrees F for Moline for their own period of records. Figure 11 (A) shows average monthly temperature distribution for both stations.

Larger precipitation amounts were generally observed at both stations during the months of April through September, with the highest events typically occurring during late spring and early summer. See average monthly precipitation distribution, Figure 11 (B).

The average monthly temperature at Keokuk, ranges from 78 degrees F in July to 25 degrees F in January. Temperatures above the average were recorded from April through October, while the rest of the year were below the average. Extreme values have been recorded in the months August, 106 degrees F maximum, and January, 22 degrees F below zero minimum.

Prevailing wind direction at Moline, is west/northwest from November through April with a mean speed of 10 miles per hour (mph). Lower than average winds occur from May through October blowing east/south. Information on wind direction and speed was not available for the Keokuk station.

3.3 SURFACE WATER HYDROLOGY

The sites are located in the uplands of the Mississippi River Valley and within Devils Creek Basin. Two main streams, Sugar Creek and its tributary Devils Creek, drain the 140 square miles basin yielding an estimated average discharge of 94.2 cubic feet per second, via Sugar Creek, into the Mississippi River (Figure 12).

The Baier site is located east of Sugar Creek and in between two of its ephemeral tributaries. The narrow ridge where the Baier site lies is slightly over 700 feet above mean sea level and covers an area of 12.4 acres. Surface water drains into the west/northwest and south drainage networks in the immediate vicinity of the site (Figure 2). These steep natural channels will carry their waters downstream to lower lands where wider and longer ephemeral creeks will finally discharge them into Sugar Creek about 1.5 miles southwest of the site.

The McCarl site is at the southwest end of an ephemeral tributary of Devils Creek. The site lies at about 700 feet above mean sea level and slopes northeast to provide drainage for the 3.3 acres of grassland and woods (Figure 3). Water is initially conveyed by a steep narrow creek that runs east, to a gentle and wide creek that later changes course to the southeast and discharges about 1.4 miles from the site into Devils Creek.

Large fluctuations in stream flow are typical of rivers in the area. Small streams like Sugar Creek will be greatly affected by seasonal weather changes. Snow in the winter has been shown to produce low runoff. Runoff increases during early spring with increasing temperatures and melting of snow. By mid-spring, evapotranspiration losses become significant, slightly decreasing stream flow. Evapotranspiration is in late spring, offset by precipitation producing larger runoff. Precipitation is still high in summer, but stream flow decreases sharply because of increased evapotranspiration. Precipitation and runoff decrease in the fall.

The gaging stations for Devils Creek Basin are classified as low flow, partial-record stations and will not provide enough information for the elaboration of a flow duration curve. Flow duration curves developed for neighboring stations with longer records indicate that streams of the capacity of Sugar Creek will have flows of 2.0 cubic feet (or larger) per second per square mile 5 percent of the time. Low-flow frequency discharge for Sugar Creek was found to be less than 0.1 cubic feet per second, as an average for a 7 day low flow, with a 2 year recurrence interval. (Iowa Geological Survey Water Atlas No. 4, 1971.)

Due to the relatively high precipitation, the general clayey nature of the soils, and the moderate to steep slopes. Runoff from the sites is expected to be relatively large during late spring.

3.4 GEOLOGY

This chapter provides a description of the regional and site-specific physiographic, topographic and geologic features. The regional geologic characterization was prepared from a review of published and unpublished literature and from WCC experience in the geologic environment and geographic area. The site-specific characterization is based on data collected during preliminary field studies in the summer of 1989 and the RI in the spring and summer of 1990 by WCC and from previous studies by EPA.

3.4.1 REGIONAL GEOLOGY

3.4.1.1 Physiography and Topography

The sites are located within the physiographic region described as the Dissected Till Plains Section of the Central Lowlands Province of the Interior Plains Division of North America.

The sites are located in the uplands area of the Mississippi River Valley, approximately 6 miles to the west of the Mississippi River. There is approximately 150 feet of relief between the sites and the Mississippi River lower valley located 2.5 to 3 miles southeast of the sites (see Figure 13).

The topography of the uplands area generally consists of relatively narrow, flat to gently rolling hilltops bordered by moderate to steep drainage side slopes. Ephemeral tributaries leading from the hilltop areas are also moderately to steeply sloping.

3.4.1.2 Stratigraphy

The uplands area in the site vicinity is underlain by unconsolidated deposits of Recent and Pleistocene age having a combined thickness ranging from approximately 0 to 320 feet (USGS, 1971). Underlying these deposits is a thick sequence of consolidated bedrock. The uppermost bedrock formations in the region are Mississippian age, hereafter referred to as bedrock. A schematic illustrating a regional geologic cross-section is presented as Figure 13. The location of the regional cross-section A-A' is shown in Figure 12. Table 3-1 presents the general stratigraphic units reportedly found in the region.

UNCONSOLIDATED DEPOSITS

Unconsolidated deposits in southeastern Iowa consist of four general types: glacial till, buried channel, recent alluvium, and loess. The most widespread of these is glacial till.

The following discussion on glacial till deposits in southeastern Iowa was taken from a published Iowa Geologic Survey report (Iowa Geological Survey, 1980).

Till deposits in southeastern Iowa are formally subdivided into three formations: the Alburnett and Wolf Creek Formations of Pre-Illinoian age, and the Glasford Formation of Illinoian age (see Table 3-2). The Pre-Illinoian tills are "western derived," and deposited by glaciers which moved through Iowa. The Illinoian age till is "eastern-derived," deposited by Lake Michigan lobe ice, which moved through Illinois into Iowa. The differences in provenance produced differences in physical and mineralogic properties which permit differentiation of the deposits. The till deposits in the formations are recognized and correlated by their physical stratigraphy, pebble lithologies, and by the quantitative characterization of their particle size, sand fraction lithologies, clay mineralogy, and matrix carbonates.

The Alburnett and Wolf Creek Formations can be recognized based on distinct differences in clay mineralogy. Both formations are composed principally of basal tills and inter-till stratified sediments.

The Alburnett Formation till has only been recognized in a few locations in southeastern Iowa by others: in the deepest cores, where the Alburnett till rested on bedrock, and in a few outcrops near the Mississippi River where stream dissection has been deep enough to expose these deposits.

The Wolf Creek Formation is subdivided into the Winthrop, Aurora, and Hickory Hills Till Members based on physical stratigraphy and differences in particle size, matrix carbonate content, and sand fraction lithology. The stratigraphic relations and the physical and mineralogical properties of the Till Members are essentially identical to their properties in their type areas in east-central Iowa.

The Glasford Formation is represented in southeast Iowa by the Kellerville Till Member and some related sediments. The Kellerville Till Member is the oldest till of Illinoian age and overlies the Yarmouth Paleosol. The Kellerville Till Member can be readily separated from the Pre-Illinoian tills by: (1) its relatively high illite and moderate expandable clay mineral content; (2) its high dolomite content; and (3) the abundance of Pennsylvanian lithologies in the coarse particle sizes. The Kellerville exhibits matrix carbonate C/D (carbonate to dolomite) ratios less than 0.040, whereas 95 percent of all the Wolf Creek and Alburnett Formation till samples have C/D ratios greater than 0.040. Mazon Creek-style Pennsylvanian age fossils have been identified as cobbles in the Kellerville Till. These fossils are only known from central Illinois.

The Kellerville Till Member in southeast Iowa is subdivided into a superglacial and subglacial - or basal till facies. This subdivision is based on the stratigraphic relations, sedimentological properties, and the consistency-density-consolidation properties of the deposits. The basal till facies is comprised of firm to very stiff, dense, overconsolidated till, which is generally uniform in texture. The superglacial facies is comprised of a wide variety of sediments including: (1) till - which varies in texture, density, and consolidation properties, but generally tends to be friable to soft; (2) diamictons - poorly sorted "till-like" deposits, but which exhibit structures and sedimentological variations analogous to superglacial mud-flows; (3) a variety of sorted sediments - fluvial silts, sands and gravel, and lacustrine or paludal deposits - clays, silts, peats, etc. In some sections, these deposits are clearly interbedded, but in others, they occur as a contorted melange of sediments.

Fractures reportedly occur in places within glacial till deposits. Several explanations for observed fracturing in glacial till have been postulated by many others in other areas of the Interior Plains region. (Grisak and Cherry, 1975). These explanations include regional extension of the earth's crust due to crustal rebound following glacial loading, vertical stress imposition and release in the Quaternary deposits following re-advancement of glaciers during late Wisconsin time, and volume changes due to desiccation during antithermal conditions in post-Wisconsinan time. However, many fractures that occur in the present zone of soil profile development (0 to 90 inches below ground surface) are attributed to desiccation and freeze-thaw processes.

Reportedly, the uppermost till formation in the site vicinity is the Kellerville Till Member of the Glasford Formation. Further delineation of till formations in the site vicinity is beyond the scope of this investigation. For purposes of this report, glacial till is divided into two units: an upper, reddish-brown, weathered (oxidized unit) and a lower, grayish, unweathered (unoxidized) unit. Similar generalized separation of glacial till has been used in numerous studies by others in North America (Cravens and Ruedisili, 1987).

Ancient buried-channel deposits reportedly occur in the area of the Gordon Paleochannel to the southeast of the sites. The ancient buried-channel deposits consist of fluvially derived clay, silt, sand, and gravel deposited in the valleys of preglacial streams. These deposits are generally found overlying bedrock and underlying glacial till.

Recent alluvial deposits are confined to stream valleys. These deposits vary in width from several miles, as in some places along the Mississippi River, to a few feet in places where streams like the Skunk and Des Moines Rivers have cut narrow gorges. Alluvial deposits consist of interbedded layers of clay, silt, sand, and gravel-size materials.

Thin deposits of loess are generally found capping ridge tops within the uplands area. Thickness of loessial deposits vary considerably, but typically range from 0 to 10 feet along the ridge tops, and generally consists of silt and clay size materials.

BEDROCK

Discussion of bedrock in this study refers to selected Mississippian aged formations which represent the uppermost bedrock reportedly occurring in the region. The bedrock in the site vicinity reportedly belongs to either the Kinderhookian or Osagean Series, both of which are marine in origin. These bedrock units consist primarily of dolomite and limestone rock types. The bedrock surface at the site vicinity is found to the northwest of the Gordon Paleochannel, an ancient deep buried erosional channel cut located generally within the lowland areas of the present day Mississippi River Valley to the southeast of the sites. The top of bedrock in the region slopes generally towards the southeast and ranges from approximately 100 to 300 feet below ground surface.

3.4.1.3 Structural Geology

Minor folding of upper-most bedrock units reportedly occurs within Lee County. These folds are generally broad and trend northwest/southeast through the Fort Madison area. Maximum structural relief is less than 120 to 150 feet. Some minor doming occurs in the northwest portion of the county. No major faults are present within the region.

3.4.2 SITE GEOLOGY

3.4.2.1 Topography

BAIER SITE

As previously mentioned, the Baier site is separated into two roughly triangular sections by a road trending in a northeasterly direction through the site (Figure 2). The southeastern portion of the site is generally flat. The northwestern portion of the site has gentle to steep slopes.

The steepest slopes generally occur near the northern and western boundaries of the site.

Several drainages run in a west/northwesterly direction on the steep slopes in the northwest portion of the site and immediately west of the site. These drainage ditches lead to a relatively deep ephemeral tributary of Sugar Creek located approximately 1000 feet to the west of the site. A southerly flowing drainage ditch begins near the southeast corner of the site (Figure 2) and leads to a relatively deep ephemeral tributary of Sugar Creek located approximately 1000 feet to the east of the site.

MCCARL SITE

The McCarl site is principally flat to gently sloping land with moderate to steep slopes within the extreme northern portion (Figure 3).

3.4.3.2 Stratigraphy

Geologic cross sections B-B′ (Figure 14) and C-C′ (Figure 15) present the stratigraphy of the Baier and McCarl sites, respectively. Figure 15-A presents the key to symbols for the typical soils found beneath the sites.

Soil - The near-surface soils at the sites are principally classified as loams or silt loams in one of three groups: the Weller silt loam, the Lindley loam, and/or the Keswick loam (U.S. Department of Agriculture, 1979). These soils grade to silty clay loam, silty clay, and clay at depths ranging from 0 to 90 inches.

All three soil groups represent material formed in glacial till or loess and are typically found in upland areas on gentle to steep slopes. Surface material is generally slightly acidic (pH 4.5 to 6.0) and contains little organic matter. These soils are moderately well-drained, tending to seal during heavy rains, then becoming hard and crusty while drying. This wetting and drying may result in soil desiccation. These soils have moderately low to low permeability and high available water capacity.

Loess - Loess is generally found as a thin veneer overlying weathered glacial till in upland areas. Loess deposits are comprised of eolian (windblown) clayey silt and silty clay.

The thickness of loess deposits ranges from about 0 to 10 feet but generally averages about 5 feet on the ridge top and flatland areas. In general, the loess deposits are absent along the steep side slopes of deeper drainages adjacent to the sites.

Loessial materials were observed to be desiccated in places and contain root holes and trace amounts of organic carbon material. Vertical permeability is typically higher than horizontal permeability. Color varies from light brown to brown. Consistency varies from firm to stiff and plasticity ranges from low to high.

Weathered Glacial Till - Weathered till in the vicinity of the sites was observed to range from about 38 to 71 feet and average approximately 55 feet in thickness in monitoring well borings. The thickness of the weathered till diminishes along the steep side slopes of deeper drainage ditches adjacent to the sites.

The weathered till consists of light brown to reddish-brown sandy clay, silty clay, and clay with occasional lesser amounts of sand, gravel, cobble, and boulder size materials. Boulders up to 4 feet in diameter were observed in drainages adjacent to the Baier site. Occasional thin sand seams (<2 inches) are intercalated with deposits of finer grained materials. These sand seams could not be correlated between borings with the possible exception of a thick (<2 feet) glacial/fluvial sand layer observed near the interface between the weathered and unweathered tills in some borings at the Baier site. This sand layer does not appear to be continuous beneath the site.

The thickness of sand lenses/layers in the weathered till varies from less than 0.05 to 10.5 feet in the borings made at the sites. The relative difference in percent of total thickness of sand lenses/layers to total weathered till thickness between borings varied from 2.6 percent to 20 percent at the McCarl site and 1.7 percent to 30 percent at the Baier site. Sand lenses/layers were comprised of either clayey sand, silty sand or poorly graded sand materials.

Both high and low angle fractures were observed in the weathered till beneath the sites. Carbonate precipitate and iron staining are present along many fracture planes.

Unweathered Till - The unweathered till is distinguished from the overlying weathered till primarily on the basis of color. The color of the unweathered till is generally grey to dark grey. In some places, the weathered and unweathered tills may be separated by an olive to grey-brown mottled till transition zone.

The total thickness of glacial till was determined at only one location (MC-4C). Bedrock was encountered at approximately 220 feet below ground surface in MC-4C. This depth generally agrees with a published map (USGS, 1973) showing depth to the bedrock surface in the region. The unweathered till is approximately 163 feet thick at this location. The unweathered till is believed to range from 120 to 175 feet beneath the sites based on data available to date.

Borings into the unweathered till at the McCarl and Baier sites penetrated from 65 to 163 feet and 82 to 91.5 feet, respectively below the contact with the overlying weathered till. The thickness of sand lenses/layers in the unweathered till were observed to vary from approximately 0 to 7 feet. The relative percent of total thickness of sand lenses/layers to total unweathered till thickness in borings varied from 4 percent to 27 percent at the McCarl site and 10 percent to 23 percent at the Baier site. Sand lenses/layers were comprised of either clayey sand, silty sand or poorly graded sand materials. None of the sand lenses/layers could be correlated between borings.

Fractures in the unweathered till were not observed in the three borings (MW-D2, MW-F2, MW-K2) drilled into this zone at the Baier site nor the three borings (MC-1C, MC-4C, and MC-6C) at the McCarl site.

Bedrock - The bedrock surface was encountered 220 feet below ground surface in boring MC-4C made at the McCarl site. This depth generally agrees with a published map showing bedrock topography in southeastern Iowa (U.S.G.S., 1973). This map indicates that bedrock beneath the sites is between 175 and 225 feet below ground surface.

The bedrock encountered in boring MC-4C consisted of 3 feet of hard, light gray to gray, thinly bedded silty shale with numerous angular limestone or dolomite fragments. Underlying the shale is 5 feet (minimum) of light gray to gray finely crystalline limestone. The limestone appeared to be generally unweathered, fractured, and slightly fossiliferous.

Specific identification of the bedrock formation encountered in boring MC-4C was not attempted. However, based on published regional stratigraphic information these bedrock units are believed to be Mississippian in age.

3.5 HYDROGEOLOGY

3.5.1 REGIONAL HYDROGEOLOGY

This chapter provides a description of the potential aquifers and ground water use in the region as well as a detailed characterization of the hydrogeologic units at the site. The discussion of the regional hydrogeology was prepared from a review of published and unpublished literature and from WCC experience in the area. The site-specific characterization is based on data collected during field studies in the summer of 1989, the RI by WCC, and from previous studies by others.

3.5.1.1 Aquifers

There are two principal types of aquifers in the region; surficial and bedrock. The unconsolidated deposits near the land surface comprise the surficial aquifer. Underlying the surficial aquifer are several bedrock formations which potentially yield water to wells. The three principal bedrock aquifers are designated the Mississippian, Devonian, and Cambrian-Ordovician aquifers with reference to the corresponding age of the bedrock formations. Only the Mississippian aquifer will be discussed in this report since it is the upper-most bedrock formation in the vicinity of the sites.

MISSISSIPPIAN AQUIFER

The Mississippian aquifer is the shallowest bedrock aquifer in most of southeastern Iowa. It is separated from the surficial deposits in many places by an aquiclude (materials which have sufficient porosity to store water but a very small capacity for transmission) of Pennsylvanian aged shale. The Mississippian aquifer is found directly beneath the surficials aquifer in the vicinity of the sites. This aquifer is composed mainly of carbonate rocks (dolomite and limestone) which, in places, yield large amounts of water. The Warsaw Formation is in the lower portion of the Mississippian aquifer and contains shale strata that often act as an aquiclude or aquitard. The Wasaw Formation has a major effect on the quantity and quality of the water from underlying units.

Depth to the Mississippian bedrock surface varies considerably throughout the region because of topographic relief of the land surface and subterranean relief of the bedrock surface. The configuration of the bedrock surface was predominantly influenced by erosion from several ancient drainage systems and lies 100 to 300 feet below ground surface.

The thickness of the Mississippian aquifer in the region also varies. Erosion of a considerable amount of rock material accounts for the majority of local variations in thickness. It is estimated that the Mississippian aquifer in the site vicinity is between 100 to 200 feet thick.

Water in the Mississippian aquifer can be either confined or unconfined. Higher water levels generally occur in the major divide areas and lower ones in the area of major streams or rivers such as the Mississippi River.

Yields of over 50 gallons per minute (gpm) are available at only a few places from the Mississippian aquifer in southeastern Iowa. Generally, yields of 20 gpm can be obtained in the southeastern part of Iowa.

SURFICIAL AQUIFERS

Surficial aquifers in southeastern Iowa are of three types; alluvial, buried-channel, and glacial till. The alluvial aquifers are comprised of materials deposited in the valleys of present streams and rivers, and consist of flood plain and terrace deposits. The buried-channel aquifers consist of materials deposited in the valleys of preglacial streams which were overridden by glaciers and are now buried by younger glacial and/or alluvial deposits. Glacial till covers most of the upland area and in some areas has water-bearing zones of limited extent.

The glacial till aquifer is reportedly the only type which occurs in the site vicinity. A map showing the extent of the buried-channel aquifer in southeastern Iowa (Figure 16) indicates that the nearest edge of this aquifer is approximately 0.5 miles to the southeast of the sites. The nearest alluvial aquifer is the Mississippi River Valley aquifer which is located approximately 2 miles to the southeast of the sites.

The water table in the glacial till generally slopes from high topographic areas towards the streams or drainages. In some places in southeastern Iowa, water in deeper portions of the glacial till aquifer and also water from the shallow bedrock aquifers, may drain into buried-channel deposits, where present, and discharge eventually into surface streams. This type of ground water movement is not expected to occur at the sites since the buried-channel deposits are reportedly about 0.5 miles away.

Buried-channel aquifers yield up to 100 gpm to individual wells in several places. High pumping rates generally cause a continuous lowering of the piezometric surface in these aquifers because of the slow rate of recharge through the thick overlying glacial till and from the rocks which compose the walls of the ancient stream channels.

Glacial till aquifers yield only small amounts of water in southeastern Iowa. Simple household or livestock water quantities are generally the best that can be obtained.

3.5.1.2 Ground Water Use

Ground water is used in the site vicinity for rural domestic and livestock uses. Figure 16 indicates the location of water supply wells within a 2 mile radius of the sites. Table 3-3 provides a summary of information concerning these wells.

There are approximately 61 wells located within a two mile radius of the site according to an EPA water supply well survey conducted in 1986. A total of 14 of these wells are on record with the Iowa Geological Survey.

The John Glascow well is the closest well to the McCarl site, located approximately 500 feet to the west. This well is approximately 300 feet deep and obtains water from the Mississippian bedrock aquifer. The Jean Vogel well is the closest documented water supply well to the Baier site, located approximately 0.9 miles to the north of the site. This well is also approximately 300 feet deep and obtains water from the Mississippian bedrock. USEPA has stated that a deep well also exists on the Fedler property near the intersection of County Road X-23 and the access road (i.e., farm lane). This well would be approximately 0.8 miles from the Baier site (by measurement from the topographic map).

The Harry Gram well is the closest water supply well to either site which obtains water from the glacial till aquifer, and is approximately 0.8 and 1.2 miles from the McCarl and Baier sites, respectively. This well is approximately 60 feet deep.

Analytical results on general water quality parameters reported for glacial till aquifers in Lee County are summarized in Table 3-4.

3.5.2 SITE HYDROGEOLOGY

The previous discussion concerning the geologic materials beneath the sites described the general physical characteristics of the principle units in which ground water may occur. The physical properties of the materials and structural features of each unit will influence the location, rate, and direction of ground water movement. The following sections briefly describe the general hydrogeologic properties of these units. Boring logs and ground water monitoring well installation reports from previous studies are included in Appendix A.

3.5.2.1 Hydrogeologic Units

For purposes of discussion, the sections beneath the sites have been divided into the following hydrogeologic units based on hydrogeological information:

- Zone of Aeration
- Shallow Water Bearing Zone
- Upper Confining Unit
- Deeper Water Bearing Zone

Zone of Aeration - The zone of aeration is characterized as containing water under pressure less than that of the atmosphere, including water held by capillarity. This zone is limited above by the land surface and below by the uppermost zone of saturation (in this instance defined as the shallow water bearing zone). Collectively, the zone of aeration is comprised of loessial and weathered glacial till materials.

As previously discussed in the section on geology, the predominate material in the loess and glacial till is silty clay. The glacial till also contains discontinuous sand lenses of variable thickness.

The near surface materials (less than 90 inches in depth) are characterized as containing root holes and desiccation fractures which increase the vertical conductance of these materials. Additionally, deeper weathered glacial till is fractured in places which also increases the hydraulic conductivity of these materials. This increase in hydraulic conductivity will permit relatively rapid percolation of meteoric water from the ground surface to the water table. Evidence for this has been observed in seasonal water level measurements of the monitoring wells screened in the shallow water bearing zone. Water levels in these wells have risen and fallen during periods of higher and lower precipitation, respectively. Additional discussion of the observed response of water levels in the on-site monitoring wells is presented later in this section.

Shallow Water Bearing Zone- The shallow water bearing zone as referred to herein represents a zone of perched water in the weathered till materials immediately above the contact with the underlying unweathered till. Additional perched waters are believed to exist in some of the sand lenses that are stratigraphically higher; however, these water bearing lenses appear to be very localized.

The shallow water bearing zone is comprised of saturated silty clay, sandy clay, and sand materials. The clayey weathered till materials are also characterized as containing zones of fractures.

The shallow water bearing zone is approximately 20 to 30 feet thick in the ridgetop and flatland portions of the sites. However, the thickness of the sand deposits, which are the primary water bearing units within this zone, is typically much less than the overall thickness of the shallow, water-bearing zone. The thickness of the shallow, water-bearing zone progressively decreases towards the adjacent drainages where ground elevation drops as well. Eventually, water in the shallow water bearing zone discharges to nearby drainage areas where the zone pinches out. In some instances, as in areas north of the Baier site, water in this zone discharges along the sideslopes of the deeply cut drainages. Evidence for these discharges is observed in the form of seeps located above the weathered/unweathered till contact. In other areas such as north of the McCarl site, the drainage does not appear to cut deep enough to expose the contact, and therefore waters in this zone discharge further downslope in the drainage (e.g. to the northeast of the McCarl site).

In some instances (e.g. MW-I and MW-H) water levels in the monitoring wells appear to be much higher than others which gives the impression that the shallow water bearing zone is much thicker in places. The reason for the higher water levels in these wells appears to be related to the stratigraphic position of the well screen. By screening stratigraphically higher materials this permits perched waters in higher sand lenses to drain into these wells.

Upper Confining Unit- The upper confining unit is comprised of the unweathered till materials between the weathered till and the deeper water bearing zone. As previously discussed in the section on site geology, the unweathered till consist of the same types of earthen material as the weathered till with the primary difference being the change in soil color and the apparent absence of fracturing in the unweathered till.

The bulk hydraulic conductivity of the unweathered till is much less than the overlying weathered till as will be discussed in more detail later in this section. The absence of fractures in the unweathered till appears to be the reason for the relatively lower bulk hydraulic conductivity. The lower vertical hydraulic conductivity of the unweathered till, and the proximity of the discharge area collectively result in lateral ground water movement in the shallow water bearing zone. The resultant perched ground water condition in the shallow water bearing zone indicates that the underlying unweathered till retards downward migration of ground water in the shallow water bearing zone, and in affect serves as a confining layer.

Deeper Water Bearing Zone- The deeper water bearing zone is defined as the saturated unweathered till materials found approximately 60 feet beneath the contact with the overlying weathered till. This depth was selected for screening of a deeper monitoring well (MW-D2) during a preliminary investigation at the site when a relatively thick sand lens was discovered. Placement of well screens in the remaining deeper monitoring wells was based on two criteria; 1) the well screens should be in the same general stratigraphic position, and 2) the well screens should intercept sandy layers to increase the likelihood of ground water occurrence.

3.5.2.2 Ground Water Recharge

Recharge to the ground water in the shallow water bearing zone beneath Baier and McCarl sites results primarily from deep percolation of precipitation. Both sites are located on the surface water divide of their corresponding basins, and it is believed that no major contribution of shallow subsurface inflow occurs.

It has been observed that ground water levels in monitoring wells screened in the shallow water bearing zone are sensitive to precipitation events which indicates that percolation rates are relatively high. The actual percolation rates are not known for the sites, but based on regional studies infiltration is estimated to be 10 percent of precipitation (Iowa Geological Survey Water Atlas No. 4, 1971). Evapotranspiration is high in the region.

It is believed that the deep water bearing zone does not recharge from vertical ground water flow from the shallow water bearing zone because of the low vertical hydraulic conductivity of the Upper Confining Unit. Therefore, the only source of recharge for the deep water bearing zone is essentially from deep ground water from adjacent upland areas.

3.5.2.3 Ground Water Surface Elevations

Water levels in the on-site monitoring wells were measured at various times from August 1989 to August 1990. These data are presented in Table 3-5.

Previous ground water level data are comparable to most recent and complete ones. The water level measurements taken August 22, 1990 were used in constructing the ground water surface maps in this report. Maps for both sites are provided for the shallow and deep water bearing zones. See Figures 17 to 20.

The shape of the shallow ground water surface at both sites generally follows the topography, i.e. higher water surface elevations are associated with higher ground levels. Water levels at monitoring wells MW-A, MW-B, MW-C, MW-D1, MW-H and MW-J have been consistently higher than the rest of the wells at Baier Site. Wells such as P-4 and P-1 located in the nearby drainages show the lowest water levels for the shallow water bearing zone. The maximum difference in water levels is nearly 50 feet, occurring at MW-H and P-4. This represents a large hydraulic gradient. The sharpest declines in water levels generally occur along the steep side slopes of nearby drainages

At the McCarl site, monitoring well MC-1 an MC-4A show the highest water levels for the shallow water bearing zone. The lowest water level is observed at MC-7. The maximum difference is about 35 feet between wells MC-4A and MC-7. The steepest hydraulic gradient occurs at the steep drainage side slopes similar to the Baier site.

The deep water bearing zone at Baier site has a smaller hydraulic gradient than the shallow water bearing zone. This is evidenced by the almost 20-foot difference in water levels between wells MW-D2 and MW-K2. There is also about a 20-foot difference in water levels in the deep water bearing zone at the McCarl site as shown by wells MC-3 and MC-4C.

Fluctuations in water surface elevation of wells screened in the shallow water bearing zone occur throughout the year at both sites. These differences are believed to be related to seasonal precipitation distribution, plant water use, evaporation through macropous and the presence or absence of fractures in the upper layer of the glacial till.

Variations in surface water levels in the wells screened into the deep water bearing zone at both sites are believed to be caused by ground water recharge from upland areas and discharge to lower areas within the same hydrogeologic unit.

3.5.2.4 Transmissivity and Hydraulic Conductivity

Values of transmissivity were determined for selected locations from the product of the two aquifer parameters, average hydraulic conductivity and saturated thickness.

The saturated thickness of the shallow and deep water bearing zones was defined as the distance from the water table to the bottom of the well. Thus, saturated thickness of the tested wells can vary with the geometry of the wells.

Slug tests were performed from August 6 to 10, 1990 by WCC at the Baier and McCarl sites. Analysis of the data yields transmissivity values for the shallow and deep water bearing zone in the weathered and unweathered portions of the till, respectively. The transmissivity values from the slug tests are shown in Table 3-6. Transmissivity values for wells MC-3 and MC-4A, screened within the shallow water bearing zone at the McCarl site, ranged from 1,300 to 450 gallons per day per foot (gpd/ft). Values for transmissivity for wells in the deeper water bearing zone at the McCarl site (MC-3C, MC-4C, and MC-6C) ranged from 2,600 to 4,500 gpd/ft.

Wells MW-J and MW-K1 at the Baier site which are screened in the shallow water bearing zone, yield transmissivity values ranging from 130 to

650 gpd/ft. Wells MW-F2 and MW-K2, screened in the deep water bearing zone yield transmissivity values ranging from 130 to 650 gpd/ft.

Hydraulic conductivity rather than transmissivity is a more representative parameter to characterize the aquifer because of the large variation in stratigraphy at the sites.

The estimated hydraulic conductivity (K) values shown in Table 3-6 represent an order of magnitude value for the materials in the tested screened intervals. These values were obtained as the average of the values computed by two methods; 1) Cooper, Bredehoeft and Papadopulus Method [1967], and 2) Bouwer and Rice Method [1976].

The range in average K values for the two shallow water bearing wells MW-J and MW-K1 at the Baier site, is relatively narrow (1.0×10^{-3} to 3.0×10^{-3} cm/sec). MW-K2 and MW-F2 in the deeper water bearing zone have average K values ranging from 2.5×10^{-3} to 3.0×10^{-4} cm/sec.

Shallow water bearing wells at the McCarl site, MC-3 and MC-4A, have a range of average K values between 1.5×10^{-3} to 9.0×10^{-3} cm/sec. Wells MC-3C, MC-4C, and MC-6C have a range of average K values ranging from 2.5×10^{-3} to 6.0×10^{-3} cm/sec.

There is a correlation between the presence of sandy layers within the screened interval and the magnitude of the calculated K values. Wells MW-F2, MW-K2, and MW-J at the Baier site, are screened across materials identified as poorly graded sands or gravely sands. Wells MC-3C, MC-4C, and MC-6C at the McCarl site are also screened across similar materials. The average K values for these wells were relatively higher than in wells where the thickness of sandy layers was much less.

Slug tests performed in northern Missouri in the Dissected Glacial Till Plains have shown similar ranges of hydraulic conductivity to those found at the Baier and McCarl sites. These tests were performed in several areas located about 100 miles southwest of the sites. The field K values found at the Missouri sites are on the order of 10^{-5} to 10^{-4} cm/sec. Laboratory tests of cuttings and cored materials from the same locations ranged between 10^{-8} to 10^{-9} cm/sec (Sharp, 1985).

The average hydraulic conductivity ranges between 10^{-3} to 10^{-4} cm/sec at the Baier and McCarl sites. Laboratory results obtained for vertical hydraulic conductivity in a flexible wall permeameter from samples taken in August, 1989 at wells MW-5 and MW-6, yield K values of 1.4×10^{-9} and 1.5×10^{-9} cm/sec, respectively. These values are comparable to those found in the glacial till in northern Missouri as previously described.

The five to six orders of magnitude difference between the field and laboratory test results is believed to be caused by fractures and sand or gravel lenses within the clay-rich till.

In conclusion, the larger values of hydraulic conductivity (i.e. 10^{-3} or 10^{-4} cm/s) are interpreted as a representative value for the more permeable lenses (i.e. sands, and gravely sands in the glacial till). The lower hydraulic conductivity values (i.e. 10^{-8} and 10^{-9} cm/s) in the till is representative of unfractured clayey material in the till (i.e., unweathered glacial till).

3.5.2.5 Storage Coefficient

The storage coefficient calculated by the Cooper, Bredehoeft, and Papadopulus Method for those wells in which slug test data matched typical curves for instantaneous discharged are in Table 1, Appendix D.

Estimated values are presented in Table 3-6. They range between 10^{-1} to 10^{-3} values which are the lower limit for sands and clay, as expected considering the type of materials encountered in the glacial till under the sites. The observed range of storage coefficient values is characteristic of unconfined conditions. This is in agreement with regional studies in glacial till (Driscoll, 1986).

Other studies have indicated that time-dependant consolidation should be a factor to consider in the comparison of glacial till storage coefficient values (Sharp, 1985).

3.5.2.6 Porosity

The porosity of glacial till as a whole ranges from 0.10 to 0.25 (Driscoll, 1986). This range represents a weighted average of the water yielding materials commonly found in the till.

A value of effective porosity of 0.20 was assumed for the estimation of the lateral ground water flow velocities (see Section 3.5.2.7) at the sites.

3.5.2.7 Ground Water Flow

Monitoring well water levels for the period August 1989 to August 1990 are presented in Table 3-5. These water levels indicate that large differences in water surface elevation exist between monitoring wells screened in the shallow water bearing zone and those wells screened in the deeper water bearing zone.

The large separation in ground water surface elevation between the shallow and deep water bearing zones, together with the small values of vertical permeability encountered in the unweathered glacial till, indicate that the shallow water bearing zone is likely to drain laterally, or to nearby creeks, rather than recharging to deeper zones.

Similarities in ground water flow behavior have been found in different areas of the Dissected Glacial Till Plain. In other studies it has been found that small watersheds discharge only a small percent of the precipitation by stream flow during wet periods. This is mostly shallow ground water that drains laterally into the adjacent ephemeral channels (Gorday, 1982).

Water levels in the weathered till at Baier and McCarl sites have no apparent relationship to the potentiometric surfaces in underlying aquifers. Depths to water in weathered till at both sites are comparable. Consequently, the water percolating below the root zone in the weathered till must be removed from the system by lateral flow.

Local lateral flow to deeply cut drainages (i.e. cut below the water surface in the unweathered till) will account for small volumes of water removed from the unweathered till during wet cycles. However, water level declines in the till have been observed in adjacent areas to these drainages. It is anticipated that in those areas during dry and normal periods, fluctuations in water levels in the glacial till are partially attributed to evaporation and evapotranspiration. Evaporation of water will occur below the root zone through the openings and highly fractured upper till surface (Adams and Hauke, 1964).

Based on ground water surface contours shown in Figures 15 and 17, horizontal ground water gradients in the weathered till vary from 0.11 to 0.15 feet/feet beneath the sites.

Assuming a range of hydraulic conductivity from 0.28 ft/day (1×10^{-4} cm/s) to 2.8 ft/day (1×10^{-3} cm/s) and an average effective porosity of 0.20, the velocity of the lateral ground water in the sandy layers of the unweathered till will range from 0.2 to 2.0 ft/day. However, the rate of ground water movement over large distances is much slower since the sand layers are of limited extent. This is evidenced by the slow recharge rates to the monitoring wells during well development and purging and the low yields reported for water supply wells screened in the glacial till in the region.

The ground water flow in the deep water bearing zone is toward the south-southwest which agrees with the reported regional movement of ground water draining to nearby major tributaries of the (i.e., Sugar Creek) Mississippi River.

3.6 DEMOGRAPHY AND LAND USE

3.6.1 DEMOGRAPHY

Lee County is comprised of 334,080 acres (USDA, 1979), or 522 square miles (USDC, 1988). The population of Lee County in 1980 was 43,106 (IDED, 1988), in 1986 was 41,300 (USDC, 1988) and is projected at 40,570 for 1990 (IDES, 1990). The population density in 1986 for the county was 79.1 persons per square mile (USDC, 1988). The age structure of the population was comprised of 37.3 percent between 0 to 24 years, 37.4 percent between 25 to 54 years, and 25.3 percent over 55 years in 1984 (USDC, 1988). The projected population age structure for 1990 is; 30.5 percent 0 to 19 years, 53.6 percent 20 to 64 years and 15.9 percent over 65 years (IDES, 1990).

3.6.2 LAND USE

Lee County is mostly agricultural and the major acreage is in farms (USDA, 1979). More than 267,000 acres (approximately 80 percent of the county) were designated farmland in 1982 (USDC, 1988). There were 60 farms in Lee County in 1982, 19.8 percent of these farms were less than 50 acres, and 12.1 percent were greater than 500 acres (USDC, 1988). The average farm in 1982 was comprised of 252 acres (USDC, 1988).

Row crops are grown on the loessial flats of the farms in Lee County and timber is harvested from the steeper slopes (USDA, 1979). There were 75,000 acres of timber in Lee County in 1979 (USDA, 1979). The remaining land is either urbanized or criss-crossed by hard-surfaced roads and highways (USDA, 1979).

3.7 ECOLOGY

3.7.1 BAIER SITE ECOLOGY

The Baier site is an area of low rolling terrain characterized by grasslands, sumac shrublands, stands of white oak, hickory, and black walnut with dogwoods, cottonwoods, redbuds, and maples comprising the understory. The woodland habitat at the Baier site is divided by an open grassy area. The fallow pasture immediately south of the site is dominated by mid-grass species and tall-grass species which are typically found in mesic areas (those areas which support vegetation types that require a fair amount of moisture to survive). White oak, hickory, black walnut, and black locust are the dominant tree species in the deciduous woodlands; the dominant shrub species on the Baier site includes red sumac; sedges, mosses, and plant species tolerant of mesic conditions are found within the woodlands along the drainage pathways.

The most conspicuous mammals on the Baier site are the eastern cottontail (Sylvilagus floridanus), raccoon (Procyon lotor) and white-tailed deer (Odocoileus virginianus). Other common mammals possibly inhabiting the Baier site include bats, squirrels, mice, opossums, and skunks.

Several different species of birds are attracted to the diverse habitats at the Baier site. Different species are found according to their preferred habitat for nesting and feeding. These habitats include the open grassland, shrub habitats and the deciduous woodlands. Species identified during site visits include indigo bunting (Passerina cyanea), red-winged blackbird (Agelaius phoeniceus), blue jay (Cyanocitta cristata), brown thrasher (Toxostoma rufum) and killdeer (Charadrius vociferous).

Upland game birds visible on site visits include bobwhite (Colinus virginianus), turkey (Meleagris gallopava) and ring-necked pheasant (Phasianus colchicus). The turkey vulture (Cathartes aura), a scavenger along roadsides and in fields has been identified during site visits also.

Turtles, toads and lizards are probably found on the Baier site. Northern cricket (Acris crepitans) and tree frogs (Hyla species), a bullsnake (Pituophis melanoleucus sayi) and red milksnake (Lampropeltis triangulum syspila) have been identified during site visits.

The aquatic habitats on the Baier site are restricted to the ephemeral drainage pathways (drainages that lasted a very short time) leading off-site to the intermittent streams that flow into Sugar Creek. No standing water bodies, such as ponds or lakes, are present on the site.

According to the Bureau of Preserves and Ecological Services within the Iowa Department of Natural Resources (IDNR), there is one species listed on the State of Iowa threatened species list in sections 28 and 22 of Township 68 North, Range 5 West. This threatened species is the orange-throated darter (Etheostoma spectabile) which was collected in Pitman Creek in 1971. Pitman Creek is located approximately one and one-half miles north of the Baier site. Surface water drainage from the site is towards the west-northwest or the southeast. Surface water draining from the site ultimately flows into Devils Creek or Sugar Creek. Pitman Creek flows into Sugar Creek in the southwest corner of Section 20. Therefore, it is impossible for the surface water drainage from the Baier site to impact Pitman Creek and consequently the orange-throated darter.

The Indiana bat (Myotis sodalis) is an endangered species listed on both the State of Iowa and the Federal endangered species lists. According to the IDNR, the Indiana bat may be expected in the area based on habitat. The Indiana bat is found in areas where there are large trees with shaggy bark. The worm-eating warbler (Helmitheros verivorus) and hooded warbler (Wilsonia citrina) are considered rare, but have no special legal status and also may be expected in the area due to available habitat. The warblers are typical of mature woodland with large trees.

A detailed account of the ecology of the Baier site, including threatened and endangered species, is included in the Ecological Assessment (refer to Appendix I).

3.7.2 MCCARL SITE ECOLOGY

The McCarl site is a disturbed, graded area with a drainage pathway to the north. This site is characterized by invasive flora, notably crabgrass, bermuda grass, queen anne's lace, and wild daisies. The deciduous wooded area is comprised of sumac and cedar shrubs, stands of white oak, pin oak, and hickory with cottonwoods, ash and maples comprising the understory. The woodland habitat at the McCarl site surrounds the disturbed, graded area to the east, west, and north. The wooded habitat surrounding the disturbed, graded area consists primarily of red sumac shrubs interspersed with red cedars. White oak, pin oak, hickory, and black locust are the dominant tree species in the deciduous woodlands; the dominant shrub species on the McCarl site includes red sumac; sedges, cockleburs, ferns, saw grass, grape vines and plant species tolerant of mesic conditions are found within the woodlands along the drainage pathways.

The most conspicuous mammals on the McCarl site are the raccoon (Procyon lotor) and white-tailed deer (Odocoileus virginianus). Common rodents possibly inhabiting the McCarl site include mice, squirrels, and chipmunks. Other common mammals possibly utilizing the McCarl site include bats, skunks and opossums. Bird species identified during site visits include blue jays (Cyanocitta cristata), starlings (Sturnus vulgaris), and an assortment of sparrows. Turtles, toads, and lizards are probably found in the deciduous woodlands on the McCarl site.

The aquatic habitats on the McCarl site are restricted to the ephemeral drainage pathways leading off-site to the intermittent streams that flow into Devils Creek. No standing water bodies, such as ponds or lakes, are present on the site.

The threatened and endangered species for the region, which includes the Baier site and McCarl site, are briefly described in Section 3.7.1 and are discussed in detail in the Ecological Assessment (refer to Appendix I).

4.0 ANALYTICAL RESULTS AND FINDINGS

This section provides the analytical results and findings of the field investigations conducted by Woodward-Clyde Consultants in May 1989, July 1989, and the spring and summer of 1990. The majority of the analytical results are summarized in a tabular form within this section. Raw laboratory analytical data is not included with this submittal. Raw data packages related to the RI/FS activities were transmitted to EPA on August 31, 1990.

For purposes of clarity, the definition of contamination used in this section is warranted. For this discussion, contamination is used to describe soil or ground water which exhibits detectable concentrations of chemical compounds that do not necessarily occur naturally in the environment or which may be present at concentrations that exceed site background levels.

4.1 BAIER SITE - SOIL AND SEDIMENT

4.1.1 MAY 1989

Visual observations made during intrusive hand augering and test pit excavations revealed the presence of buried paint cans, ash-like material, and various sludges of different consistencies and colors. Due to subsurface debris, hand auger advancement was frequently "refused" before the soil/waste contact was reached. Additional intrusive activities using a garden shovel were conducted in the vicinity of the suspected burn pits. Intrusive activities in the suspected burn pits revealed that the waste material extended only a few inches below ground surface. Table 2-1 details the depth to the soil/waste contact in the suspected source areas (including the alleged burn pits) at the Baier site and shows that depths up to 36 inches were encountered.

As previously stated, samples collected during the May 1989 field activities were generally collected in accordance with the abbreviated SAP.

A deviation from the SAP was the collection and submittal of selected soil samples for volatile organic compound (VOC) analysis. This decision was field implemented as a result of observed HNu readings in excess of 300 ppm (see Table 2-1).

In general, selected soil and waste samples were analyzed for total metals (arsenic, cadmium, chromium, lead, and selenium), soil pH, and volatile organics. Selected composite waste samples were analyzed for the Toxicity Characteristic Leaching Procedure suite of analytes. TCLP analyses were used to characterize the waste as hazardous or nonhazardous. Analytical results from the soil and waste samples collected during the May 1989 field investigation are presented in Tables 4.1-1, 4.1-2, and 4.1-3.

A review of Tables 4.1-1 and 4.1-3 indicates that the volatile organics toluene, xylene, and ethylbenzene are present in the site soils and waste material. Toluene concentrations ranged from non-detectable to 88 mg/kg. Ethylbenzene concentrations ranged from non-detectable to 280 mg/kg and xylene concentrations ranged from non-detectable to 4000 mg/kg. In addition to these three volatile organics, methylene chloride and acetone were also detected but are attributed to laboratory contamination and/or interference.

Further review of Tables 4.1-1, 4.1-2, and 4.1-3 indicates that the paint pigment related metals cadmium, chromium, selenium, and lead were also present in the site soils and waste material at concentrations in excess of nationally occurring background ranges. Lead exhibited the highest concentrations ranging from 13.2 mg/kg to 39,600 mg/kg. Cadmium, chromium, and selenium concentrations ranged from non-detectable to 1410 mg/kg; 8.7 mg/kg to 1830 mg/kg, and non-detectable to 361 mg/kg, respectively. In general, test pit TP-03 (Figure 2) exhibited the highest metals concentrations.

It should also be noted that soil and waste samples were also analyzed for arsenic. Arsenic concentrations above normally occurring background ranges were not reported.

Review of Table 4.1-3 indicates that the waste samples can be considered characteristically hazardous by the presence of leachable lead and cadmium above their respective regulatory levels (5 mg/l lead and 1 mg/l cadmium). The concentrations of lead and cadmium in the TCLP samples ranged from 8.4 mg/l to 87 mg/l for lead, and 1.4 mg/l to 1.7 mg/l for cadmium.

Data obtained from chemical analysis conducted in May 1989 provided a general correlation between concentrations and both sample matrix (waste or soil) and depth. Total metals concentrations were generally higher for the uppermost soil or waste samples than for underlying soil samples. This indicates that the migration of metals is limited by attenuation and that significant metals concentrations were probably not present more than a few feet beneath the soil/waste contact with highest concentrations in the 6-inch interval directly below the contact.

4.1.2 JULY 1989

The July 1989 investigation focused on the soils below the waste/soil contact. Eight shallow borings to a depth of five feet below the waste/soil contact were installed and three deep borings to a depth of 20 feet below the waste/soil contact were installed. Additional waste samples were not collected.

Soil samples obtained from the July field activities were analyzed for both chemical and geotechnical parameters. Chemical analyses performed included total metals (arsenic, cadmium, chromium, lead, and selenium), VOCs, moisture content and soil pH. Geotechnical samples were analyzed for permeability, moisture content, Atterberg limits and grain-size/hydrometer analysis. Results of the chemical analysis of soil samples obtained during the July 1989 field investigation are found in Tables 4.1-4, 4.1-5 and 4.1-6. Schematic diagrams of the contaminant concentrations with depth are provided in Figures 21A through 21E. Boring locations are depicted in Figure 2.

A review of Tables 4.1-4, 4.1-5, and 4.1-6 confirms the data collected in May 1989 and Tables 4.1-4 and 4.1-6 indicates that toluene, xylene, and ethylbenzene are present in the site soils. These volatile organics were detected in the majority of samples collected and are considered the volatile organics of concern. Along with these volatile organics, methylene chloride, acetone, 2-butanone, 4-methyl-2-pentanone, and 1,1,1-trichloroethane were also reported. However, their distribution, frequency of detection, and magnitude do not warrant their consideration as contaminants of concern.

The concentrations of toluene observed during the July 1989 investigation ranged from non-detectable to 21 mg/kg. Ethylbenzene concentrations ranged from 0.21J mg/kg to 85 mg/kg and xylene concentrations ranged from 0.95 mg/kg to 350 mg/kg. Concentrations of the other detected organics (excluding non-detectable values) ranged from 0.0035 mg/kg to 10 mg/kg.

Further data review indicates that as with the May 1989 results, the soil samples below the waste/soil contact contain concentrations of cadmium, chromium, selenium, and lead above naturally occurring background ranges. Lead exhibited the highest concentrations with ranges from 6.1 mg/kg to 1840 mg/kg. Cadmium, chromium, and selenium concentrations ranged from non-detectable to 60.1 mg/kg; 8.8 mg/kg to 107 mg/kg; and non-detectable to 14.1 mg/kg.

The data illustrate that the migration of metals is generally limited to the upper 2 to 3 feet below the waste/soil contact. Metals concentrations observed in the soil samples obtained are generally within the background ranges 2 to 3 feet below the waste/soil contact. However, a review of Figures 21A through 21E illustrates that volatile organic compounds have migrated to greater depths.

These results are consistent with the behavior of metals and VOCs in a natural soil environment and confirmed the initial conclusions and findings of the May 1989 investigation.

4.1.3 REMEDIAL INVESTIGATION

4.1.3.1 XRF Screening

In order to maximize the amount of real time data available in the field and assess the areas requiring actual soil sampling and analysis, X-ray fluorescence screening for lead as an indicator chemical was employed in the field.

The instrument was calibrated using site-specific soils (dried and sieved as described in Section 2.2) and spiked with known concentrations of lead in an analytical laboratory. After spiking, the samples were analyzed in the laboratory so the final lead concentration was known. Calibration spike samples contained lead concentrations of 82 mg/kg, 139 mg/kg, 325 mg/kg, 583 mg/kg, 886 mg/kg, 1,127 mg/kg, 1,710 mg/kg, 2,873 mg/kg, 3,990 mg/kg and 5,216 mg/kg. Table 4.1-7 presents the laboratory analyses of the calibration standards, the analysis mean, the standard deviation and the spike levels of lead, cadmium and chromium added to each calibration standard. Cadmium and chromium were not quantified in the laboratory.

Table 4.1-8 presents the XRF field screening results for the approximately 200 soil samples collected from the Baier site and subjected to XRF screening. The table presents the data in a grid column/row format and shows the concentrations recorded in the 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot depths below ground surface (e.g., location B-E-3 is interpreted as B = Baier Site, E = Column E, and 3 = Row 3). Figure 4 shows the location of the sampling points on the Baier site. Samples were collected on 25-foot centers outside the previously identified source areas depicted on Figure 4.

Table 4.1-8 illustrates that the 500 ppm exceedance criteria was exceeded in the 2- to 3-foot interval at locations B-E-3, B-G-3, B-K-3 and B-Q-5. As a result, deep borings were installed in these locations to a depth of 6 feet to collect samples for CLP metals and CLP semi-volatile analyses (see Figure 4 and Section 4.0). In addition, because the XRF screening values in the upper two intervals at location B-R-7 exceeded 10,000 ppm and the 2- to 3-foot interval was reported at 404.3 ppm, a decision was made to install a deep boring at this location to demonstrate that lead attenuation with depth was occurring. The laboratory analytical results for these deep borings are discussed in Section 4.1.3.3.

To demonstrate the effectiveness of XRF as a field screening tool, random samples were selected from the population of samples with XRF concentrations below 500 ppm (the exceedance criteria), except sample B-R7-1 (XRF > 10,000 ppm) for laboratory verification. Table 4.1-9 presents the results of the XRF laboratory verification analysis compared to the XRF field screening analysis. A review of this table illustrates that of 18 samples analyzed in the laboratory, only one sample exhibited a higher laboratory value than XRF screening value. The important point to note is there were no false positives reported which resulted in the reported XRF value as less than 500 ppm (the exceedance criteria). This indicates that as a screening tool to determine where deep borings needed to be installed (i.e., 2- to 3-foot intervals greater than 500 ppm) the utilization of XRF technology was a very effective and conservative tool. The field generated (raw) XRF data and all XRF QA/QC data are provided in Appendix E.

4.1.3.2 Soil Gas Analysis

Soil gas analyses utilizing a portable GC were also utilized to provide real time data in the field. A modified soil gas procedure (see Section 2.4) was utilized to analyze for toluene, xylene, and ethylbenzene in the field to determine where borings to 6 feet needed to be installed per the approved Work Plan. Approximately 45 soil gas samples (including duplicates and blanks) were analyzed from the Baier site. Samples were collected on 50-foot centers (every other grid) outside the previously established source areas as illustrated in Figure 4.

Soil gas analytical data and all associated QA/QC data are contained in Appendix F. A review of the data for the Baier site indicates the exceedance criteria of 1 mg/kg of the sum total of toluene, xylene, and ethylbenzene was exceeded at location B-F-3 (sum total of toluene, ethylbenzene, and xylene = 7.59 mg/kg), B-R-5 (sum total of toluene, ethylbenzene, and xylene = 184.14 mg/kg), and B-R-7 (sum total of toluene, ethylbenzene, and xylene = 49.31 mg/kg). Because the exceedance criteria was exceeded in these locations, deep borings were installed and samples collected for the analysis of CLP volatile organics. In addition, a deep boring was also installed at location B-D-3 even though the sum total of toluene, xylene, and ethylbenzene concentrations was only 0.87 mg/kg and did not exceed the pre-approved exceedance criteria. The remaining soil gas samples collected and analyzed at the Baier site all exhibited non-detectable concentrations of toluene, xylene, and ethylbenzene at a detection limit of 0.01 mg/kg.

Table 4.1-10 presents the results of the soil gas field analysis compared to the verification laboratory analysis. These results indicate that soil gas analyses were very effective as a screening technique. It should be noted that the laboratory detection limits were greater than the soil gas field detection limits. However, USEPA split all verification samples for laboratory analysis and their data indicated non-detectable levels of toluene, xylene, and ethylbenzene in all verification samples at a detection limit of 0.006 mg/kg (see Table 4.6-4). The USEPA detection limits were below the field screening detection limits (see Section 4.6 Split Sample Data Comparison), thus confirming the effectiveness of the soil gas screening techniques. [Note: It should also be noted that the USEPA split soil gas verification samples exhibited non-detectable levels of all CLP volatile organic compounds].

4.1.3.3 Soil Analyses

Nine additional soil borings were installed after screening was conducted at the Baier site with XRF and soil gas technologies. Four of these borings were analyzed for volatile organic compounds, and six were analyzed for metals and semi-volatile organics (boring B-R-7 was analyzed for all three). Soil samples were collected at the 1.5- to 2.0-, 3.5- to 4.0-, and 5.5- to 6.0-foot intervals for volatiles, and at 0- to 2-, 2- to 4-, and 4-

to 6-foot intervals for metals and semi-volatiles. Samples from B-D-3, B-Q-5, and B-R-7 were split in the field and analyzed as duplicates. Deep boring locations are illustrated on Figure 4. The analytical results are briefly discussed below.

Volatiles

Total xylenes appear to be the major volatile organic contaminant in all borings, ranging from 12 to 2,600 mg/kg in B-R-7, and from non-detectable to 67 mg/kg in the other three borings (see Table 4.1-11). Very low concentrations generally at or near the detection limits of acetone, methylene chloride and 2-butanone (common laboratory contaminants) were found in one or more samples. Concentrations of the other volatile organics of concern (toluene and ethylbenzene) ranged from non-detectable to 290 mg/kg and non-detectable to 520 mg/kg, respectively. As with xylene, the highest concentrations were observed in boring B-R-7. Concentration versus depth profiles for the borings analyzed for volatile organics are provided in Figure 22.

In three of the four borings (B-D-3, B-F-3, B-R-5), the concentrations of volatile organic compounds appear to increase with depth (Table 4.1-11). The exception, boring B-R-7, had the greatest concentrations at the 1.5- to 2.0-foot interval. The concentrations of the contaminants in B-R-7 were generally between 50 and 100 times greater than concentrations of the same contaminants collected from other borings.

Metals

In soil boring B-L-3, the 0- to 2-foot sampling interval was the only interval measured. Metals analyzed from this sample were at or near background levels. The remaining five borings all contained appreciable quantities of pigment-related metals (Table 4.1-12). The metals found in highest concentrations were lead (12.5 to 37,100 mg/kg) and zinc (35.5 to 32,000 mg/kg). These two metals were found above background levels in at least one sampling interval from all borings. Cadmium, chromium, and selenium were also found above background concentrations in one or more borings. Concentrations ranged from non-detectable to 510 mg/kg for cadmium, 12.6 to 1,320 mg/kg for chromium, and non-detectable to 75.1 mg/kg for selenium. Arsenic was not found above background levels in any sample.

In four of the five samples containing appreciable levels of contaminants, the region of contamination was restricted to the 0 to 4-foot sampling interval. A sharp reduction in the concentrations of metals was noted in the 4- to 6-foot interval. The exception, boring B-Q-5, contained some of the highest contaminant concentrations measured and did not exhibit metals attenuation with depth. The high levels of contamination are distributed fairly uniformly throughout the entire 6-foot sampling interval from this boring. Concentration versus depth profiles for the borings analyzed for CLP metals are presented in Figure 23.

4.1.3.4 Sediment Analyses

Twelve sediment borings were collected from drainage pathways on or adjacent to the Baier site. Samples were collected from the 0- to 1-foot interval for analysis. Ten of the 12 samples were analyzed for volatile organic compounds (i.e., all samples except B-Sed-7 and B-Sed-8), and all 12 samples were analyzed for metals (Table 4.1-13). In addition, sample B-Sed-6 was split in the field for duplicate analysis.

Volatile organic compounds were either non-detectable or detectable at levels near the detection limits for all samples. Metal concentrations were also very low for 9 of the 12 samples, with most values at or near background levels. The exceptions were samples B-Sed-3, B-Sed-5, and B-Sed-11. These samples exhibited elevated levels of metals. In these samples (B-Sed-3, B-Sed-5, and B-Sed-11), lead ranged from 210 to 1,190 mg/kg, zinc from 269 to 1,310 mg/kg, chromium from 24.8 to 95.0 mg/kg, cadmium from 3.9 to 35.0 mg/kg, and selenium from non-detectable to 5.5 mg/kg. With the exception of cadmium, the greater value in each case was from the sample collected at B-Sed-5. The highest cadmium concentration was observed in B-Sed-11. Arsenic was present at background levels from all three samples.

4.2 BAIER SITE - GROUND WATER

This section summarizes the analytical results from ground water samples collected at the Baier site by Woodward-Clyde Consultants (WCC) in August, September, and December 1989 and in March and June 1990. June was comprised of two sampling events, the initial sampling of newly installed wells, and a quarterly sampling event. In July 1990, monitoring wells MW-D1, MW-D2, MW-L1 and MW-L2 were sampled as part of the June 1990 quarterly sampling event. These wells were sampled at a later date by USEPA when access to the property on which the wells are located could not be obtained by Du Pont.

The results of each sampling event are discussed below. The locations of the monitoring wells are presented in Figure 2. Summary tables 4.2-1, 4.2-2, and 4.2-3 present the results of the organics, total and dissolved metals, and general ground water parameters, respectively, for the six sampling events. Note that the tables only present data for the detected volatile organics and semi-volatile organics, and detected total and dissolved primary and secondary drinking water metals. All samples were analyzed for the full suite of Contract Laboratory Program (CLP) volatile organics, CLP semi-volatile organics, and CLP metals (total and dissolved) in accordance with the CLP statement of work. Primary and secondary drinking water metals were selected for presentation purposes only because they include the identified metals of concern. Their use does not imply that ground water at the Baier site is a regulated drinking water source. (Note: In the following discussion, the suffix B following an inorganic analysis [metals] indicates the reported value is less than the contract required detection limit [CRDL], but greater than the instrument detection limit [IDL]. The suffix B following an organic analysis indicates the analyte was found in the associated blank sample. The suffix J indicates an estimated value.)

4.2.1 AUGUST 1989

Ground water samples were collected at the Baier site following the installation of seven additional ground water monitoring wells (six deep and one shallow). Both existing U.S. Environmental Protection Agency (USEPA) and WCC installed wells were sampled for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids in general accordance with the procedures and methodologies included in the Work Plan for Focused Ground Water Investigation (WCC, 1989e) and the draft Quality Assurance Project Plan (WCC, 1989c).

Volatile organics detected at the Baier site during the August 1989 sampling event included 1,1,1-trichloroethane (67 ug/l) and toluene (9 ug/l) in monitoring wells MW-A and MW-G, respectively (see Tables 4.2-1(A) and 4.2-1(I)). Toluene (4,600 ug/l), ethylbenzene (12,000 ug/l), total xylenes (37,000 ug/l), acetone (10,000 ug/l), methylene chloride (2,000B ug/l), 2-butanone (12,000 ug/l), and 4-methyl-2-pentanone (25,000 ug/l) were detected in monitoring well MW-F (see Table 4.2-1(G)). One semi-volatile organic, naphthalene also was detected in well MW-F at a concentration of 1,500.0 ug/l. Bis(2-ethylhexyl)-phthalate and methylene chloride were detected in several samples, but also were detected in the field blank analyzed by ENSECO and validated by USEPA and are attributed to the ubiquitous nature of phthalates in the environment and laboratory contamination (USEPA, 1990).

Total metals detected at the Baier site during the August 1989 sampling event included barium (at concentrations ranging from 21.1B to 414 ug/l) and chromium (9.6B to 57 ug/l) detected in all wells sampled (see Table 4.2-2). Arsenic (2.3B to 14 ug/l) and lead (5.5 to 38.3 ug/l) were detected in all wells sampled except for well MW-D2 (see Tables 4.2-2). Selenium was detected in well MW-C (28.2 ug/l) and MW-D1 (115 ug/l) (see Tables 4.2-2(C) and 4.2-2(D)).

A total metals sample could not be obtained at well MW-G due to insufficient recharge.

Dissolved metals detected at the Baier site included barium (36.6B to 255.0 ug/l) detected in all wells sampled, arsenic (2.1B ug/l) detected in well MW-B, lead (1.2B to 18.0B ug/l) detected in wells MW-B, MW-D1, MW-D2, and MW-I, and selenium (3.1B to 140.0 ug/l) detected in wells MW-A, MW-B, MW-C, MW-D1, MW-E, and MW-G (see Table 4.2-2).

General water quality parameters are included in Table 4.2-3.

4.2.2 SEPTEMBER 1989

A verification ground water sampling event was conducted on the newly installed wells in September 1989. Ground water samples were collected from the WCC installed monitoring wells at the Baier site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. The existing USEPA installed monitoring wells, MW-A, MW-B, and MW-C were not sampled during this event.

The volatile organic toluene (5,000 ug/l), ethylbenzene (10,000 ug/l), total xylenes (30,000 ug/l), benzene (230J ug/l), acetone (26,000 ug/l), 2-butanone (16,000 ug/l), and 4-methyl-2-pentanone (36,000 ug/l), along with the semi-volatile organic naphthalene (520J ug/l), were detected in monitoring well MW-F (see Table 4.2-1(G)). These concentrations were confirmed by a duplicate sample collected from the well. All other wells sampled at the site during September 1989 exhibited non-detectable levels of volatile organics and semi-volatile organics at their respective detection limits except for the detection of bis(2-ethylhexyl)phthalate which is not attributed to environmental contamination because of the low levels observed and because phthalates are ubiquitous in the environment (USEPA, 1990). The results are also consistent with the initial ground water sampling event conducted in August 1989.

Total metals detected at the Baier site during the September 1989 sampling event included barium (102B to 432 ug/l) detected in all wells sampled, arsenic (1.2B to 5.7B ug/l) detected in wells MW-D1, MW-F, and MW-H, chromium (11.7 to 44.9 ug/l) detected in wells MW-D1, MW-D2, MW-E, MW-G, and MW-H and lead (1.7B to 20.2 ug/l) detected in wells MW-D1, MW-F, MW-G, and MW-H. Selenium (94 ug/l) was detected in well MW-D1. Results are presented in Table 4.2-2 and include both primary drinking water metals and secondary drinking water metals for trend analysis.

Dissolved metals detected at the Baier site during the September 1989 sampling event included barium (84.8B to 377.0 ug/l) detected in all wells sampled, and selenium (124.0 ug/l) detected in well MW-D1 (see Table 4.2-2(D)).

General water quality parameters are included in Table 4.2-3.

4.2.3 DECEMBER 1989

Ground water samples were collected in December 1989 from USEPA and WCC installed wells at the Baier site. Wells MW-D1 and MW-D2 were not sampled because access to the Fedler property where the wells are located was denied. Ground water samples were analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids.

Volatile organics detected in monitoring well MW-F at the Baier site included toluene (31,000 ug/l); ethylbenzene (680,000 ug/l); total xylene (840,000 ug/l); acetone (44,000 ug/l); and 2-butanone (25,000 ug/l) (see Table 4.2-1(G)). Methylene chloride also was observed in MW-A, MW-B, MW-C, MW-G, and MW-H but is attributed to laboratory contamination because of the extremely low concentrations observed and the fact that these data were all CLP coded indicating that methylene chloride was also observed in the associated laboratory blank. Bis(2-ethylhexyl)phthalate also was observed in several wells but its presence appears to be related to it ubiquitous nature in the environment. All other volatile organics and semi-volatile organics were reported at non-detectable at their respective limits (see Table 4.2-1).

Total metals detected at the Baier site during the December 1989 sampling event included barium (288.0 to 546.0 ug/l); chromium (7.8B to 130 ug/l); and lead (3.5B to 38.6 ug/l) detected in all wells sampled, arsenic (5.4B to 22.9 ug/l) detected in wells MW-A, MW-B, MW-C, MW-E, MW-H, and MW-I, cadmium (6.1 ug/l) detected in well MW-A, and selenium (2.2B to 34.08 ug/l) detected in wells MW-C, MW-G, and MW-I (see Table 4.2-2).

Dissolved metals detected at the Baier site during the December 1989 sampling event included barium (21.6B to 568 ug/l) detected in all wells sampled, arsenic (2.2B to 3.3B ug/l) detected in wells MW-B, MW-C, MW-G, and MW-H, and selenium (47.4 ug/l) detected in well MW-C (see Table 4.2-2).

General water quality parameters are included in Table 4.2-3.

4.2.4 MARCH 1990

Ground water samples were collected at the Baier site during a March 1990 quarterly sampling event conducted prior to the remedial investigation. Ground water samples were collected from the USEPA and WCC installed monitoring wells at the Baier site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids.

The volatile organics toluene (3,500 ug/l), ethylbenzene (9,900 ug/l), total xylenes (34,000 ug/l), acetone (24,000 ug/l), 2-butanone (15,000 ug/l), and 4-methyl-2-pentanone (35,000 ug/l), and semi-volatile organics benzoic acid (280J ug/l), and naphthalene (420J ug/l) were detected in MW-F (see Table 4.2-1(G)). A duplicate sample (MW-FD) was collected from this monitoring well and the volatile organics toluene (3,700 ug/l), ethylbenzene (10,000 ug/l), total ylenes (35,000 ug/l), acetone (25,000 ug/l), 2-butanone (16,000 ug/l), 4-methyl-2-pentanone (37,000 ug/l), and semi-volatile organic naphthalene (300J ug/l) were detected in this duplicate sample (see Table 4.2-4). All other wells sampled at the site during the March 1990 sampling event exhibited non-detectable levels of semi-volatile organics at their respective detection limits. Acetone (a common laboratory contaminant; USEPA, 1990) was detected in MW-H (4J ug/l), MW-I (4J ug/l), the field blank (3B ug/l), and the trip blank (21 ug/l) (see Tables 4.2-1(J) and 4.2-1(K), respectively). The volatile organics 1,1,1-trichloroethane (3J ug/l) and chloroform (10 ug/l) were detected in MW-A and MW-G, respectively (see Tables 4.2-1(A) and 4.2-1(I)). These results are consistent with previous sampling events and volatile organics reported.

Total metals detected at the Baier site during the March 1990 quarterly sampling event included barium (144B to 1,160 ug/l) and chromium (5.4B to 276 ug/l) detected in all wells sampled, arsenic (1.8B to 16.5 ug/l) and lead (3.3B to 127 ug/l) detected in MW-A, MW-B, MW-C, MW-E, MW-F, and the duplicate of MW-F, MW-H, and MW-I, and cadmium (3.6B ug/l) detected in MW-A (see Table 4.2-2).

Dissolved metals detected at the Baier site during the March quarterly 1990 sampling event included barium (20.2B to 702.0 ug/l) detected in all wells sampled, arsenic detected in MW-B (1.8B ug/l), MW-F (3.0B ug/l), and MW-FD (2.7B ug/l), and selenium (47.9 ug/l) detected in MW-C (see Table 4.2-2).

General water quality parameters are included in Table 4.2-3.

4.2.5 JUNE AND JULY 1990 INITIAL

Ground water samples were collected at the Baier site following the installation of monitoring wells; MW-F2, MW-J, MW-K1, MW-K2, MW-L1, and MW-L2. Ground water samples were collected from these wells and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. Monitoring wells MW-L1 and MW-L2 were installed and initially sampled in July by USEPA. All other newly installed monitoring wells were initially sampled in June by WCC.

The volatile organic carbon disulfide (12.0 ug/l) was detected in MW-F2, ethylbenzene (460 ug/l), and total xylene (530 ug/l) were detected in MW-J, toluene (3.0J ug/l) and benzene (2.0J ug/l) were detected in MW-L1, toluene (4.0J ug/l), benzene (1.0J ug/l) and acetone (9.0BJ ug/l) were detected in MW-L2 (see Table 4.2-1). Bis-(2-ethylhexyl)phthalate was detected in MW-K1 (8.0J ug/l), and in MW-L1 (6.0J ug/l). Di-n-butylphthalate was detected in MW-K2 (2.0J ug/l), there were no other semi-volatile organics detected (see Table 4.2-1).

Total metals detected at the Baier site during the initial sampling event following the installation of several wells included arsenic (2.9B to 71.3 ug/l), barium (144B to 2,800 ug/l), chromium (12.3 to 1,190 ug/l), lead (2.3B to 425 ug/l) detected in all wells sampled (see Table 4.2-2). Cadmium (20.8 ug/l) was detected in MW-K2 and selenium (11.8 ug/l) was detected in MW-L1.

Due to suspected inadequate well development, total metals concentrations observed in MW-K1, MW-K2, and MW-L2 were extremely high. Verification sampling and the subsequent re-verification sampling (discussed below) did not confirm these initial total metals results. For this reason, the high end of the ranges reported above do not reflect the true ground water quality at the site.

Dissolved metals detected at the Baier site during the initial sampling event following the installation of several wells included barium (18.3B to 220.0 ug/l) detected in all wells sampled, arsenic (1.3B to 6.9B ug/l) detected in all wells sampled except MW-F2 and MW-L2, selenium detected in MW-K1 (9.9 ug/l) and MW-L2 (13.3 ug/l) and chromium (44.8 ug/l) detected in MW-L2 (see Table 4.2-2).

General water quality parameters are included in Table 4.2-3.

4.2.6 JUNE 1990 AND JULY 1990 QUARTERLY SAMPLING EVENT

Ground water samples were collected at the Baier site during a quarterly sampling event. The quarterly sampling event also represented verification sampling of the new wells. Ground water samples were collected from the USEPA and WCC installed monitoring wells at the Baier site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. Samples from all wells but MW-D1, MW-D2, MW-L1, and MW-L2 were collected in June 1990. Samples from MW-D1, MW-D2, MW-L1, and MW-L2 were collected by USEPA and split by WCC in July 1990. One monitoring well (MW-K2) was resampled in August 1990 because the results from the verification sampling in June 1990 could not be reconciled with the results from the original samples. These data are included as data collected during this quarterly sampling event.

The volatile organic carbon disulfide was detected in MW-I (2.0J ug/l) and MW-F2 (2.0J ug/l); a duplicate sample from MW-F2 had carbon disulfide concentration of 7 ug/l (see Table 4.2-1(H)). Acetone was detected in MW-D1 (5BJ ug/l), MW-D2 (4BJ ug/l), MW-G (5BJ ug/l), and MW-F (20,000 ug/l) (see Table 4.2-1). With the exception of MW-F, the levels observed may result from laboratory contamination because acetone has been identified by USEPA as a common laboratory contaminant (USEPA 1990). In addition, these data were CLP coded, indicating the associated laboratory blank also exhibited the presence of acetone. Methylene chloride (another common laboratory contaminant; USEPA, 1990) was detected in MW-G (1J ug/l) (see Table 4.2-1(I)).

Ethylbenzene was detected in MW-F (11,000 ug/l) and MW-J (320 ug/l). Total xylenes were detected in MW-F (42,000 ug/l) and MW-J (340 ug/l). The volatile organics toluene (4,900 ug/l) and 4-methyl-2-pentanone (33,000 ug/l) were detected in MW-F (see Table 4.2-1(G)). The volatile organic compound 1,1,1-trichloroethane (96 ug/l) was detected in MW-A. The only semi-volatile organic detected was bis(2-ethylhexyl)phthalate (8BJ ug/l) (a compound ubiquitous in the environment) in MW-K1.

All other monitoring wells sampled during this event exhibited non-detectable levels of volatiles and/or semi-volatiles at their respective detection limits. These results are consistent with the historical trends of volatile organics reported for the Baier site.

Total metals detected at the Baier site during this quarterly sampling event included barium (54B to 1,920 ug/l) and chromium (9.1B to 74.9 ug/l) in all wells sampled; arsenic (1.1B to 9.7B ug/l) in all wells sampled except MW-E and the re-verification (August 1990) sample from MW-K2; lead (1.8B to 31.9 ug/l) in all wells sampled except MW-B, MW-E, MW-F2, MW-G, and the re-verification (August 1990) sample from MW-K2; selenium (1.4B to 148 ug/l) in MW-A, MW-C, MW-D1, MW-E, MW-G, MW-K1, and the verification (June 1990) sample from MW-K2 (see Table 4.2-2). Cadmium was not detected in any of the wells sampled.

Dissolved metals detected at the Baier site during this sampling event included barium (36.3B to 814 ug/l) detected in all wells sampled, selenium (3.4B to 178 ug/l) detected in MW-A, MW-C, MW-D1, MW-D2, MW-E, and MW-K1; arsenic detected in MW-B (2.6B ug/l), MW-F (2.3B ug/l), MW-J (2.4B ug/l), and MW-K1 (8.1B ug/l); and chromium detected in MW-A (8.5B ug/l) and MW-D1 (5.2B ug/l) (see Table 4.2-2). The dissolved metals cadmium and lead were not detected in any of the wells sampled.

General water quality parameters are included in Table 4.2-3.

4.2.7 SUMMARY - BAIER SITE GROUND WATER

To date, WCC, on behalf of DuPont, has conducted six ground water sampling events at the Baier site. These events were undertaken in August 1989 when all monitoring wells were sampled, September 1989 when verification sampling was conducted on the newly installed monitoring wells, December 1989 when the entire monitoring network was sampled, March 1990, a quarterly sampling event when all the monitoring wells were sampled, June 1990 when newly installed wells were initially sampled, and June 1990 (quarterly) when all wells were sampled as part of a quarterly sampling event (including verification sampling on the newly installed wells). (Note: In December 1989 and March 1990, monitoring wells MW-D1 and MW-D2 which are located on the Richard Fedler property, were not sampled because access to the wells was denied. In July 1990, monitoring wells MW-D1 and MW-D2 were sampled as part of the June 1990 quarterly sampling event because access to these wells was denied in June. Monitoring wells MW-L1 and MW-L2 were initially sampled in July 1990 and their results are incorporated in the June 1990 initial sampling results. Monitoring wells MW-K2 and MW-L2 were resampled in August 1990 because the data collected during the initial and verification sampling events could not be reconciled.) Ground water data related to the Baier site wells are presented in Table 4.2-1 (organics), 4.2-2 (total and dissolved metals) and 4.2-3 (general water quality parameters).

The primary volatile organic contaminants of concern in the ground water at the Baier site include toluene, ethylbenzene, and total xylene. Acetone, 2-butanone, and 4-methyl-2-pentanone represent secondary volatile organic contaminants of concern. Metals of potential concern at the Baier site include chromium, lead, and selenium (see Section 7.0).

Other organic compounds, including the volatile organic compound, methylene chloride, and the semi-volatile organic compound, benzoic acid, were detected in several ground water samples, but are generally attributed to laboratory contamination (USEPA, 1990) and not considered contaminants of concern. The phthalate bis(2-ethylhexyl)phthalate was detected in several ground water samples obtained from the Baier site and also was detected in at least one of the field blanks analyzed by ENSECO and validated by USEPA, and is generally attributed to the ubiquitous occurrence of phthalates in the environment.

Additional total and dissolved metals (aluminum, arsenic, barium, copper, iron, manganese, and zinc) were detected in ground water samples collected from the Baier site but were generally not present above naturally occurring background levels and are not considered potential contaminants of concern.

4.3 MCCARL SITE

4.3.1 MAY 1989

Visual observations made during intrusive hand augering and test pit excavations at the McCarl site revealed very little waste attributable to the paint manufacturing process. Some paint cans, ash-like material and sludge castings were evident but quantities were much smaller than those observed at the Baier site.

Soil/waste samples were collected and analyzed for total metals (arsenic, cadmium, chromium, lead, and selenium) soil pH and volatile organics. A composite waste/soil sample for waste characterization purposes also was analyzed for the CLP suite of analytes. Analytical results from the soil and waste samples collected during the May 1989 field investigation are presented in Tables 4.3-1, 4.3-2, and 4.3-3. Samples were not collected in a systematic manner but were collected from areas containing waste material in a biased approach. This allowed the determination of volatile organics present and worst case metals levels.

A review of Tables 4.3-1 and 4.3-3 indicates that toluene, ethylbenzene, and xylene are present in the site soils and waste-like materials. Toluene concentrations were non-detectable in all soil samples collected. However, toluene was reported at 0.54 mg/l in a sample analyzed by TCLP. Ethylbenzene concentrations were non-detectable in six of the seven samples collected. A level of 29 mg/kg was reported in the soil sample collected from TP-09 (see Table 4.3-1 and Figure 5). Xylene concentrations were also non-detectable in six of seven samples. The single detection of xylene (240 mg/kg) was also reported in TP-09 (see Table 4.3-1). The sample analyzed by TCLP from TP-09 exhibited concentrations of xylene and ethylbenzene at 12.5 mg/l and 0.61 mg/l, respectively (see Table 4.3-3).

Further review of Tables 4.3-1 and 4.3-2 indicate that the paint pigment related metals cadmium, chromium, selenium, and lead are also present in the site soils in excess of naturally occurring background ranges. Lead was detected most frequently above background and lead detections ranged from 14 mg/kg to 15,700 mg/kg. Cadmium, chromium, and selenium concentrations ranged from non-detectable to 293 mg/kg; 10.1 mg/kg to 3630 mg/kg; and non-detectable to 42 mg/kg. In general, samples collected from TP-09 contained the highest contaminant concentrations. It should also be noted that samples were collected and analyzed for arsenic. Arsenic concentrations above background were not detected.

Review of Table 4.3-3 indicates that the waste-like sample collected from TP-09 can be considered characteristically hazardous due to the presence of lead at 50 mg/l.

As previously stated, the samples obtained at the McCarl site during the May 1989 field event were generally collected in accordance with the abbreviated SAP. The collection and submittal of selected samples for volatile organic analysis was based on a field decision made after HNu readings were recorded and based on the conditions encountered at the Baier site (see Tables 2-1 and 2-2).

As stated above, little, if any, waste similar to the material observed at the Baier site was encountered. Test pits were extended over approximately 100 feet in an effort to characterize the amount and location of waste at the site (see Figure 5). The depth of the test pits was relatively shallow because no signs of waste material were observed in the test pits. Municipal refuse and charred construction debris were observed in numerous locations during intrusive activities. These are the probable sources of PAH compounds identified by E&E which are commonly found in locations where wood and other related debris have been burned.

During the excavation of test pit TP-09, a 36-inch diameter corrugated galvanized pipe placed vertically in the ground was found at or near the ground surface. The first few feet of the pipe was filled with charred construction debris, including wood, nails, bricks, and wire. Further excavation, including the removal of the top 3 feet of the pipe, revealed what appeared to be an abandoned water well that had been backfilled with native soil. The area was backfilled with the material excavated from the test pit.

The nature of the waste-like material encountered at the McCarl site was generally ash-like deposits with semi-solidified paint residue in partially decomposed paint cans. Isolated solid sludge casts were also found. Municipal refuse, construction debris, charred wood, an old car, a refrigerator, and other items dissimilar in nature to material found at the Baier site were found at the McCarl site.

4.3.2 JULY 1989

During the July 1989 investigation, no additional soil samples were collected at the McCarl site. However, three additional ground water monitoring wells were installed as described in Section 2.2. Ground water data is discussed below in Section 4.4.

4.3.3 REMEDIAL INVESTIGATION

4.3.3.1 XRF Screening

XRF screening was also conducted on approximately 290 samples collected from the grid system established at the McCarl site. Samples were collected and screened from the 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot depth intervals in order to provide real time data and assess the areas requiring deep borings, soil sampling and chemical analysis. The same calibrations were used throughout the project (see Section 4.1.3.1 and Table 4.1-7).

Table 4.3-4 presents the XRF field screening results for the soil samples collected and screened from the McCarl site (Note: Location M-I-12 is M = McCarl Site, I = Column I, and 12 = Row 12). A review of the table illustrates that the 500 ppm exceedance criteria was exceeded in the 2- to 3-foot interval at locations M-I-12, M-J-7, M-J-8, M-J-10, M-J-11, and M-K-10. As a result, deep borings were installed in these locations to a depth of 6 feet and samples were collected for the analysis of CLP metals and CLP semi-volatile organics (see Figure 6).

The laboratory analytical results from the deep borings are discussed in Section 4.3.3.3.

To demonstrate the effectiveness of XRF as a field screening tool, random samples were selected from the population of samples with XRF concentrations below 500 ppm (the exceedance criteria) for laboratory verification. Table 4.3-5 presents the results of the XRF verification analysis compared to the XRF field screening analysis. A review of this table illustrates that out of the 24 samples analyzed in the laboratory, none of the laboratory results exceeded the XRF screening results. This demonstrates that false positives were not a problem and that the XRF screening technology provided a very effective and conservative estimate of the areas requiring deep borings. The lack of false positives (i.e., XRF concentrations below 500 ppm and laboratory verification samples above 500 ppm) indicates that potential source areas at the site were conservatively identified.

The field generated (raw) XRF data and all the associated QA/QC data are provided in Appendix E.

4.3.3.2 Soil Gas Analysis

Soil gas analyses utilizing a portable GC were also conducted to provide real time data in the field. A modified soil gas procedure (see Section 2.4) was utilized to screen for the presence of toluene, xylene, and ethylbenzene. The purpose was to identify potential source areas which required the installation of 6-foot borings. Approximately 55 soil gas samples (including duplicates and blanks) were analyzed from the McCarl site. Samples were collected on 50-foot centers (every other grid) across the entire site as illustrated in Figure 6.

A review of the soil gas data generated at the McCarl site indicates that the exceedance criteria of 1 mg/kg of the sum total of toluene, xylene, and ethylbenzene was exceeded at location M-D-13 (the sum total of toluene, xylene, ethylbenzene = 217.08 mg/kg), M-H-9 (the sum total of toluene, xylene, ethylbenzene = 69.56 mg/kg), and M-J-7 (the sum total of toluene, xylene, ethylbenzene = 0.59 mg/kg and 1.93 mg/kg from a duplicate sample). As a result of the soil gas screening results, 6-foot borings were installed at these locations and samples collected for the analysis of CLP volatile organics. The remaining samples collected and analyzed at the McCarl site exhibited non-detectable concentrations of toluene, xylene, and ethylbenzene at a detection limit of 0.01 mg/kg. Soil gas field analytical data and all associated QA/QC data are contained in Appendix F.

Table 4.1-10 presents the results of the soil gas field analysis compared to the verification laboratory analysis. These results indicate that the soil gas analyses were very effective as a screening technique to identify potential "hotspots" (source areas). It should be noted that the laboratory detection limits were greater than the soil gas field detection limits. However, USEPA split all verification samples for laboratory analysis and their data indicated non-detectable levels of toluene, xylene, and ethylbenzene in all verification samples at a detection limit of 0.006 mg/kg. The USEPA detection limits were below the field screening detection limits (see Section 4.6: Split Sample Data Comparison), thus confirming the effectiveness of the soil gas screening technique. (Note: It should also be noted that the USEPA split soil gas verification samples exhibited non-detectable levels of all CLP volatile organic compounds).

4.3.3.3 Soil Analysis

Field screening of the McCarl site led to the installation of eight soil borings. Of these borings, three were analyzed for volatile organic compounds and six for metals (boring M-J-7 was analyzed for both). Soil samples were collected at the 1.5- to 2.0-, 3.5- to 4.0-, and 5.5- to 6.0-foot intervals for volatile organics, and at 0- to 2-, 2- to 4-, and 4- to 6-foot intervals for semi-volatiles and metals. In addition, samples

M-H9, M-J7, and M-K10 were split in the field and analyzed as duplicates. A second set of 27 soil samples (0- to 1-foot composites) were collected across the site for use in the risk assessment when the 0-1 foot interval exceeded the 500 ppm lead screening criteria with XRF. These samples were analyzed for metals only.

Volatiles

Volatile organic compound concentrations were relatively low in the three measured borings at all depths (Table 4.3-6). As was evident in the Baier soils, total xylenes also appear to be the major volatile organic compounds at the McCarl site. In general, the lowest contaminants were in the 1.5 to 2-foot intervals for all three borings. The highest concentrations were in boring M-H-9, with xylenes ranging from non-detectable to 200 mg/kg, ethylbenzene from non-detectable to 36 mg/kg, and the remaining compounds at substantially lower concentrations. The exception was acetone (a common laboratory contaminant), which was measured at 32 mg/kg in boring M-D-13 from 5.5 to 6 feet. Concentration versus depth profiles of the borings analyzed for volatile organics are presented in Figure 24.

Metals

The metal profiles of the soil borings at the McCarl site (Table 4.3-7) were very similar to that of the Baier soil borings. The metals found in highest concentrations were lead (11.1 to 3,230 mg/kg) and zinc (25.8 to 4,790 mg/kg). These two metals were found above background levels in at least one sampling interval from all borings. Cadmium, chromium, and selenium also were above background levels in one or more boring. Concentrations ranged from non-detectable to 69.6 mg/kg for cadmium, 11.6 to 236 mg/kg for chromium, and non-detectable to 9.2 mg/kg for selenium. Arsenic was not detectable above background levels in any sample.

In two of the six soil borings (M-J-8, M-J-10) the concentration of metals detected above background were restricted to the 0- to 2-foot sampling interval. Three of the borings (M-I-12, M-J-7, M-J-11) had concentrations of metals above background in the 0- to 2-, and 2- to 4-foot intervals only. Boring M-K-10 had higher concentrations of metals measured throughout the entire 0- to 6-foot sampling region. Concentration versus depth profiles for the borings analyzed for CLP metals are presented in Figure 25.

The soil samples collected for the risk assessment essentially reflect surface soil concentrations. Soil samples were analyzed for 23 metals (see Table 4.3-8). Most of the metals were present at concentrations which could be considered within background ranges. The exceptions were those metals commonly used in paint pigments, including barium, cadmium, chromium, copper, lead, manganese, selenium, and zinc. Of these eight metals, lead and zinc were the only metals found at elevated concentrations in all samples, ranging in concentration from 281 to 3,560 mg/kg for lead and 357 to 6,020 mg/kg for zinc. Cadmium and selenium were found in elevated concentrations in two samples (M-D-12 and M-F-11) only. The other contaminants were present in elevated concentrations in various locations throughout the site, but were not indicative of any obvious distribution patterns. Concentrations of the metals on site ranged from 1.9 to 443 mg/kg for cadmium, non-detectable to 177 mg/kg for selenium, 473 to 7,410 mg/kg for barium, 17.2 to 407 mg/kg for chromium, 10.5 to 1,410 mg/kg for copper, and 604 to 2,560 mg/kg for manganese.

4.3.3.4 Sediment Analyses

Two sediment borings were collected from drainage pathways on the McCarl site (see Figure 3). Samples were collected from the 0- to 1-foot interval for analysis of metals and volatile organic compounds (Table 4.3-9). Volatile organic compounds were either non-detectable or detected at low concentrations near the detection limits, for both samples. Concentrations of metals detected in these samples were low for both samples, with most values at or near background levels. The exceptions were lead (166 mg/kg) and zinc (429 mg/kg) in sample M-Sed-1.

4.4 MCCARL SITE - GROUND WATER

This section summarizes the analytical results from ground water samples collected at the McCarl site in August, September, and December 1989, and in March and June 1990. June 1990 was comprised of two sampling events, the initial sampling of newly installed wells and a quarterly sampling event. The results of each sampling event are discussed below. Tables 4.4-1, 4.4-2, and 4.4-3 present the summary results of the organic analyses, total and dissolved metals analyses, and general ground water quality parameters, respectively, for the six sampling events. The locations of the monitoring wells are presented in Figure 3. As with the Baier site data, the tables only present data for the volatile organics, semi-volatile organics, and total and dissolved primary and secondary drinking water metals detected. All samples were analyzed for the full suite of CLP volatile organics, CLP semi-volatile organics, and CLP metals in accordance with the CLP statement of work. Primary and secondary drinking water metals were selected for presentation purposes only because they include the identified metals of concern. Their use does not imply that ground water below the McCarl site is a regulated drinking water source. (Note: In the following discussion, the suffix B following an inorganic [metals] analysis indicates the reported value is less than the contract required detection limit [CRDL] but greater than the instrument detection limit [IDL]. The suffix following an organic analysis indicates the analyte was found in the associated blank sample. The suffix J indicates an estimated value.)

4.4.1 AUGUST 1989

Ground water samples were collected at the McCarl site in August 1989 following the installation and development of four ground water monitoring wells. Both USEPA and WCC installed wells at the McCarl site were sampled for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids in general accordance with the procedures and methodologies included in the Work Plan for Focused Ground Water Investigation (WCC, 1989e) and the draft Quality Assurance Project Plan (WCC, 1989c). Monitoring well MC-4B was dry following installation (and remains dry) and was not sampled.

Analytical results from the McCarl site monitoring wells indicate the presence of carbon disulfide (3.0J to 12.0 ug/l) in wells MC-1, MC-2, MC-3, and MC-5 (see Table 4.4-1). Low levels of methylene chloride, acetone, bis(2-ethylhexyl)phthalate, and benzoic acid also were detected in several wells but are generally attributed to laboratory contamination or are recognized as ubiquitous in the environment (USEPA, 1990).

Total metals detected at the McCarl site during the August 1989 sampling event included barium (53.8B to 1,050 ug/l), chromium (7.6B to 102 ug/l), and lead (2.2B to 35.4 ug/l) detected in all wells sampled, arsenic (1.7B to 20.3 ug/l) detected in wells MC-4A, MC-5, and MC-6, and selenium (45 to 98 ug/l) detected in wells MC-2, MC-3, MC-5, and MC-6 (see Table 4.4-2).

Dissolved metals detected included barium (121B to 360 ug/l) detected in all wells sampled, chromium (5.6B ug/l) detected in well MC-3, selenium (56.1 to 244 ug/l) detected in wells MC-2, MC-3, MC-5, and MC-6, and arsenic (2.7B ug/l) detected in well MC-3 (see Table 4.4-2).

General water quality parameters are included in Table 4.4-3.

4.4.2 SEPTEMBER 1989

Ground water samples collected in September 1989 from the WCC installed wells at the McCarl site were analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. The existing USEPA installed wells, MC-1, MC-2, and MC-3 were not sampled during this event.

During the September 1989 sampling event, carbon disulfide (51.0 ug/l) was detected in well MC-6. No other volatile organics above their respective detection limits were detected (see Table 4.4-1). Butylbenzylphthalate (6J ug/l) and di-n-octylphthalate (3BJ ug/l) were detected in well MC-5.

Bis(2-ethylhexyl)phthalate was detected in several wells; however, phthalates are most likely present because they are ubiquitous in the environment.

Total metals detected at the McCarl site during the September 1989 sampling event included barium (248 to 419 ug/l), chromium (13.9 to 36.1 ug/l), and lead (3.2B to 8.6 ug/l) detected in all wells sampled, arsenic (4.3B ug/l) detected in well MC-4A and selenium detected in wells MC-5 (34.3 ug/l) and MC-6 (125 ug/l) (see Table 4.4-2).

Dissolved metals detected at the McCarl site during the September 1989 sampling event included barium (199B to 245 ug/l) detected in all wells sampled and selenium detected in wells MC-5 (38.8 ug/l) and MC-6 (150 ug/l) (see Table 4.4-2).

General water quality parameters are included in Table 4.4-3.

4.4.3 DECEMBER 1989

Ground water samples were collected in December 1989 from both USEPA and WCC installed wells at the McCarl site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids.

Methylene chloride (attributed to laboratory contamination) and 1,2-dichloropropane (3.0J ug/l) were detected in well MC-5. No other volatile organic compounds were detected above their respective detection limits in any of the McCarl site wells during this sampling event. The semi-volatile organic bis(2-ethylhexyl)phthalate was detected in low levels in all wells; however, its presence is attributed to the ubiquitous occurrence of phthalates in the environment (see Table 4.4-1).

Total metals detected at the McCarl site during the December 1989 sampling event included barium (166B to 520 ug/l) and lead (11.3 to 57.1 ug/l) detected in all wells sampled, arsenic detected in wells MC-2 (2.6B ug/l) and MC-4A (2.1B ug/l), chromium (35.7 to 80.6 ug/l) detected in wells MC-2, MC-4A, MC-5, and MC-6, and selenium (48.5 to 133 ug/l) detected in wells MC-2, MC-3, MC-5, and MC-6 (see Table 4.4-2).

Dissolved metals detected at the McCarl site during the December 1989 sampling event included barium (97.9B to 341 ug/l) detected in all wells sampled, lead detected in well MC-1 (1.1B ug/l), and selenium (33 to 184 ug/l) detected in wells MC-2, MC-3, MC-5, and MC-6 (see Table 4.4-1).

Ground water quality parameters are included in Table 4.4-3.

4.4.4 MARCH 1990

Ground water samples were collected at the McCarl site during a quarterly sampling event conducted prior to the remedial investigation. Ground water samples were collected from the USEPA and WCC installed monitoring wells at the McCarl site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids.

Volatile organic compounds were not detected in any of the wells sampled (see Table 4.4-1).

Total metals detected at the McCarl site during the March 1990 sampling event included barium (102B to 433 ug/l) detected in all wells sampled, lead (2.6B to 18.1 ug/l) detected in all wells sampled except the duplicate sample collected from MC-3 (MC-3D), selenium (48B to 117 ug/l) detected in all wells sampled except MC-1 and MC-4A, arsenic detected in MC-2 (1.6B ug/l), MC-4A (2.1B ug/l) and MC-6 (4B ug/l), and chromium (6.9B to 125 ug/l) detected in MC-2, MC-4A, MC-5, and MC-6 (see Table 4.4-2).

Dissolved metals detected at the McCarl site during the March 1990 sampling event included barium (93B to 161B ug/l) detected in all wells sampled and selenium (27B to 140 ug/l) detected in all wells except MC-1 and MC-4A (see Table 4.4-2).

General water quality parameters are included in Table 4.4-3.

4.4.5 JUNE 1990 AND AUGUST 1990 INITIAL

Ground water samples were collected at the McCarl site following the installation of monitoring wells; MC-3C, MC-4C, MC-6C, and MC-7. Ground water samples were collected from these wells and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate, and total dissolved solids. Monitoring well MC-7 was initially sampled in August, all other newly installed monitoring wells were initially sampled in June. In addition, MC-7 was only sampled for volatile organics and total and dissolved metals because of the volume of water available following purging.

The volatile organic acetone (a common laboratory contaminant) was detected in MC-7 (3BJ ug/l), MC-3C (3J ug/l), and MC-6C (3BJ ug/l); 2-butanone (3J ug/l) and carbon disulfide (2J ug/l) were detected in MC-3C (see Table 4.4-1). The only semi-volatile detected was bis(2-ethylhexyl)-phthalate (4.0J ug/l) in MC-3C. This semi-volatile is ubiquitous in the environment.

Total metals detected at the McCarl site during this initial sampling event included arsenic (3.3B to 53.6 ug/l), barium (71.1B to 2,700 ug/l), and chromium (8.7B to 211 ug/l) detected in all wells sampled; lead detected in MC-3C (45.4 ug/l), MC-4C (13.7 ug/l), and MC-6C (234 ug/l); and cadmium was detected in MC-6C (104 ug/l) (see Table 4.4-2).

Dissolved metals detected at the McCarl site during the initial sampling event included barium (32.1 to 84.4B ug/l) detected in all the wells sampled, arsenic (2.9B ug/l) and lead (1 ug/l) detected in MC-3C, and selenium (48B ug/l) detected in MC-7 (see Table 4.4-2).

General water quality parameters are included in Table 4.4-3.

Due to suspected inadequate well development, total metals concentrations observed in MC-6C were extremely high. Verification sampling and subsequent reverification sampling (discussed below) did not confirm these initial total metals results. For this reason, the high end of the ranges reported above do not reflect the true ground water quality of the site.

4.4.6 JUNE 1990 QUARTERLY SAMPLING EVENT

Ground water samples were collected at the McCarl site during a quarterly sampling event conducted in late June 1990. Ground water samples were collected from the USEPA and WCC installed monitoring wells at the McCarl site and analyzed for volatile organics, semi-volatile organics, total and dissolved metals, nitrate, hardness, alkalinity, chloride, sulfate and total dissolved solids.

The volatile organics detected at the McCarl site during the June 1990 quarterly sampling event included acetone (a common laboratory contaminant; USEPA, 1990) in MC-4A (2J ug/l) and MC-6C (2J ug/l); carbon disulfide (2J ug/l) in MC-3; toluene (2J ug/l) in MC-3C and 1,2-dichloropropane (2J ug/l) in MC-5 (see Table 4.4-1). The semi-volatile organic bis(2-ethylhexyl)phthalate (a compound ubiquitous in the environment) was detected in MC-4C (4BJ ug/l) and MC-6C (7BJ ug/l) (see Table 4.4-1). All other monitoring wells sampled during this event exhibited non-detectable levels of volatile and/or semi-volatiles at their respective detection limits.

Total metals detected at the McCarl site during the June 1990 quarterly sampling event included barium (92B to 375 ug/l) detected in all wells sampled; chromium (5.6B to 32.1 ug/l) detected in all wells sampled except MC-3; selenium (2B to 139 ug/l) detected in all wells sampled except MC-3C, MC-4A, and MC-6C; lead detected in MC-2 (12.9 ug/l), MC-3 (2.8B ug/l), MC-4C (5.3 ug/l), MC-5 (6.2 ug/l), MC-6 (7.8 ug/l), and MC-6C (9.2 ug/l); and arsenic detected in MC-2 (2B ug/l), MC-3C (2.1B ug/l), MC-4C (1.9B ug/l), MC-5 (1B ug/l), MC-6 (1.3B ug/l), and MC-6C (3.5B ug/l) (see Table 4.4-2).

Dissolved metals detected at the McCarl site during the June 1990 quarterly sampling event included barium (96.2B to 297 ug/l); selenium (1.4B to 179 ug/l) detected in all wells sampled except MC-3C and MC-4A; and arsenic detected in MC-3C (2.2B ug/l), MC-4C (2.2B ug/l) and MC-6 (1.9B ug/l) (see Table 4.4-2).

General water quality parameters are included in Table 4.4-3.

4.4.7 SUMMARY - MCCARL SITE GROUND WATER

To date, WCC on behalf of Du Pont has conducted six ground water sampling events at the McCarl site. These events were undertaken in August 1989 after the installation and development of four monitoring wells; in September 1989 from WCC-installed monitoring wells, in December 1989 from USEPA- and WCC-installed wells, in March 1990 from USEPA- and WCC-installed wells, and in June 1990 when initial verification and quarterly samples were collected. Ground water data related to the McCarl site monitoring wells are presented in Tables 4.4-1 (organics), 4.4-2 (total and dissolved metals), and 4.4-3 (general water quality parameters).

The metals of potential concern in the ground water at the McCarl site include the metals arsenic, barium, cadmium, chromium, lead, and selenium. No volatile organic or semi-volatile organic contaminants of concern have been identified (see Section 7.0). The volatile organic compounds methylene chloride, acetone, and semi-volatile benzoic acid, although detected in several ground water samples, are generally attributed to laboratory contamination (USEPA, 1990). The phthalates bis(2-ethylhexyl)phthalate (attributed to the ubiquitous occurrence of phthalates in the environment), butylbenzylphthalate and di-n-octylphthalate (present in concentrations that represent estimated values only) also were detected in several ground water samples collected from the McCarl site.

The additional metals detected in the total and dissolved metals analyses collected from the ground water at the McCarl site, aluminum, copper, iron, manganese, and zinc were detected in several samples.

4.5 FEDLER PROPERTY

Six soil borings were drilled and sampled on the Fedler property at a suspected dump site near the entrance of the property. An additional five borings were drilled and sampled near the head of a drainage region adjacent to the Baier site service road (see Figures 8 and 9). Samples from both boring sets were analyzed for volatile organic compounds at the 3.5-foot level. An exception was the Ditch-1 sample, which was not analyzed for volatiles. Samples from both sets were also analyzed for metals. Sampling intervals were 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot. In addition, a 3.5- to 5-foot sampling interval was analyzed for the drainage ditch samples. Results from the analyses of the samples collected from the alleged "farm dump" are presented in Table 4.5-1. In general, the contaminant profiles for both the volatiles and the metals were the same for all soil samples at all depths. Metals were low in all cases, and fell within the national background ranges. Volatile organic compounds were either not found or found in very small quantities. Estimated values are given for acetone, methylene chloride, and toluene, with values for these compounds ranging from 1J to 9J ug/kg.

In addition to the samples collected at the alleged "farm dump" and drainage ditch heads, USEPA also collected samples from the Baier site grid (see Figure 4), which fell upon the Fedler property. These samples were collected from grid locations I-11 through T-11 and J-12 through S-12. These grid locations would have been a part of the XRF and soil gas screening conducted by WCC but access restrictions required that USEPA sample on the Fedler property. As a result, samples were not field screened but were submitted for laboratory analysis. Samples were collected from the 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot intervals for metals analysis and the 3- to 3.5-foot intervals for volatile organic analysis.

In general, data provided by USEPA (Appendix G) indicate that the metals of concern (i.e., lead, cadmium, chromium, and selenium) are not present above naturally occurring background levels in any of the intervals sampled.

Summary tables provided by Jacobs Engineering are also presented in Appendix G.

4.6 SPLIT SAMPLE DATA COMPARISON

Samples from both soil and ground water matrices were taken from both the Baier and McCarl sites and split and analyzed by DuPont and/or EPA. These sample types consisted of the following makeup:

- Sixteen soil/sediment samples were analyzed for metals. Sample B-D-3 represented a EPA duplicate and was not analyzed by DuPont;
- Five soil samples were field screened using x-ray florescence and subsequently analyzed in the laboratory by EPA and DuPont:
- Twelve soil samples were analyzed for VOCs; and
- Nine ground water samples were analyzed for metals.

The purpose of this split sample program was to verify consistency between field sampling and laboratory analytical procedures.

Split sample data for soils and sediments generally indicated good agreement for the compounds of concern which include arsenic, cadmium, chromium, lead, and selenium. Moreover, the analytical data from the split samples for aluminum, copper, iron, manganese, and zinc also demonstrated good agreement. As an example, the data for arsenic indicate that the average difference between the EPA and DuPont analytical values is 3.3 mg/kg. A review of Tables 4.6-1, 4.6-2, and 4.6-3 reveals the consistency between the analytical data for split samples and clearly demonstrates the close agreement between DuPont and EPA data for these samples. As an example, on Table 4.6-2(A), the three samples identified B-SED-1, B-SED-5, M-J-10 show a very narrow range between the two analytical laboratories for arsenic and the other compounds of concern. In addition to the good agreement between analytical laboratories for soil sample data, it is important to note that the agreement between the laboratories is very good for sediment samples, soil samples taken from various depths, and soils from either the McCarl or the Baier sites. Incidently, sample B-D-3 in Tables 4.6-1(B) and 4.6-2(B) are EPA duplicate samples which show very good agreement for the EPA laboratory as a "self-check".

Table 4.6-3 summarizes the split sample analytical data for soil samples analyzed in the field by the x-ray florescence (XRF) screening method and subsequently analyzed in the laboratory by EPA and/or DuPont. Samples B-D-3, B-G-10-2, and B-H-8-1 were screened using XRF and analyzed in the laboratory by EPA but not by DuPont as agreed in the RI/FS Work Plan. These data demonstrate that in general there is reasonably good agreement between the XRF field screening method and the analytical data as provided by the laboratory. Samples B-R-7-1 and B-R-5-2 do not demonstrate the level agreement previously seen. The XRF data and laboratory data generated by DuPont is not in agreement with the laboratory data generated by EPA. However, the EPA value reported for B-R-5-2 which is not in agreement with the XRF value reported from the field screening is closer to the value reported for B-R-7-1. It is possible that the sample EPA reported for B-R-5-2 may have been mislabeled; however, the exact reason for the lack of agreement in sample B-R-5-2 is not known.

Table 4.6-4 summarizes the findings of a split sample program for soils taken from the Baier and McCarl sites and analyzed for VOCs. These samples were analyzed by the soil gas head space method which is a semi-quantitative field screening technique and, subsequently, were analyzed in the laboratory by DuPont and EPA. Three samples were taken from both sites and analyzed for toluene, total xylene, and ethylbenzene. All three measurements were non-detectable for these three analytes at a detection limit ranging from 6.3 ug/kg (EPA detection limit) to 100 ug/kg (DuPont detection limit) for total xylene. The detection limit reported for the soil gas survey was 10 ug/kg in all cases. The results of this segment of the split sample program demonstrate the validity of the soil gas head space method.

Additional split sample data for volatile organics in soils for samples taken from both sites are reported in Tables 4.6-1(A) and 4.6-1(B). Again, there is excellent agreement between DuPont's laboratory and EPA's laboratory. Toluene, total xylene, and ethylbenzene were not detected at a detection limit of 6 ug/kg, but acetone and methylene chloride were detected as estimated values and/or were detected in association with the blank. These two compounds are likely to be laboratory contaminants. Only one split sample, (B-D-3) exhibited the presence of an analyte. Total xylene was found in this sample at 6,400 ug/kg (DuPont) as compared to 640 ug/kg (EPA). There is a tenfold discrepancy between the two values; however, the value reported by DuPont can be considered to be conservative given the fact that it is higher.

Ground water samples were split between EPA and DuPont during two separate sampling events. These samples were analyzed for total and dissolved metals by both DuPont and EPA. The results indicate that again there is good agreement between EPA and DuPont for the compounds of concern as well as other associated analytes. This holds true for the total and dissolved metal fractions of the ground water. These data are presented in Tables 4.6-5(A) through 4.6-5(E).

It can be concluded that the split sample analytical program for soils, sediment, and ground water for metals and volatile organic compounds exhibited good agreement with very little exception. These findings demonstrate that the sampling procedures and analytical methodologies were consistent throughout the program. Therefore, it can be concluded that there is a high degree of confidence that the data reported for this RI/FS project are valid and accurately depict the rate and extent of contamination at both the McCarl and Baier sites.

4.7 ANALYTICAL DATA QUALITY

The purpose of this section is to present a summary analysis of the laboratory data quality as submitted by ENSECO to WCC. To accomplish this, the quality assurance/quality control (QA/QC) laboratory packages were reviewed for 20 samples. These samples include:

- Thirteen ground water samples which were taken on September 27, 1990; and
- Seven sediment samples taken on May 11, 1990.

The sediment samples were analyzed for volatile organic chemicals (VOCs) semi-volatiles, and metals. The ground water samples were submitted for VOCs and semi-volatiles. The following includes the analytical QA/QC review for both media.

4.7.1 GROUND WATER ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL

Thirteen ground water samples were taken on June 27, 1990 and logged in by ENSECO on June 28, 1990. These samples were subsequently analyzed for VOCs and semi-volatiles. The QA/QC packages associated with these analyses were reviewed for the following:

- Surrogate recoveries;
- Matrix spike/matrix spike duplicates (MS/MSD);
- GC/Mass Spectrometer (MS) tuning;
- Internal standards recovery; and
- Calibration.

Review of the surrogate recoveries for VOCs indicated that all were within the range of the QA/QC limits. For example, the recovery for d8-toluene ranged from 95 to 105 percent which compares favorably to the CLP established limits of 88 to 110 percent. The recoveries for BFB and DCE were also within their respective ranges. In a similar fashion, the semi-volatiles surrogate recoveries were all within their respective range of recoveries with the except of two individual surrogates

The matrix spike/matrix spike duplicate (MS/MSD) for VOCs were all within the established limits as established by the CLP with the exception of one outlier for MSDs that was only 1 percent in excess of the upper limit. The MS/MSD data for semi-volatiles also demonstrated the same level of acceptability.

The tuning parameters for both the volatiles and semi-volatiles samples analysis were all within acceptable limits, with regard to percent relative abundance criteria. Bromoflorobenzene (BFB) tuning for VOC analysis was conducted on July 3, 1990 and July 9, 1990 which were the respective days of analysis. DFTPP tuning for semi-volatiles analysis also demonstrated acceptable tuning with regard to percent relevant abundance criteria.

Internal standards data indicate that all internal standards checked were within the upper and lower limits as established for VOC and semi-volatile analysis. Most of the reported values for internal standards were at the mid-point between the upper and lower limits of acceptability. Calibration documentation was submitted for both VOCs and semi-volatiles consisting of the following 5-point concentration calibration and continuing calibration checks were included in the QA/QC review package.

4.7.2 SEDIMENT SAMPLE ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL

A total of seven sediment samples including duplicates were submitted for analysis by CLP methodologies for VOCs, semi-volatiles, and metals. These methods include GC/MS, inductively coupled argon plasmic emissions (ICP), graphite furnace, and others. The subsequent QA/QC packages were submitted along with the data and were subjected to review.

Initial calibration and continuing calibration documentation for metals were submitted for all of the analytes of interest. In addition, the CRDL standards information for all of the metals which are required to be analyzed under the CLP were submitted and found to be within the limits for the initial and final checks. All of the CRDL standards information were within 10 to 20 percent of the initial versus the final point. The interference check sample documentation for ICP was submitted and found to be within 2 to 3 percent of the theoretical level. The laboratory control samples for both ICP and graphite furnace analysis were within the limits established for each analyte. The agreement reported for the laboratory control sample for ICP analysis were all generally within 5 percent of one another. The laboratory control sample analyses for arsenic and mercury were within 7 percent. The only exception was selenium. Other documentation was submitted and found to be within an acceptable range were the ICP inter-element corrections and the ICP linear range reports.

The VOC and semi-volatiles QA/QC package mirrored the QA/QC summary as discussed in Section 4.7.1 for ground water. In summary, the surrogate recovery for d8-toluene, BFB, and DCE demonstrated very good recovery with the vast majority of samples falling within a very narrow 10 percent range. The MS/MSD data also demonstrated very good recoveries and relative percent recoveries (RPDs). Tuning, internal standards recovery, initial calibration, and continuing calibration check documentation all demonstrated good analytical QA/QC.

Semi-volatile surrogate recoveries were all within limits with the majority of the individual recovery data falling at the mid-point for the range of upper and lower limits of acceptability. The MS/MSD information demonstrated a slightly high value for recovery on phenols, but all other data points were well within acceptability limits. The RPD range fell in a very narrow minus 6 percent to plus 8 percent range. Tuning, internal standards recovery, and initial and continuing calibration documentation all demonstrated good analytical QA/QC performance.

In summary, review of the QA/QC data package submitted for ground water and soil samples taken during the RI/FS project demonstrated good analytical performance by ENSECO. The results of the QA/QC review for the current data packages are consistent with an evaluation submitted by ESAT, USEPA's laboratory support contractor, which provided a data validation review of samples split between Du Pont and USEPA in September 1989. The review conducted by USEPA's contractor stated, "In general, there is good agreement between the PRP and EPA data, and the PRP data is generally of good quality and should be acceptable for most Agency purposes." The review further goes on to state, "Surrogate and MS/MSD data indicate good performance, and outliers are virtually absent. GC/MS tuning information indicates no problem with instrument performance." USEPA's review of Du Pont's organic data closes by stating, "For these samples, which were the same samples for which split sample data is reported, sample QC generally indicates good performance and fairly high data quality..." The report generated by USEPA regarding a data assessment of the inorganics sample packages indicates, "The soil data has generally acceptable calibrations, matrix spikes, and other QC checks..." The report concludes that on the whole, "The data appears acceptable." Based on USEPA's review of the data packages submitted by ENSECO, on behalf of Du Pont, and the current review of QA/QC data packages, the laboratory analytical data QA/QC are considered acceptable. Moreover, all data with regard to this particular RI/FS should be considered accurate and precise. These data, then, are useful for any purpose in support of USEPA and/or Du Pont decision-making.

5.0 CONTAMINANT FATE AND TRANSPORT

Previous sections of this report have discussed contaminant source areas and described chemical classes associated with past disposal activities at the sites. The results of chemical analyses of environmental samples have also been presented. The recent remedial investigation and removal action studies have identified two major classes of chemicals in soil, sediment, and ground water at the Baier site and McCarl sites. These chemical classes include metals and volatile organic compounds (VOCs). Based on the results of these investigations, it is apparent that several of the chemicals identified at the sites are persistent in the environment given the fact that waste disposal has not occurred for over 30 years.

The identification and remediation of potential hazards resulting from the release of chemical residues at the sites are important goals of the RI/FS process. An essential part of characterizing the potential migration of chemical releases involves understanding the physicochemical properties of the compounds identified at the sites. The properties of chemical contaminants combined with environmental fate and transport processes are significant factors governing the potential migration of contaminants off-site.

Sections 5.1 and 5.2 describe key environmental fate processes and also discuss the physicochemical properties of the most prevalent contaminants identified at the sites. Because site-specific factors such as geology and hydrogeology are not considered in these two sections, this information alone is insufficient for understanding the potential migration of contaminants at the Baier and McCarl sites. Rather, this information is intended to provide general background on those factors that may affect contaminant mobility and predicting potential releases into various environmental media. Section 5.3 integrates the information presented in Sections 5.1 and 5.2 with site-specific data which address important migration routes.

5.1 POTENTIAL ENVIRONMENTAL FATE PROCESSES

As stated, the potential for a chemical to be released to the environment and its subsequent environmental fate is partially influenced by several chemical and physical processes. The key environmental processes affecting contaminant releases are summarized in Table 5-1. However, other environmental processes affect the degradation or movement of contaminants between various environmental media (i.e., air, water, and soil). The mechanisms are summarized in Table 5-2.

In addition to environmental processes, various physicochemical and biological processes also serve to influence the mobility and chemical fate of contaminants. These processes specifically relate to interactions between contaminants and environmental matrices (i.e., soils). Table 5-3 presents a summary of these processes.

Sections 5.1 and 5.2 as well as Tables 5-1 through 5-3 present preliminary information while Section 5.3 specifically discusses the potential mobilities and environmental fates of the contaminants identified at the sites. The major goal of Section 5.3 is to establish a relationship between potential contaminant mobility at the sites and the results of soil and ground water analyses. This relationship is important in defining the site-specific potential for off-site contaminant migration.

5.2 GENERAL PHYSICOCHEMICAL PROPERTIES OF METALS AND VOLATILE ORGANIC CHEMICAL

This section presents a summary of the physicochemical properties of the two classes of chemicals identified at the sites. A discussion of how these properties affect the persistence and potential mobility of each class of chemical is also provided. Specific examples of metals and VOCs have been selected to illustrate the general fate and transport characteristics of each chemical class. The chemicals selected in this section represent the more prevalent compounds detected in soil, sediment, surface water, or ground water at the sites.

5.2.1 METALS

Metals are unique as chemical contaminants because they are also naturally occurring. Thus, metals exist in the environment at concentrations thought of as normal or background. The results of analyses (Section 4.0 of this RI report) revealed that numerous metals were detected at the McCarl site. However, many metals were detected at concentrations within their respective background ranges, and thus their presence at the sites is not related to past waste disposal activities. The concentrations of metals detected in the McCarl site soils and the respective background ranges are given in Table 5-4. Among the metals detected at concentrations greater than background, the transition (i.e., heavy) metals, as a group, appear to be the most prevalent at the sites and are most readily linked to past disposal of paint wastes and sludges.

[illegible]

One of the most fundamental factors in evaluating fate and transport is the fact that metals, for the most part, exist in the environment as salts. The physicochemical properties of a salt are dependent upon the anion (e.g. chlorides, sulfates, carbonates, etc.) as well as the metallic cation. Although the identities of specific metal salts at hazardous waste sites are not usually known with certainty, generalizations may be made regarding the mobility and fate of these chemicals based on their compositions. The fact that several of the metals present at the Baier and McCarl sites were used as paint pigments further clarifies the potential mobilities of these compounds. The reasons for this are as follows:

- Only specific metal salts (e.g. lead oxide, lead chromate, cadmium selenite, cuprous oxide, zinc oxide, etc.) are used as paint pigments;
- Paint pigments characteristically exhibit low water solubility; and
- Paint pigments are intended to be highly stable in order to ensure the durability of the paint and, therefore, do not readily dissociate into their constituent metal ions and counter ions.

Thus, the metals detected in waste areas on the sites likely exist as stable, poorly mobile salts.

In general, inorganic compounds, including salts of metals, possess low vapor pressures that are basically unmeasurable. Thus, potential releases of metals to air through volatilization are not relevant for this class of contaminants. However, certain metals may exhibit affinities for soils through adsorption or ion-exchange mechanisms, and thus releases to air through fugitive dust emissions are possible. The adherence of metals to soil particles may also facilitate potential releases through surface runoff under conditions involving soil erosion (i.e., movement of soil particles off-site). Arsenic is an example of a metal that exhibits a significant affinity for certain soil types.

Fundamentally, the most important physicochemical property governing the mobility of metals is water solubility. The salts of metals may exhibit a wide range of water solubilities. The salts of transition metals and several environmentally prevalent anions (e.g. sulfates, carbonates, chlorides, etc.) are essentially insoluble in water. Indeed, the metal salts selected as paint pigments are highly insoluble in water. This quality greatly decreases the mobility of metals through mechanisms involving water such as the migration through surface water, surface runoff, or percolation through soils. The latter is of primary importance in limiting the movement of metals from soils to ground water.

The following sections discuss the environmental fate and transport of specific transition metals. These metals include arsenic, cadmium, chromium, lead, and selenium. They have been selected as specific examples because these metals were detected at concentrations above background at both the Baier and McCarl sites. Moveover, these metals are of toxicologic significance and their potential impacts on human health will be partially dependent upon their fate and transport characteristics.

5.2.1.1 Arsenic

Elemental arsenic (As) exists as a variety of compounds (arsenicals) which occur naturally or are synthetic. Naturally occurring arsenicals are found in soil, minerals, water, and food. Arsenic is the twentieth most abundant element in the earth's crust with concentrations ranging between 60 and 188,000 parts per billion, depending upon the nature of the geological material in which the arsenic is entrained. It is found in the ores of copper, lead, cobalt, nickel, zinc, selenium, silver, and gold.

Generally, background arsenic concentrations in soil are greater than those found in water. Although background arsenic levels in soil are dependent upon geographical area, commonly cited ranges include: 0.2 mg/kg to 40 mg/kg and 2 mg/kg to 150 mg/kg. A variety of studies conducted in the United States, as well as Europe, have shown that natural, or background levels of arsenic in surface water occur on the order of a few micrograms per liter. In many regions, background levels of arsenic in ground water appear higher but are more variable than those found in surface water.

Arsenicals above naturally occurring levels have been introduced into the environment through human activities such as smelting, coal burning, and the use of pesticides. Considering these activities, a likely source of arsenic found at the sites is pesticides given the agricultural setting of the region. Several arsenicals have been widely used as pesticides; although, the subsequent development of DDT and related compounds curtailed the use of arsenical pesticides. Arsenical compounds may be grouped in several categories, including trivalent inorganic, pentavalent inorganic, and organic forms. These forms are interconvertible depending upon environmental conditions. These facts underscore the importance of understanding the environmental fate and impact of arsenicals since the toxicity of arsenic is also form-dependent.

Arsenical compounds may undergo any of three general types of environmental reactions, including:

- oxidation - reduction;
- methylation; and
- hydrolysis.

The predominant chemical transformation of arsenicals in soil is the oxidation of trivalent forms of arsenic to pentavalent forms. This reaction occurs under conditions of adequate oxygen tension (i.e., aerobic conditions) and is exemplified with the conversion of arsenite. This reaction is important in understanding the fate of arsenicals in the environment. The trivalent forms of arsenic, such as arsenic trioxide, have high water solubility (15,000 mg/l) and are poorly sorbed by soil (K_{oc}=5 ml/g). Pentavalent forms of arsenic are typically reported as insoluble in water and strongly sorbed by soil. Thus, oxidation of arsenicals can significantly attenuate their mobility.

The transport of arsenic in soils is governed by adsorption/desorption processes. The colloidal fraction of soils, specifically clays, contain ferrous and aluminum oxides that readily adsorb arsenicals. Thus, clay layers in soil effectively serve to retard the downward migration of arsenicals especially under oxidizing conditions favoring the formation of arsenate.

Methylation of arsenic may occur under both anaerobic and aerobic conditions. This reaction is generally attributed to soil microorganisms. In aquatic systems, phytoplankton are thought to be responsible for biomethylation reactions. The extent of methylation of arsenical compounds is oxygen-dependent. Anaerobic organisms produce dimethylated compounds, whereas aerobic organisms produce trimethylated compounds. Biomethylation represents a mechanism by which the volatility of soil-borne arsenicals may be increased to the extent that release to air may occur. However, although biomethylation represents a relatively important pathway in the environmental fate of arsenicals, quantitatively it produces relatively little impact on the air release of soil-borne arsenic.

The third general environmental reaction of arsenicals is hydrolysis. This reaction is relatively specific for the oxides of arsenic. The nature of hydrolytic reaction is dependent upon the oxidation state of arsenic. Arsenic trioxide (A_2O_3) reacts with water to form arsenous acid, which, in turn, may yield three salts (ortho-, meta-, and phroarsenites). Arsenic pentoxide (As_2O_5) hydrolyzes in a slightly different manner in that initially three distinct acids (ortho-, meta-, and pyroarsenic acids) are formed. Each acid may then yield its respective salt. Arsenite formed by hydrolysis may subsequently undergo oxidation-reduction and/or biomethylation reactions.

In conclusion, the environmental chemistry of arsenic in soils favors the production of arsenate. Subsequently, the mobility of arsenates is limited by poor water solubility and high affinity for adsorption to clays. The low volatility of inorganic arsenic along with the tendency of adsorption to clays further limits the potential for air releases.

Arsenicals have not been reportedly used as paint pigments, and therefore, the arsenic detected at the sites in soil and ground water is likely naturally occurring (i.e., background). This is consistent with the concentrations detected at both sites.

5.2.1.2 Cadmium

Cadmium is generally found as sulfides in the ores of zinc, copper, and lead. It is obtained as a by-product in the treatment of these ores. Because of its metallic and non-corrosive properties, cadmium is used in plating operations, as a pigment for paints and plastics, and in various solders and batteries. It has been introduced as a contaminant into the environment as a result of smelting operations, plumbing corrosion, and as a contaminant in phosphate fertilizers. It is often found in sewage sludge. The presence of cadmium at the site is likely attributed to its use as a paint pigment.

Cadmium exists in several oxidation states and readily forms a number of salts with varying degrees of solubility. The +2 oxidation state predominates in nature. Cadmium sulfide and cadmium selenite are commonly used as yellow-orange paint pigments. Cadmium sulfide possesses low solubility in water (130 ug/100 ml) and cadmium selenite is reported to be insoluble in water. Thus, the cadmium paint pigments present at the site would have low mobility in surface water and water percolating through soils.

In soil, sorption is an important fate and transport mechanism. Cadmium appears to have a selective adsorption affinity for oxides and/or hydroxides of iron, manganese and aluminum. Soluble cadmium salts may be subject to hydrolysis at pH values encountered in the environment. Isomorphous substitution in carbonate minerals can also occur and results in reductions of aqueous cadmium concentrations.

5.2.1.3 Chromium

A major source of chromium is through smelting of chromite ore. The principal substances for production of chromium chemicals is sodium chromate and dichromate. Because of chromium's high melting point, moderate thermal expansion, and stability, it has many uses including hardening of steel and other alloys, manufacture of stainless steel, metal plating, as a paint pigment and salt in leather tanning, as a mordant dye in the textile industry, as an additive in preservatives, and an anti-corrosive in cooking systems, boilers, and well drilling muds. In addition to these uses, it is introduced into the environment through chemical processing, combustion of fossil fuels, and cement production. High concentrations of chromium have been detected in sewage sludges from many countries. As in the case of cadmium, the presence of chromium (above background) at the sites is probably due to the disposal of paint wastes containing chromium pigments (i.e., dichromites and chromates).

Chromium is found in various oxidation states ranging from +2 to +6. Only the trivalent (+3) and hexavalent (+6) forms are of biological significance. They are the most stable and common forms in the natural environment. The trivalent form of chromium is more common in nature than the hexavalent form. However, the hexavalent form is of greater importance in industrial applications where dichromate is used as a powerful oxidizing agent.

Du Pont's records indicate that lead chromate was the primary chromium pigment used in plant operations and was used in red paints. Lead chromate is virtually insoluble in water and, thus, would possess low mobility in soils. The oxidation state of chromium in this pigment is +6, but oxidation/reduction processes occurring in soils favor the formation of the trivalent form. Therefore, any free chromate resulting from the dissociation of lead chromate would be reduced to the trivalent state.

Trivalent chromium readily forms precipitates with hydroxides, carbonates, and sulfides in soil. This property is a major mechanism for attenuation in soils along with adsorption to organic matter and clay minerals. Trivalent chromium salts are subject to hydrolysis, but subsequently precipitate as insoluble hydroxides, especially $Cr(OH)_3$.

Hexavalent chromium has been observed in deep ground waters of southwest at significant concentrations. It is not adsorbed to any significant degree by clays, ferric hydroxides, or ferric and manganese oxides, but may have some affinity for organic materials in soils and natural waters. These observations suggest that hexavalent chromium exhibits a greater mobility than many other heavy metals. However, as stated, environmental processes in soil ultimately result in the reduction of hexavalent chromium.

5.2.1.4 Lead

Lead is obtained through roasting of the mineral, galena. In addition to its natural occurrence in most soils and rocks, lead is found in batteries, gasoline additives, paint pigments, medicine, ammunition, containers for corrosives, metal alloys, and glass production. It is introduced into the environment through a variety of mechanisms including combustion of lead containing fuels and the use of lead arsenate as a pesticide. The presence of lead at the Fort Madison sites is likely accounted for by the presence of waste residues containing the paint pigments lead oxide and lead chromate. These pigments contain lead at the +2 oxidation state.

Lead salts characteristically exhibit poor solubility in water. As previously stated, lead chromate is insoluble in water. Lead oxide, another common paint pigment, may exist as PbO, PbO_2, Pb_2O_4, or Pb_2O_3. The water solubilities of these forms vary and range from 2.3 mg/100 ml to insoluble. The quantities of lead released through the dissolution of lead oxide would, however, be subject to other processes that would attenuate the mobility of the ion.

In soil, lead also readily precipitates as sulfides, hydroxides, and carbonates. Lead is also subject to adsorption, particularly on aluminum silicates. There is a great affinity between lead and organic matter in soil, and this process is more important in the fixation of lead in soil than either precipitation as the carbonate or sorption by hydrous oxides. Hydrolysis can be important at pH values greater than 5. Collectively, these processes attenuate the solubility, mobility, and bioavailability of lead. Benthic anaerobic microbes can methylate lead to form tetramethyl lead which is volatile and more toxic than inorganic lead.

5.2.1.5 Selenium

Selenium (Se) is a naturally occurring, but heterogeneously distributed element in the earth's crust and sedimentary rocks. It is seldom found in pure form and is more often associated within sulfide minerals or as selenides of silver, copper, lead, and nickel. Selenium compounds are found in soil, water, and air, as well as grains, cereal, and metal. Background concentrations of selenium in soil typically range from 0.1 to 2.0 mg/kg.

Selenium is a member of the sulfur family. Due to its chemical/physical properties, it is used in photographic equipment and home entertainment equipment. It is also used as a pigment for paints, plastics, and rubber, in glass production, pharmaceuticals, fungicides, medicines, and as a feed additive for livestock. The concentrations of selenium exceeding background at the sites may be accounted for by paint pigments such as cadmium selenite. Indeed, the results of chemical analyses of soils have revealed a correlation between the presence of cadmium and selenium.

The environmental fate of selenium is influenced by its oxidation state and the associated chemical properties of its different forms. The common oxidation states of selenium are (-2), (+2), (+4), (+6), all of which may be found in soils under a variety of conditions. In alkaline, aerobic soils, selenates are the predominant chemical species. This form of selenium is highly soluble in water and exhibits low tendencies to sorb onto soil particles. However, in acidic soils, such as the surficial soils at the sites, selenium is present as the selenite anion which is firmly bound in iron oxides colloids. Other forms of selenium including selenides which are insoluble and relatively immobile in soil.

Inorganic selenium species can be methylated by microbes, soil fungi and bacteria to organoselenides (such as dimethylselenide), resulting in the generation of volatile organic species which may be lost to the atmosphere from both soil and water surfaces. The oxidation of elemental selenium to selenite $(Se)_3^{-2}$) by microorganism activity has also been reported.

5.2.2 VOLATILE ORGANIC COMPOUNDS (VOCS)

The VOCs detected in soil and ground water at the sites include acetone, ethylbenzene, toluene, and xylene. The physicochemical properties of this class of compounds are markedly different than those of metals suggesting the potential for different fate and transport mechanisms.

In contrast to metals, VOCs exhibit significant vapor pressures and, therefore, possess the potential for releases to air through volatilization. The VOCs also possess greater solubility in water than many metal salts, including those used as paint pigments. Because of this, the VOCs are relatively mobile in soil (depending upon soil type) and through surface runoff mechanisms. The magnitudes of the log k_{ow} values for VOCs indicate that retardation by soils would be moderate. Moreover, the potential for absorption is low compared to metals and suggests that release through fugitive dust emissions would be quantitatively less significant than volatilization.

The VOCs detected at the sites were likely introduced through the disposal of paint wastes since this class of compounds are commonly used as solvents in paint formulations. Importantly, waste disposal was commonly accompanied by burning which would promote volatilization. Moreover, disposal of paint wastes has not occurred in the sites for over 30 years, thus allowing the passage of numerous half-lives for volatilization. collectively, these facts suggest that VOC residues in surface soils (i.e., soil-air interface) would be vanishingly small.

The following sections provide additional information concerning specific volatile organic compounds.

5.2.2.1 Acetone

Acetone is produced in large quantities and used as a solvent and as a chemical intermediate in the manufacture of methyl isobutyl ketone, and paints, other chemicals.

There are a number of physicochemical and biological processes that may jointly affect the fate and transport of acetone in the environment. If releases occur onto surface soils, the environmental fate of acetone will be predominantly governed by volatilization due to it's high vapor pressure (270 mm Hg). In soils, acetone may also undergo rapid biodegradation by microorganisms. Following release to the atmosphere, acetone can be degraded through photolysis and reaction with photochemically-produced hydroxyl radicals. The estimated average half-life from these combined processes is 22 days and is shorter in summer and longer in winter.

Releases of acetone occurring in the subsurface (i.e., releases from buried wastes) will be governed by the mobility of acetone in soils. Two physicochemical characteristics of acetone facilitate its mobility in soils. The first is the high water solubility of acetone which is estimated to be 1 x 10^6 mg/L (i.e., infinitely soluble). The second is the low log k_{ow} of the compound (-0.24) which indicates relatively low potential for adsorption to soils. Thus, under conditions where volatilization cannot occur, acetone may leach into ground water.

5.2.2.2 Ethylbenzene

Ethylbenzene is produced and used as a solvent and is also used also in the manufacture of styrene. It is possible that this compound was used as a solvent in the manufacture of paints.

From the available data it would appear that the principal mechanisms governing the fate of ethylbenzene in the environment are volatilization and subsequent atmospheric photodestruction. Although ethylbenzene possess the lowest vapor pressure among the VOCs detected at the sites (7 mm Hg), it still possesses sufficient volatility to favor air releases from surface soils.

If released, ethylbenzene would tend to leach through soils and possibly into ground water. However, ethylbenzene possesses only moderate water solubility compared with other VOCs at the sites and has one of the highest log k_{ow} values. These properties will tend to limit the mobility of ethylbenzene to a greater extent than other VOCs.

As stated, ethylbenzene has a moderate adsorption in soil, especially in soil with a low organic carbon content. It is likely that ethylbenzene will biodegrade slowly in soil and ground water, although there is no direct data concerning its biodegradability. Ethylbenzene will not hydrolyze in soil or ground water and it will not be expected to directly photolyze, but it can react with photochemically produced hydroxyl radicals.

5.2.2.3 Toluene

Toluene, also known as methylbenzene, is produced from petroleum, coal, and as a by-product from styrene production. It is used as a solvent and thinner for paints and lacquers, and as an intermediate in chemical syntheses.

The environmental fate and transport processes of toluene are similar to those of ethylbenzene. However, quantitatively toluene possesses a greater potential for release into air (vapor pressure equals 28 mm Hg) and mobility in soils.

When released onto surface soils, toluene will evaporate into the atmosphere where it will be principally degraded by reaction with photochemically reactive hydroxyl radicals. In addition, the tendency for toluene adsorption to soil or sediment, based on its reported log k_{ow} value (2.73) will be less than ethylbenzene. This property suggests that toluene may be expected to exhibit moderate mobility in soil and therefore may leach to the ground water. Toluene will not hydrolyze under normal environmental conditions. Because toluene's water solubility is greater than that of ethylbenzene, it is expected to be the more mobile of these two homologous compounds.

Biodegradation will occur both in soil and ground water and is dependent upon the presence of acclimated micro-organisms.

5.2.2.4 Xylenes

Xylene, also known as dimethylbenzene, exists as a mixture of three geometric isomers: ortho-, meta-, and para-xylene. The physicochemical properties of the individual isomers vary, but all would be expected to exhibit similar fate and transport characteristics.

Xylenes are used as solvents and chemical intermediates in the production of polyester, alkyl resins, lacquers, and other organic syntheses. Many household products, especially aerosols of paint, varnishes, shellac, and rust preventatives contain xylenes.

As previously stated, the fate and transport processes of all three isomers of xylenes are fairly similar. When released onto soils, xylenes will evaporate into the atmosphere and, to a certain degree, leach into soils and possibly to ground water.

Both the vapor pressures and water solubilities are intermediate between those of ethylbenzene and toluene. The vapor pressure of all isomers is reported to be 10 mm Hg which is sufficient to support release through volatilization. Similarly, the water solubilities of the isomers are intermediate to those of ethylbenzene and toluene (the range for the isomers is 130 to 198 mg/L). Thus, the fate and transport of xylenes will be similar to the other VOCs, but will differ in extent.

Xylene will react with hydroxyl radicals in the atmosphere and will degrade (half-lives range from 1.0 to 1.7 hours in summer to 10 to 15 hours in winter). 1,3-xylene (meta-xylene) has a higher photochemical reactivity than the other isomers.

In soils, xylenes exhibit low to moderate adsorption capacity as predicted from the log k_{ow} values, (2.95 to 3.26) and thus will be moderately retarded by soils. However, a major process regulating the fate of xylenes in soil and ground water is biodegradation. Xylenes degrade readily in soils under both aerobic and anaerobic dentrifying conditions. Some degradation in ground water will occur also, but there are insufficient data to assess the rate of this process. Moreover, xylenes are resistant to hydrolysis.

Bioconcentration of xylenes is not expected to be significant.

5.3 CONTAMINANT MIGRATION AT THE BAIER AND McCARL SITES

This section describes the site-specific factors that influence the mobility and potential migration of contaminants in soils and ground water. The discussion provided in this section also provides an explanation as to the limitations in the content of contamination disclosed by the results of the RI.

5.3.1 FATE AND TRANSPORT IN SOILS

The physical characteristics of the subsurface at the Baier site and McCarl site are described in the sections of this report pertaining to geology and hydrogeology (Section 3.0). Based on information presented in those sections, the following summary is presented:

- The soil profile at the sites consists of 0 to 5 feet of loess, approximately 55 feet of weathered glacial till, and approximately 150 feet of unweathered glacial till on the average;
- The glacial tills are very "tight" in places and consist primarily of montmorillonite clay which possesses a higher cation exchange capacity of the three major silicate clay type;
- Glacial tills at the sites exhibit permeabilities ranging from 10^{-3} to 10^{-9} cm/sec;
- The depth to bedrock is approximately 225 feet;
- The weathered and unweathered till contains discontinuous sand lenses and clay; and
- The weathered till is fractured in places, while the unweathered till appears to be absent fractures.

These factors all play a very important role in contaminant fate and transport.

The principal mechanism for transport of contaminants in unsaturated soils is infiltration downward to the ground water table. However, the contaminants found at the sites that may be transported by this mechanism are subjected to site-specific factors that lead to attenuation of concentrations with depth. These factors which include clay content of the tills, permeability, thickness of the overburden, etc. coupled with the physicochemical properties of individual contaminants govern the fate and transport of contaminants.

The following discussion provides a general understanding of the relative importance and interaction of these processes in the subsurface in reference to the selected metals and VOCs.

5.3.1.1 Metals

As shown on Figure 23 (Baier site) and Figure 25 (McCarl site), the concentrations of metals in soil decrease significantly with depth and many metals appear localized to surface soils. The reasons for the observed attenuation of metals with depth is attributed, to a large degree, to chemical processes associated with soil pH, cation exchange capacity (CEC), and oxidation/reduction.

Soil pH varies with depth beneath the sites. As shown in Tables 4.1-1 through 4.1-6, soil pH increases gradually from acidic conditions in near surface soils to alkaline conditions at depths greater than 15 feet. The pH conditions contribute to the attenuation of metals by governing the relative solubilities of the salts of metals. Fundamentally, basic pH conditions cause metals to be less soluble by favoring the formation of insoluble metallic hydroxides or the metal salt form.

Cation exchange capacity analyses were performed on samples from intervals at 3 to 4 feet and 18 to 19 feet below the ground surface at three locations at the Baier site, including one background boring (BB-1). The results of these analyses indicate that the range of CEC is 86 to 132 meg/100.

The CEC of soil is influenced by the type of silicate clay: montmorillonite - 80-100 meq/100g; illite - 15-40 meq/100g; and, kaolinite - 3-15 meq/100g. Based on results of 287 analyses of clay mineralogy by the Iowa Geological Survey, expandable clay (such as montmorillonite) is the most predominate clay type in glacial tills in southeastern Iowa. The soils beneath the Fort Madison sites are generally uniform with depth, and are typical for the area. Given that the predominant form of clay in the area is montmorillonite, which has a high CEC, adsorption to clays should be a significant attenuation mechanism even at depth for most of the metals of concern. The data verify this assumption.

The water solubility of the metals found at the Fort Madison sites is questionable given that they were initially used as paint pigments. By design, paint pigments are intended to be highly insoluble compounds that resist transport in water. It is unlikely that the pH values associated with the soils at these sites would be sufficient to dissociate the pigments into soluble forms. Therefore, the most likely way that insoluble paint pigments could be transported in the soils would be as particulates migrating through fractures in the weathered till.

The change from oxidizing to reducing conditions, or vise versa, may alter the oxidation state of selected metals. In some instances this alteration may cause a metal to become more or less mobile. The separation between oxidizing and reducing environments at the sites lies at the interface between the relatively thick (38-71 ft.) deposit of weathered (oxidized) glacial till and the even thicker (greater than 150 feet) underlying deposit of unweathered (unoxidized) glacial till. A distinct contrast in color from generally reddish brown to gray marks the division between these oxidation and reducing environments, respectively.

The oxidation environment, in general, is characterized by the presence of free oxygen and iron in the ferric form (Fe+3). The presence of hydrous ferric oxides (limonite and goethite) give a yellowish color to soils. During a dry season, these hydrous oxides may lose their water content and change to red hematite. At intermediate stages or where admixed with manganese oxides, the soils are brown with tints of orange, red and yellow. The gray color of the unweathered till is an indication that the iron has been reduced to a ferrous state (Fe+2) by bacteria.

The following discussion presents specific explanations for attenuation of selected metals:

- Cr6+ is the predominant form of chromium in equilibrium with atmospheric oxygen. However, Cr6+, with its high positive reduction potential, is a strong oxidizing species. The reduction of Cr6+ if present at the sites, is considered likely, particularly since this transformation is more rapid in acidic soils. Acidic conditions are present in the near surface soils beneath the sites. Based on this information it is likely that chromium in soils at relatively shallow depths or below may be in a trivalent form which is much less mobile due to greater adsorption to particulates.

  Trivalent chromium also readily forms precipitates with hydroxides, carbonates, and sulfides in soils. This behavior represents another major mechanism for the observed attenuation in soils at the sites.

- The attenuation of cadmium observed with depth at the sites is believed to be largely attributed to soil pH. Studies by others have demonstrated that cadmium adsorption by soils increased by a factor of three for every pH unit increase between pH 4 and 7.7(ref.). Other studies have shown that cadmium adsorption increased markedly up to pH 8(ref).

- Selenium introduced at the site as a result of the disposal activities was likely in form of cadmium selenite, a common paint pigment used to produce a yellowish color. In this form (selenite) selenium is insoluble and relatively immobile in soil.

  In near surface acidic soil, selenium is likely present as selenite anion which tends to bind with high affinity to iron oxide colloids. In deeper alkaline soils, selenates are believed to be the predominant compound species. This form of selenium is highly soluble in water and exhibits low tendencies to sorb onto soil particles.

- Given the pH conditions found at the Fort Madison sites, any arsenic found on-site is most likely to exist in the pentavalent state, primarily in the form of arsenate compounds. The arsenates are highly insoluble compounds with a high affinity for clays and, thus, are highly immobile. The relatively uniform distribution of arsenic observed with depth on-site is an indication of background arsenic levels instead of transport from surface soils.

5.3.1.2 Volatile Organic Compounds

The volatile organic compounds (acetone, ethylbenzene, toluene, and xylene) found at the sites are generally considered to have moderate mobility in soil with regard to transport processes. Potentially, the most chemically active zone for reduction of volatile organic compound concentrations is expected to be at or near the ground surface. This zone is the most active because the principal mechanisms for removal of these compounds from the soil are volatilization and biodegradation.

With the exception of xylene, the primary mechanism for reduction of VOC concentrations in soil is volatilization. In soils, xylene may be released through volatilization, but a major process regulating fate is likely to be biodegradation.

The VOCs found at the Baier and McCarl sites possess a moderate degree of water solubility. Thus, a major potential pathway for VOCs migrating downward through the soil is percolation with, and in the absence of, water. Factors which affect the migration of VOCs are the same factors which affect the percolation of water. A factor effecting the movement of water and, therefore, movement of VOCs is the highly impermeable nature of the glacial tills. In addition, by nature of their physicochemical properties, the VOCs are themselves moderately retarded.

5.3.2 FATE AND TRANSPORT IN GROUND WATER

Once contaminants enter the shallow water bearing zone, their fate is influenced by the contaminants' physical and chemical properties and the properties of the soils on-site.

Unlike the overlying unsaturated till, where downward percolation of meteoric waters is the primary transport mechanism, transport of contaminants in the shallow ground water zone is controlled by the ground water flow regime. Ground water flow gradients, together with mechanisms of attenuation and dispersion, will affect the rate and direction of movement and the concentrations of the contaminants.

Results of laboratory analyses of ground water samples from the deeper water bearing zone indicate that the contaminants found in the shallow water bearing zone have not migrated to the deeper zone. The reason for this observation is that ground water in the shallow hydrologic units do not communicate with the deeper units because:

- The till that separates the shallow and deep hydrologic units is 70 to 100 feet thick and physically impedes communication; and
- The bulk hydraulic conductivity of the unweathered till between the shallow and deep water bearing zones is very low and the unweathered till is very thick.

Additional evidence that water in the shallow water bearing zone is restricted from moving into the unweathered till and deeper water-bearing zone is indicated by the color change between the weathered and unweathered tills. Ground water in the oxidized weathered till contains free oxygen as evidenced by the yellowish color of the weathered till. The gray color of the unweathered till indicates that these waters containing free oxygen are restricted from moving downward.

The hydrogeologic setting previously described (Section 3.0) also indicates that ground water in the shallow water bearing zone is directed laterally towards drainages adjacent to the sites. The underlying unweathered till serves as a confining layer which, in combination with the proximity of discharge area for ground water in the shallow water bearing zone, prevents deeper percolation of ground water from the shallow water bearing zone.

Based on the discussion above, it is anticipated that contaminated ground water in the shallow water bearing zone is directed laterally towards the adjacent drainages. Deeper migration of contaminated ground water in the shallow water bearing into the unweathered till is not anticipated.

The following sections provide specific discussion on the fate of selected metals and VOCs in the ground water.

5.3.2.1 Metals

With the exception of selenium, the absence of dissolved metals in ground water supports the contention that metals found in surface soils will be strongly retained in the near and surface soil at the sites. Relatively low levels of some of the metals of concern have been detected by metals analysis of unfiltered samples. In most instances the results of dissolved analysis of filtered samples from the same well did not detect the same metal or the concentration level was much lower. A possible exception to this is selenium.

Selenium in ground water was detected at some locations at similar concentrations for both dissolved and total analyses. One possible reason for the occurrence of selenium in this environment may be the soil pH conditions. As previously discussed, in the alkaline soils at deeper depths beneath the sites, selenate is the predominant species. This form of selenium is soluble in water which may explain its presence in ground water samples. In addition, selenate is an anion and therefore will not be adsorbed onto clay minerals found in the water-bearing zones.

5.3.2.2 VOCs

Most of the VOCs found on-site have solubilities which could impact the ground water. However, site-specific factors limit the migration of VOCs through ground water. Indeed, only one shallow well from either site displayed appreciable VOC contamination. This was a shallow well (MW-F) at the Baier site. (A second well at the Baier site exhibited much lower levels of ethylbenzene and xylene.) Importantly, the limited hydrologic connections in the glacial till prevent extensive contaminant migration to the deeper water-bearing unit. Thus, contaminants present in the shallow water-bearing unit are essentially localized because the flow of ground water between the shallow and deep is restricted. Therefore, the most probable ultimate fate of VOCs detected in the shallow well will be discharged towards the sideslopes of adjacent drainages as surface seeps. Once VOCs reach the surface, concentrations will be decreased primarily through volatilization and dilution.

5.3.3 FATE AND TRANSPORT IN SURFACE WATER

Surface water at the sites generally occurs in the form of run-off or ground water seepage. There are no permanent streams or ponds on either site.

Erosion and subsequent transport of contaminated soil or waste caused by surface water run-off does not appear to occur at the sites. This is evidenced by results of sediment sampling in adjacent drainages downstream of the sites, which indicate the contaminants of concern are not migrating off-site.

Some ground water seepage may occur along the drainage pathways at the Baier site; however, these seeps do not appear to offer a source of potential contamination because of the very low seepage rate. What little seepage may occur is rapidly evaporated. In addition, the most likely contaminants to be found in the ground water would be VOCs, which would be volatilized upon exposure to the atmosphere.

5.3.4 FATE AND TRANSPORT IN AIR

Airborne contaminants can be derived from two possible sources:

- Direct volatilization of contaminants in the soil and surface water; and
- Fugitive dust emissions from soil containing adsorbed contaminants.

Volatilization of VOCs occurs via off-gassing from surface soils. This does not appear to be a complete migration pathway for the following reasons:

- VOCs are not present in detectable amounts at the soil/air interface because previous off-gassing has removed most available VOCs from the surface soils; and
- Assuming that the atmosphere functions as an infinite reservoir, the concentrations of VOCs at the point of release would be further reduced by dilution upon release.

Fugitive dust also represents a migration pathway because of the lack of dust-generating sources on both the Baier site or McCarl site. Potential dust emissions are limited by the following factors:

- There is a lack of exposed surface soil due to rocks, leaf litter, and vegetative cover;
- The sites are located in a non-arid climatic region where the surface soil moisture content retards dust formation; and
- Surrounding vegetation provides a wind-break for the sites.

5.4 SUMMARY AND CONCLUSIONS

The mobility and migration of contaminants at the Baier site and McCarl site is governed by a variety of physicochemical, environmental, and site-specific geologic factors. Two general classes of contaminants have been detected at the sites including metals and volatile organic compounds (VOCs).

Generally, the metals appear as the least mobile contaminants at the sites. This is attributed to the general physicochemical properties of metals as well as the specific chemical forms (i.e., paint pigments) present at the sites. The low mobility of metals at the sites is supported by the fact that metal contamination is limited to surface and shallow soils and is absent in ground water.

The potential for mobility is greater for VOCs than metals; however, contamination by this class of compounds also appears localized. Surface soils were not found to contain VOCs because volatilization has effectively removed any of these compounds originally introduced to the surface of the sites. While the moderate mobility of VOCs in soils has resulted in some localized contamination in shallow ground water, the potential for migration to the deeper hydrologic unit appears low because of site-specific geologic factors such as the thickness and impermeability of the till separating the shallow and deep hydrologic units. Therefore, the most probable ultimate fate of the VOCs detected in the shallow well will be discharged towards the sideslopes of adjacent drainages as surface seeps and subsequent volatilization and dilution.

In conclusion, the presence of contaminant metals and VOCs at the Baier and McCarl sites appears localized and the potential for further migration appears limited due to the nature of both the contaminants and the hydrologic characteristics of the sites.

6.0 BASELINE RISK ASSESSMENT AND ECOLOGICAL ASSESSMENT

A baseline risk assessment (RA) was performed to evaluate the potential risks to human health posed by potential soil and ground water contamination at the McCarl site and Baier site. The term baseline refers to the fact that the evaluation of risks is made for the sites in their unremediated state. The results of the RA were used in evaluating potential remedial alternatives for the sites, including the no-action scenario. The RA is presented as Appendix H of the RI report.

An ecological assessment was performed as a companion to the RA. The purpose of this assessment was to qualitatively evaluate the potential effects of the site contaminants on environmental receptors at the sites. A summary of the results of the ecological assessment is also presented in this section, and the Ecological Assessment is presented as Appendix I of the RI report.

The RA was performed using guidance provided in the Risk Assessment Guidance for Superfund, Volume I; Human Health Evaluation Manual (Part A) (USEPA, 1989). Other relevant guidance documents used include the Superfund Exposure Assessment Manual (USEPA, 1988) and the Exposure Factors Handbook (USEPA, 1989). Environmental data and site information obtained during the remedial investigation were used in the RA. In addition, the RA made use of information from recent toxicology literature and USEPA data bases, including the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST).

Two major classes of contaminants were identified in soils and ground water at both sites during the remedial investigation. The contaminants, including metals and volatile organic compounds (VOCs), were detected in areas of each site that were apparently associated with past waste disposal activities. However, surficial soils at both sites were found to contain only metals. This is consistent with the fate and transport characteristics of VOCs since these compound would volatilize from surface soils over an extended period of time. Ground water at both sites was generally found to contain only metals (both primary and secondary drinking water metals) although two shallow monitoring well on the Baier site were found to contain VOCs. This suggests the presence of a localized source of VOCs in the shallow ground water at the Baier site.

An analysis of potential exposure pathways at the sites indicated that surface soil is the medium with the greatest potential for human exposures. Thus, persons entering either site could be exposed to contaminant metals through incidental ingestion or through dermal contact with surface soils. The evaluation of exposure pathways also revealed that the potential for fugitive dust emission at either site is low. Therefore, the exposure pathway linking soil contaminants and human populations through fugitive dust appears incomplete.

The ground water ingestion pathway does not appear to be complete because the characteristics of the water-bearing units indicates that these units are not capable of supplying sufficient water for domestic use. Therefore, the potential for health risks were not evaluated under conditions of current site use. However, a hypothetical scenario for ground water ingestion was evaluated as a potential future use of the Baier site and McCarl site ground water. This scenario was based on the ingestion of ground water adjacent to the sites.

Ground water may appear at the surface via seeps; however, the extent and rate of seepage is not sufficient to create a potential for human exposures. Moreover, the seepages do not result in ponding of water. Thus, exposure to surface water was not considered a complete exposure pathway at the sites.

The RA evaluated potential exposures and health risks for several groups of persons who may enter the site as a result of certain recreational or occupational activities. Because of the rural nature of the site, it was assumed that hunters (both adult and juvenile) may enter the site at various times of the year. Persons involved in collecting wild edibles such as mushrooms and/or berries were also considered for in the exposure scenarios. Under this scenario, it was assumed that both an adult and a child may take part in the activity. Persons who might pass through the sites while hiking were also evaluated in the exposure assessment. Finally, the assumption was made that a farmer might enter the sites from surrounding farmland to cut back brush or trees, etc. These exposure scenarios represent the range of activities and receptors that may likely enter the sites under current land use conditions. Future use evaluations were limited to hypothetical ground water ingestion because these two sites are located several miles from a small town and thus represent very remote sites that may or may not be developed for residential use.

The RA focused on two separate groups of contaminant metals for the Baier site and McCarl site, respectively. The contaminants of concern selected for the Baier site included arsenic, chromium, cadmium, lead, and selenium. The selection of these contaminants was based on the results of soil sampling activities conducted by Woodward-Clyde Consultants pursuant to the Removal Action Work Plan (Woodward-Clyde Consultants, October 1989) and the RI. The contaminants of concern selected for the McCarl site included the five selected for the Baier site plus barium, copper, manganese, and zinc.

Exposure point concentrations were developed using data obtained from surficial soil samples. Potential health risks were evaluated for two levels of exposure: a representative level (i.e., the arithmetic contaminant mean) and a reasonable maximum exposure (RME; i.e., the upper 95th confidence limit of the arithmetic mean used as a worst-case level of exposure).

As presented in Table 6-1, cumulative potential cancer risks were within the 10^{-9} to 10^{-6} range for both dermal and ingestion routes in all scenarios. The highest potential risks were calculated using RMEs. The receptor group with the greatest cumulative potential risks is the farmer scenario at the Baier site, with a risk of 1.2×10^{-6} (based on ingestion). Cumulative risks associated with other receptors/exposure routes, based on the RME data, ranged from 2.4×10^{-9} to 7.6×10^{-7}. Cumulative potential cancer risks were even lower when calculated for more likely exposure concentrations, based on the mean contaminant concentration, with values ranging from 1.2 10^{-9} to 4.0 x 10^{-7}. Because of the relatively poor dermal absorption of arsenic, the greatest potential risks were always associated with the oral route of exposure.

Estimated cancer risks for the hypothetical future ground water use scenario were on the order of 10^{-5}. However, this level of risk corresponds to potential risks associated with background levels of arsenic in ground water.

In general, the potential for non-carcinogenic (i.e., toxic) health hazards does not exist at either site (including future ground water use). However, potential exposures of young children to lead in wastes on the Baier site may warrant concern. The evaluation of potential health hazards posed by lead was performed by estimating blood lead levels that may result from exposure to lead in soil.

Exposure of a young child (e.g. 6 years of age) to areas of lead contamination on the Baier site resulted in estimated blood levels in excess of the USEPA advisory range for blood lead at both the representative and RME levels of exposure. It is noted, however, that exposure point concentrations developed for lead in Baier soils were based on sampling from waste disposal areas only and therefore are not representative of exposure to all of the Baier site soils.

The objective of the ecological assessment was to qualitatively evaluate the potential impacts of contaminated soils and wastes on wildlife and vegetation at the Baier site and McCarl site. The approach used in this ecological assessment is that recommended in the U.S. Environmental Protection Agency's 1989 interim guidance document, "Risk Assessment Guidance for Superfund, Volume II; Environmental Evaluation Manual.

Many of the initial steps used to evaluate potential human health risks were also applicable to the ecological assessment; for example, identification of contaminants of concern and evaluation of potential the releases, migration, and fate of chemicals in the environment. After these initial steps, the next steps in an ecological assessment are to identify wildlife populations and habitats that may be potentially impacted, evaluate the chemical concentrations at these locations and characterize the potential for adverse impacts. Both flora and fauna are considered as potential receptors.

The objective of selecting compounds of concern is to identify a subset of chemicals that represent those chemicals that are the most toxic, environmentally mobile and/or environmentally persistent and that would potentially occur in concentrations sufficient to be threatening to environmental receptors.

The twelve chemicals selected for this ecological assessment are:

- three volatile organic compounds (VOCs) (ethylbenzene, toluene, and total xylenes);
- two semi-volatile compounds (naphthalene and 2-methylnaphthalene); and
- seven metals (arsenic, cadmium, chromium, iron, lead, selenium, and zinc).

The contaminants of concern were selected based on the following criteria:

- The chemicals are considered at least moderately toxic: and
- The persistence of the chemical in the environment may contribute to a potential hazard to biota.

The evaluation of potential ecological exposures is the second step in an ecological assessment. There are four basic elements in evaluating ecological exposure: identifying the environmental transport pathway, identifying exposure points, evaluating the chemical concentrations at the exposure point and evaluating the route or exposure pathway of chemical intake for the wildlife species. These distinct elements which are all necessary in order for wildlife species to be exposed to the chemicals of concern are discussed below:

- An exposure or environmental transport pathway is the mechanism by which chemicals are transported from a source or sources to a wildlife receptor. In this ecological assessment the sources were on-site soils and contaminated sediments.
- The exposure locations or areas of concern in this ecological assessment were the points where wildlife receptors can potentially contact the medium (soil, sediments, or vegetation) on which the chemicals of concern are deposited.
- For a chemical to pose an ecological risk to wildlife, the chemical must travel through environmental media to the exposure point and reach receptors in biologically significant concentrations. The exposure pathway must be complete or there is no hazard. The exposure pathway in this ecological assessment was the release of the chemicals of concern to the soils and sediments, environmental transport of the chemicals to the exposure point and uptake of the contaminated media by a receptor.
- Media uptake routes are the final connection between chemical release and the exposed wildlife. The potential routes included dermal exposure to contaminated soils and sediments and ingestion of contaminated soils, sediments, and vegetation. Ingestion was considered the most important route in this ecological assessment.

There were three terrestrial pathways of concern at the Baier site, soil, sediment and soil/vegetation, and two terrestrial pathways of concern at the McCarl site, soil and soil/vegetation. Within these terrestrial pathways six scenarios were identified at the Baier site involving; earthworms, worm-eating warblers, voles, barn owls, the eastern cotton tail rabbit, the eastern squirrel, and the white-tailed deer and three scenarios were identified at the McCarl site involving; earthworms, worm-eating warblers, mice, barn owls, and raccoons.

None of the wildlife species identified above should be adversely affected by the metals of concern. The concentrations of the metals of concern were within or below those concentrations in the literature that have been documented as having no adverse affects on these species. There is no available literature detailing the effects of volatile organic compounds or semi-volatiles on wildlife; therefore, potential effects of VOCs or semi-volatiles on the wildlife species identified above were not evaluated.

Therefore, the evaluation of the potential effects of the chemicals of concern (for which literature was available) on the wildlife and ecology of the Baier and McCarl sites was these chemicals do not appear to pose a threat to the ecology of these sites.

7.0 NATURE AND EXTENT OF CONTAMINATION

7.1 SUMMARY

The purpose of this section is to summarize the nature and extent of contamination identified at the Baier and McCarl sites. This section focuses on those media which, by the distribution and nature of contamination, may be of potential concern from a public health, environmental or regulatory standpoint. The risk assessment and the ecological assessment (Section 6.0) identify these concerns where they exist based on the RI activities performed to date.

In general, the two media of concern identified at the Baier site and the McCarl site are ground water and soil. Surface water features are limited at, and in the vicinity of, each site. Analytical data generated by sediment sampling indicate that potential impacts to surface water are not of significant concern. Air quality has not been investigated and is not considered to be an important public health concern at the sites because no open waste piles or large areas with the potential for dust generation are present on either site.

As stated in Section 4.0, for purposes of clarity, a definition of contamination is warranted. For this discussion, contamination is used to describe soil or ground water which may exhibit detectable concentrations of chemical compounds that do not necessarily occur naturally in the environment or which may be present at concentrations that exceed site background levels. With this definition, contaminated soil or ground water may require remediation, but their remediation is not implicit when described as contaminated. The risk assessment and the ecological assessment define the potential risk to public health and the environment and were primary considerations, along with ARARs, during the development of remedial action objectives.

Ground water contamination levels were compared to the maximum contaminant level (MCL) as a convenient reference point and for the purpose of comparison only. Use of the MCL as a reference point should not be construed as an indication that the ground water beneath the Baier site and/or McCarl site are regulated drinking water sources.

7.1.1 BAIER SITE

The following two sections describe the nature and extent of contamination of the soil and ground water, respectively, at the Baier site.

7.1.1.1 Soils

A variety of organic and inorganic chemical compounds were identified during the remedial investigation as being present in soil samples at the Baier site. These chemical compounds and their concentrations have been discussed and summarized previously (see Section 4.0). The chemical compounds of potential concern identified in the soil at the Baier site include the metals cadmium, chromium, lead, selenium, and zinc, and the volatile organics toluene, ethylbenzene and xylene. Other metals and organics were detected infrequently and/or in low concentrations. These constituents did not have a major influence on the overall nature and extent of contamination at the site.

Figure 26 presents the extent of soil contamination at the Baier site as determined by adjusted XRF analysis for lead at 350 ppm, for each of the three depth intervals, 0-1 foot, 1-2 feet, and 2-3 feet, respectively. The planar surface areas for each of the selected depth intervals, as shown in Figure 26 are 71,200 square feet (sf), 50,400 sf, and 29,100 sf, respectively. The total estimated volume of contaminated soil at the Baier site is approximately 8,800 cubic yards (cy). [Note: To add a degree of conservatism to the volume calculation, the third interval (2 to 3 feet) was assumed to extended to a total depth of 6 feet below ground surface based on the results of the deep boring sampling and analysis. Therefore, this portion of the calculation was performed over a depth interval of 4 feet.]

The extent of contamination presented in Figure 26 was established based on previous soil sampling activities and the soil sampling performed as part of the RI field activities at the Baier site. To error on the side of conservatism, X-ray fluorescence (XRF) screening data were used as the primary indicator in establishing the limits of contamination at the site. An examination of the soil chemical analyses revealed that lead was the most widespread contaminant of concern. Other potential contaminants were also present wherever lead was present. Therefore, the concentration and extent of lead contaminated soil is a representation of the presence of other potential contaminants present in the soil and overall extent of contaminated site soils. XRF screening of lead as a means to estimate limits of soil contamination was viable due to the quantity and quality of data sets available with incremental depth values.

Verification of the accuracy of the lead XRF screening method as discussed in Section 4.0 was performed prior to utilizing the XRF screening data to establish contaminant extent. Numerous XRF samples were submitted to the lab for verification analysis (lead and other metals) so that XRF values could be compared to actual laboratory values. The verification analysis indicated that the XRF screening provided conservative lead results when compared to the laboratory analysis. Therefore, the XRF data were adjusted or normalized to more closely match the results of laboratory analysis. A statistical analysis was performed on data from both analyses (XRF and laboratory results) which resulted in a correlated equation with lab results as the dependent variable and XRF results as the independent variable (see Appendix J).

Evaluation of the data revealed that, in general, the correlation of the data was slightly different above and below a lead level of 500 ppm as given by XRF. Two different linear regressions were performed on the data: one for those data under 500 ppm, and another for data above 500 ppm. The XRF data were then corrected or adjusted by use of the regression equation.

The resulting normalized data were spatially plotted (as shown in Figure 26) for each one-foot depth interval (0- to 1-foot, 1- to 2-foot, and 2- to 3-foot). A computerized contouring algorithm, utilizing kriging, was then used to generate boundaries for lead in each depth interval. The figure indicates that the concentration of lead decreases rapidly with depth.

Volumes of soil with lead concentrations greater than 350 ppm were estimated in order to establish working limits for the feasibility study. These volume estimates were made by taking the product of the area bounded by the 350 ppm contour and the thickness of each interval. To add a degree of conservatism to the volume calculations, the third interval was extended to a total depth of six feet below ground surface. Results of deep sampling performed as part of the RI field activities indicated that, in every case except one, the soil lead concentrations were below 350 ppm at depths of six feet below ground. Figures 23 and 25 present the data showing the attenuation of lead concentrations and other metals at selected deep boring locations for each site. As previously stated the total estimated volume of contaminated soil at the Baier site is approximately 8,800 cy.

A sample collected by Jacobs Engineering Group (see Figure 2), approximately 10 feet below the drainage ditch head located adjacent to the site on the Fedler property, exhibited a lead concentration of 880 mg/kg (B-Sed-11, Table 4.1-13). A second sample collected 100 feet below the drainage ditch head exhibited a lead concentration of 21.0 mg/kg. This small area of potentially lead contaminated soil in the drainage ditch would result in a volume of contaminated soil ranging from approximately 18 cubic yards (assume 50 feet in length, 2 feet deep, and 5 feet wide) to approximately 50 cubic yards (assume 100 feet in length, 3 feet deep, and 5 feet wide).

7.1.1.2 Ground Water

There are currently 16 ground water monitoring wells and four piezometers at the Baier site. The ground water monitoring well network includes 12 shallow wells and four deep wells. The wells in the Baier site monitoring network have been sampled various numbers of times depending on when they were installed. All wells have been sampled at least two times. In general, ground water samples collected from the Baier site monitoring wells have been analyzed for volatile organic compounds, total and dissolved metals, and general water quality parameters, including alkalinity, chloride, sulfate, hardness, nitrate, total dissolved solids, and total suspended solids. All wells were sampled at least twice for semi-volatile organic compounds. Semi-volatiles were dropped from all wells with the exception of MW-F when it became obvious that they did not represent a problem at the site.

The purpose of this discussion is to summarize the existing ground water data and focus on the general findings concerning the nature and extent of potential ground water contamination. Tables of relevant ground water data related to the monitoring wells at the Baier site are included in Section 4.0. General ground water analytical results are discussed in Section 4.0.

Organic Compounds

A total of 11 volatile organics and four semi-volatile organics have been identified in the ground water samples obtained to date from the Baier site. A list of these compounds and their range of detection is presented below with the exception of MW-F. Data for monitoring well MW-F is presented in Table 4.2-1(g) and is not considered here because of the unique nature of the volatile organic contamination at this location.

Volatile Organics	Range (ug/l)	Number of Detections Above Detection Limit	Total Number of Samples Analyzed
Toluene	ND(5)-12	5	55
Total Xylene	ND(5)-530	2	55
Ethylbenzene	ND(5)-460	2	55
Methylene chloride	ND(5)-8B	11	55
Acetone	ND(10)-9BJ	7	55
1,1,1-Trichloroethane*	ND(5)-96	4	55
Carbon disulfide	ND(5)-13	7	55
Chloroform	ND(5)-10	1	55
Benzene	ND(5)-2J	2	55

*All observed detections occurred in MW-A.

Semi-Volatile Organics	Range (ug/l)	Number of Detections Above Detection Limit	Total Number of Samples Analyzed
bis (2-ethylhexyl) phthalate	ND(10)-23	25	38
Benzoic Acid	ND(50)-3J	2	38
Naphthalene	ND(10)-16	1	38
Di-n-Butylphthalate	ND(10)-2J	1	38

(Note: J indicates on estimated value and B indicates compound found in associated blank also).

A thorough review of the data indicates that the areal extent of volatile organic ground water contamination is generally limited to the area surrounding monitoring well MW-F and MW-J (Figure 28). Volatile organics detected in MW-J (Table 4.2-1(L)) were limited to low concentrations of ethylbenzene and xylene; whereas MW-F has significantly higher levels and a larger number of constituents present.

Confirmation of the localized extent of volatile organic ground water contamination is also provided by a review of the ground water data from MW-E, MW-G and PZ-03 (Tables 4.2-1(F), 4.2-1(H), 4.2-1(Q)). The only volatile organic compound detected at MW-E during five rounds of sampling was carbon disulfide at a concentration of 2J ug/L during the August 1989 sampling event (the initial well sampling). Data from the five rounds of sampling conducted at MW-G indicate that toluene, acetone and chloroform were detected one time each over the 5 sampling events. The detected toluene concentration was 9 ug/l in August 1989. Chloroform was detected in March 1990 at 10 ug/l, and acetone was detected at 5BJ ug/l in June 1990. Methylene chloride was detected three times at concentrations ranging from 1J to 5B ug/l. These questionable sporadic hits and low levels further indicate that ground water contamination by the organic compounds of concern (primarily total xylene, toluene, and ethylbenzene) is localized in the area of MW-F and MW-J as stated above. Piezometer PZ-03, located downslope, was sampled in August 1990 and the only volatile organic compound detected was acetone at a concentration of 3BJ ug/L.

In summary, ground water contamination by organics is limited to a localized area of the Baier site as depicted in Figure 28. Vertical extent is limited to the upper water bearing unit because the deep wells (MW-D2, MW-F2, MW-K2, and MW-L2) do not exhibit the consistent presence of volatile organics at concentrations of concern. Volatile organics detected in deep water bearing unit wells were limited to two hits of toluene; one in MW-D2 at a concentration of 11 ug/l (August 1990), and one in MW-L2 at a concentration of 4J ug/l (July 1990). Five hits (including duplicates) of carbon disulfide, one in MW-D2 at a concentration of 2J ug/l in August 1989 and 4 in MW-F2 (2 environmental samples and 2 duplicates) at concentrations ranging from 2J to 13 ug/l. In addition, acetone was detected one time each in MW-D2 and MW-L2 at concentrations of 4BJ (July 1990) and 9BJ ug/l (July 1990), respectively. The final volatile organic compound observed in a deep well was a single hit of benzene at 1J ug/l detected in MW-L2 during

July 1990 (the initial well sampling). These data indicate that the vertical extent of ground water contamination at the Baier site is limited to the upper water bearing zone in the weathered till.

METALS

The primary drinking water metals arsenic, barium, cadmium, chromium, lead, and selenium were considered when evaluating potential ground water contamination at the Baier site. Concentrations of other detected metals were generally in the range that is considered normal background levels for the glacial till-type material encountered at the Baier site.

A discussion of the total and dissolved metals concentrations is presented in Section 4.0. Tables presenting ground water analytical results for the primary drinking water metals listed above and the secondary drinking water metals (for informational purposes) are also presented in Section 4.0.

A general summary of the total and dissolved primary drinking water metals identified as being of potential concern and their concentration ranges is presented below:

TOTAL

Analyte	Range (ug/l)	MCL	Number of Detections Above MCL	Number of Times Not Detected	Total Number of Samples Analyzed
Arsenic	ND(1) - 22.9	50	0	14	56
Barium	21.1B - 1920	1000	3	0	56
Cadmium	ND(3.0) - 6.1	10	0	54	56
Chromium	ND(8.0) - 276	50	11	3	56
Lead	ND(1.0) - 232	50	2	15	56
Selenium	ND(1.0) - 150	10	10	41	56

DISSOLVED

Analyte	Range (ug/l)	MCL	Number of Detection Above MCL	Number of Times Not Detected	Total Number of Samples Analyzed
Arsenic	ND(1.0) - 8.1B	50	0	43	57
Barium	ND(5.0) - 814	1000	0	1	57
Cadmium	ND(3.0) - ND(5.0)	10	0	57	57
Chromium	ND(5.0) - 8.5B	50	0	55	57
Lead	ND(1.0) - 13.0B	50	0	53	57
Selenium	ND(1.0) - 178	10	12	40	57

(**Note:** The above summaries do not contain information related to the initial sampling event at MW-K1, MW-K2 and MW-L2. These wells exhibited unusually high levels of total metals which are attributed to inadequate initial well development and resulting heavy sediment loading. The high total metals concentrations in these wells were not confirmed by subsequent verification sampling events. Thus, metals data generated during the initial sampling event are considered spurious and are not considered here).

Four metals (barium, chromium, lead, and selenium) were identified in the total metals fraction at concentrations exceeding their respective primary drinking water regulations (MCL). However, barium and lead were only identified three times and two times, respectively above their MCLs. In addition, the exceedances were all reported in shallow water bearing unit wells.

Barium exceeded its MCL of 1000 ug/l in well MW-C (1160 ug/l in March 1990), MW-G (1920 ug/l in June 1990) and MW-J (1730 ug/l in June 1990). [Note: June 1990 was the initial sampling event at MW-J and inadequate monitoring well development and heavy sediment loading may have resulted in the high value.] The maximum total barium concentrations identified in these wells during the other sampling events were 512 ug/l (MW-C, December 1989), 305 ug/l (MW-G, September 1989), and 167B ug/l (MW-J, June 1990 verification sampling). It should be noted that EPA has proposed raising the barium MCL to 5000 ug/l. A revision to this number would result in all total barium detections being below the revised primary drinking water standard.

Total lead exceeded its MCL of 50 ug/l in well MW-C in March 1990, and in well MW-J in June 1990, during the initial sampling. Total lead concentrations observed in MW-C and MW-J during these sampling events were 127 and 232 ug/l, respectively. The maximum total lead concentration observed in these wells during other sampling events were 38.6 ug/l (MW-C) and 4.98 ug/l (MW-J). The concentration of total lead observed in MW-J during verification sampling was almost 50 times lower than the concentration observed during the initial sampling (i.e. 4.9 versus 232 ug/l). This factor indicates that the initial total metals results (including lead) were very probably impacted by inadequate well development and heavy sediment loading.

Total chromium levels above the current MCL of 50 ug/l were reported on 11 occasions. MCL exceedances were reported in MW-A, MW-C, MW-E, MW-G, MW-H, MW-I, MW-J, and MW-L1. Total chromium values above the MCL in these wells ranged from 57 ug/l (MW-H, August 1989) to 276 ug/l (MW-C, March 1990). Eight of the eleven detections were below the proposed chromium MCL of 100 ug/l. The only wells exhibiting total chromium values above 100 ug/l were MW-C (130 ug/l in December 1989 and 276 ug/l in March 1990) and MW-J (170 ug/l in June 1990, during the initial sampling event). The total chromium verification sampling event at MW-J indicated a concentration of 15.3 ug/l. This is further evidence of the impact that sediment loading (from inadequate well development), may have had on the initial sampling event.

The total metal analyte which exhibited the greatest number of detections above its respective MCL was selenium. Total selenium above the current MCL of 10 ug/l was detected on 10 occasions. [Note: EPA has proposed to raise the MCL for selenium to 50 ug/l. This would result in four detections above the MCL, all occurring in MW-D1]. Total selenium concentrations above the current MCL were observed in MW-C in August 1989, December 1989, and June 1990. During this period, total selenium values ranged from 28.2 to 41.6 ug/l. Total selenium concentrations exceeding the MCL were also observed four times in MW-D1. During the four sampling events conducted between August 1989 and August 1990, total selenium values in MW-D1 ranged from 94.0 to 150 ug/l.

The remaining three selenium concentrations which exceeded the MCL were 24.7 ug/l in June 1990 (MW-E), 46.0B ug/l in June 1990 (MW-K1 verification) and 11.8 ug/l in July 1990 (MW-L1 initial sampling event).

Selenium was the only dissolved metal analyte detected above its MCL. Dissolved chromium and dissolved lead were detected two times and four times at maximum concentrations of 8.5B ug/l and 13.0B ug/l, respectively, which are far below their respective MCL's.

Selenium, in the dissolved fraction, was detected above its MCL on 12 occasions. As with the total selenium values, wells MW-C and MW-D1 exhibited the most frequent dissolved selenium detections above the MCL. [Note: At the proposed MCL of 50 ug/l, dissolved selenium would have exceeded the MCL only five times - once in MW-C, and four times in MW-D1]. Concentrations of dissolved selenium in MW-C ranged from 47.4 to 50.4 ug/l during the four sampling events conducted between August 1989 to June 1990. Well MW-D1 exhibited dissolved selenium values above 10 ug/l in August 1989, September 1989, July 1990, and August 1990 ranging from 124 ug/l to 178 ug/l.

The remaining four dissolved selenium detections above the MCL were reported in MW-B (84.0B ug/l in August 1989), MW-E (25.1 ug/l in June 1990), MW-K1 (33.7 ug/l in June 1990 verification sampling) and MW-L1 (13 ug/l in August 1990 verification sampling).

The above summary from the ground water data collected to date indicates that metals contamination of ground water at the Baier site by metals is limited to dissolved selenium at concentrations exceeding the current MCL.

Although USEPA has issued a study containing findings and recommendations that the use of a 0.45 micron filter was not useful, appropriate, or reproducible in providing information on metals mobility or in the determination of truly dissolved constituents in ground water systems, the dissolved metals fraction was selected to represent potential ground water contamination and current ground water conditions at the Baier site. The paper by Puls and Barcelona (USEPA, 1989) generally addresses the transport of colloidal (clay size) materials through sand or sand and gravel aquifer materials. However, the geologic conditions at the Baier site primarily consists of fine grained materials (clay and silt) with discontinuous lenses of silty or clayey sand. It is, therefore, concluded that the passage of suspended colloidal materials through these deposits is limited because the formation primarily consists of similar sized materials. Therefore, the dissolved metals fraction was selected to represent potential ground water contamination and current ground water conditions at the Baier site for the following reasons:

- Monitoring wells completed in low-yield, clay-rich sediments often result in ground water samples containing filterable solids which are not truly representative of aquifer or perched water conditions (Kent, et al 1988);
- Metals adsorbed to sediment entering a monitoring well may adversely impact the analysis for total metals by desorbing during the field preservation process, therefore, constituents of interest that may occur naturally in the formation matrix may be dissolved when acidified and result in a sample that is not representative of the water contained in the aquifer (Kent, et al 1988).
- Filtration is necessary to analyze samples for inorganic constituents which are acidified before or during analysis. Acidification may release ions held on particles and alter the constituent chemistry of the solution (EPA, 1987).
- Installation of monitoring wells inhibits the capacity of an aquifer or perched water bearing unit to filter sediment from the ground water in the area of the monitoring well borehole.

In addition, the User's Guide to the Contract Laboratory Program cautions that if the sample contains a significant particulate fraction, acidification without filtration could result in deceptively high metals values for the water sample (USEPA, 1986). To assess this potential for impact to the total metals results, total suspended solids were collected and analyzed in March 1990 and June 1990. During these two sampling events, 17 of the 26 total metals detections above an MCL occurred. During these same sampling events in wells that exhibited a total metal above an MCL, total suspended solids ranged from 348 mg/L to 7,300 mg/L with an average of 2023 mg/L.

It is therefore concluded that total metals concentrations observed in the ground water do not accurately represent metals contamination of the ground water at the Baier site. The areal extent of ground water contamination by metals at the Baier site is therefore generally defined by monitoring wells MW-C and MW-D1. Since concentrations of dissolved selenium above the MCL were only reported once in MW-B, MW-E, MW-K1, and MW-L1 and since these values only range from 13 ug/l to 33.7 ug/l (below the proposed limit of 50 ug/l). These wells are not considered in an evaluation of areal extent of potential ground water contamination by selenium.

The areal extent of ground water contamination by metals is generally limited to the area encompassing monitoring wells MW-C and MW-D1 and is approximately depicted on Figure 28. The vertical extent of potential ground water contamination by selenium is also defined by these wells because the deep water bearing unit wells (MW-D2, MW-F2, MW-K2, and MW-L2) did not exhibit concentrations of selenium in the total or dissolved fraction above the MCL. In fact, deep water bearing unit wells (with the exception of data generated in MW-K2 and MW-L2 during the initial sampling event, which was discounted because of inadequate monitoring well development) did not exhibit the presence of any of the metals of concern in the total or dissolved fraction above their respective MCLs. This indicates that any potential ground water contamination by metals is confined to the upper water bearing unit in the vicinity of MW-C and MW-D1, as described above.

SUMMARY

In conclusion, the areal and vertical extent of ground water contamination at the Baier site is limited to two discrete areas. Contamination by volatile organics is confined to the area encompassing monitoring wells

MW-F and MW-J (see Figure 28). Contamination by metals, which is defined by the presence of dissolved selenium because of the heavy sediment loading and biased total metals results, is limited to the area encompassing MW-C and MW-D1 (see Figure 28). The vertical extent is limited to the upper water bearing unit, as none of the deep water bearing unit wells at the Baier site exhibited volatile organic or metals contamination.

7.1.2 MCCARL SITE

The following two sections describe the nature and extent of contamination of the soil and ground water, respectively, at the McCarl site.

7.1.2.1 Soils

A variety of organic and inorganic chemical compounds were also identified in soil samples during the remedial investigation at the McCarl site. These chemical compounds and their concentrations have been previously discussed and summarized in Section 4.0. The chemical compounds of potential concern include the metals cadmium, chromium, lead, selenium, and zinc and the volatile organics toluene, ethylbenzene, and xylenes. Other metals and organics were detected infrequently and at low concentrations. These constituents did not have a major influence on the overall nature and extent of contamination at the site.

Figure 27 presents the extent of soil contamination at the McCarl site, as determined by adjusted XRF analysis for lead at 350 ppm, for each of the three depth intervals, 0- to 1 - foot, 1- to 2 - foot, and 2- to 3 ft, respectively. The extent of contamination presented in Figure 27 was established based on previous soil sampling activities and the soil sampling performed as part of the RI field activities at the McCarl site. These data indicate that lead is the most widespread contaminant of concern and the other potential contaminants are present wherever lead is present. The concentration and extent of lead contaminated soils is a relative indication of the presence of other potential contaminants present in the soil. Therefore, to error on the side of conservatism XRF screening data were used as the primary indicator to establish the limits of site contamination as discussed in Section 7.1.1.1.

The planar surface areas for each of the selected depth intervals as shown on Figure 27 are approximately 22,950 sf, 7,300 sf, and 6,400 sf, respectively. Based on the 350 ppm level, the total estimated volume of contaminated soil at the McCarl site is approximately 2,100 cubic yards (cy).

7.2.1.2 Ground Water

There are currently 11 ground water monitoring wells at the McCarl site, eight shallow wells and three deep wells. The wells have been sampled various numbers of times, depending on when they were installed. All wells at the McCarl site have been sampled at least twice with the exception of MC-4B, which has been dry since installation, and MC-7, which was initially dry after installation. Well MC-4B has never been sampled because it was dry following installation and remains dry to date. MC-7 has been sampled once. Relevant ground water data tables related to the monitoring wells at the McCarl site are discussed in Section 4.0 and presented in Table 4.4.

Ground water samples collected from the McCarl site monitoring wells have been analyzed for volatile organic compounds, total and dissolved metals, and general water quality parameters, including alkalinity, chloride, sulfate, hardness, nitrate, total dissolved solids, and total suspended solids. All wells were sampled at least twice for semi-volatile organic compounds. These parameters were dropped when semi-volatiles were determined to not be a problem.

A variety of metals have been detected in the ground water samples collected from the McCarl site. A few organics, including volatile and semi-volatile organics, have also been detected. Specific analytical results were discussed in Section 4.0. This discussion attempts to focus on the general findings related to the nature and extent of potential ground water contamination at the McCarl site.

Organic Compounds

A total of six volatile organics and four semi-volatile organics were identified in the ground water samples obtained from the McCarl site. A list of these compounds and their range of detections is presented below:

Volatile Organics	Range (ug/l)	Number of Detections Above Detection Limit	Total Number of Samples Analyzed
Toluene	ND(2)-2J	1	35
Acetone	ND(10)-3BJ	5	35
Methylene Chloride	ND(5)-7B	11	35
2-Butanone	ND(10)-3J	1	35
Carbon Disulfide	ND(5)-51	9	35
1,2-Dichloropropane	ND(5)-3J	4	35

Semi-Volatile Organics	Range (ug/L)	Number of Detection Above Detection Limit	Total Number of Samples Analyzed
Benzoic Acid	ND(50)-2J	1	22
bis(2-Ethylhexyl) Phthalate	ND(10)-79B	18	22
Di-n-Octyl-Phthalate	ND(10)-8BJ	2	22
Butylbenzylphthalate	ND(10)-6J	1	22

[Note: J indicates an estimated value and B indicates compound found in associated blank also.]

A review of the data summary indicates that the relatively small number of organic detections and their low concentrations do not represent organic contamination of ground water at the McCarl site. With the exception of carbon disulfide, every volatile organic compound detected was either J-coded or B-coded, as defined above. In addition, three of the nine carbon disulfide hits were also J-coded. Furthermore, carbon disulfide was not identified as a volatile organic contaminant of concern in the soil.

Carbon disulfide was absent from the soil samples obtained and there is no known source for the material at the McCarl site.

Concentrations of organics which exceed published drinking water regulations or other health-based criteria are not present in the ground water at the McCarl site, and no further consideration is warranted. (Note: Comparison to the MCL was made as a convenient reference point only. The use of the MCL as a reference point does not imply that the ground below the McCarl site is a regulated drinking water source).

METALS

The primary drinking water metals (arsenic, barium, cadmium, chromium, lead and selenium) were considered when evaluating potential ground water contamination at the McCarl site. Concentrations of other detected metals were generally in the range that is considered normal background levels for the glacial till-type material found at the McCarl site. Total ard dissolved metals data is discussed in detail in Section 4.0 and tables presenting ground water results for the primary drinking water metals listed above and the secondary drinking water metals (for informational purposes) are also presented in Section 4.0.

A summary of the total and dissolved primary drinking water metals and their concentration ranges is presented below:

TOTAL

Analyte	Range (ug/l)	MCL	Number of Detections Above MCL	Number of Times Not Detected	Total Number of Samples Analyzed
Arsenic	ND(1.0) - 20.3	50	0	16	35
Barium	53.8B - 1050	1000	1	0	35
Cadmium	ND(3.0) -ND(5.0)	10	0	35	35
Chromium	ND(5.0) - 130	50	6	5	35
Lead	ND(2.0) - 57.1	50	1	5	35
Selenium	ND(1.0) - 139	10	18	14	35

DISSOLVED

Analyte	Range (ug/l)	MCL	Number of Detection Above MCL	Number of Times Not Detected	Total Number of Samples Analyzed
Arsenic	ND(1.0)-2.9B	5	0	30	35
Barium	32.1B-360	1000	0	0	35
Cadmium	ND(3.0)-ND(5.0)	10	0	35	35
Chromium	ND(5.0)-5.6B*	50	0	34	35
Lead	ND(1.0)-1.1B*	50	0	34	35
Selenium	ND(1.0)-244	10	19	12	35

*Indicates only detection

(**Note:** The above summaries do not contain information related to the initial sampling event at MC-6C. This well exhibited unusually high levels of total metals which are attributed to inadequate initial well development and resulting heavy sediment loading. The high total metals concentrations in this well were not confirmed by subsequent sampling events. The high total metals concentrations in this well were not confirmed by subsequent sampling events. Thus, metals data generated during the initial sampling event are considered spurious and are not considered here).

Four metals (barium, chromium, lead, and selenium) were identified in the total metals fraction at concentrations exceeding their respective primary drinking water regulations (MCL). However, barium and lead were only identified once each above their respective MCLs. Barium exceeded its MCL of 1000 ug/l in well MC-4A during the August 1989 sampling event, when barium was detected at a concentration of 1050 ug/l. It should be noted that this was the initial sampling event conducted in MC-4A following installation and inadequate well development may have resulted in higher than normal total metals concentrations, as all total metals values from MC-4A were elevated during this sampling event. The maximum total barium concentration in MC-4A during subsequent sampling events was 419 ug/l which is well below the current MCL.

Lead exceeded its MCL of 50 ug/l only once. This exceedance was recorded in well MC-1 during the December 1989 sampling event, when a concentration of lead at 57.1 ug/l was observed. Based on observed water level information, well MC-1 is generally considered upgradient of the site and this single total lead level above the MCL is considered an anomaly. The maximum concentration of total lead reported during the other sampling events at MC-1 was 10.6 ug/l in August 1989.

Total chromium levels above the MCL of 50 ug/l were reported on six occasions. [Note: EPA has proposed to raise the MCL for chromium to 100 ug/l]. Total chromium was detected at 908 ug/l in well MC-3 during the August 1989 sampling, in well MC-3C at 125 ug/l during the June 1990 sampling event (the initial sampling event), at 102 ug/l in well MC-4A during the June 1990 sampling event, at 80.6 ug/l and 125 ug/l in well MC-6 during the December 1989 and March 1990 sampling events, respectively. Total chromium was also detected in well MC-6C during the August 1990 re-verification sampling event, when total chromium at a concentration of 130 ug/l was observed.

The metal analyte which exhibited the greatest number of detections above its respective MCL for total metals analysis was selenium. Eighteen occurrences of total selenium above its MCL of 10 ug/l were reported. Total selenium detections above the current MCL were observed during the August 1989, December 1989, March 1990, and June 1990 sampling events in wells MC-2, MC-3, MC-5, and MC-6. These four shallow water-bearing zone wells account for all 18 total selenium detections above the current MCL. [Note: At the proposed MCL of 50 ug/l, there would have been 11 total selenium detections above the MCL.]

Total selenium concentrations ranged from 45.0 to 78.3 ug/l and 94.0 to 139 ug/l in wells MC-2 and MC-3, respectively. Total selenium concentrations in MC-5 and MC-6 ranged from 30.1 to 76.4 ug/l and 85.0 to 133 ug/l, respectively.

Selenium was the only dissolved metal analyte detected above its MCL. Selenium was detected in the dissolved phase above its MCL on 19 occasions. [Note: At the proposed MCL of 50 ug/l, there would have been 14 dissolved selenium detections above the MCL.] As exhibited by the trend of total selenium, wells MC-2, MC-3, MC-5, and MC-6 exhibited dissolved selenium concentrations above the MCL of 10 ug/l during the August 1989, December

1989, March 1990, and June 1990 sampling events. Dissolved selenium concentrations in MC-2 and MC-3 ranged from 56.1 to 140 ug/l and 83.0 to 179 ug/l, respectively. Dissolved selenium ranges of 27.0B to 82.3 ug/l and 150 to 244 ug/l were reported in MC-5 and MC-6, respectively. In addition, a dissolved selenium concentration of 48.0B ug/l was reported in well MC-7 during an August 1990 sampling event. This is the only time this well has been sampled to date.

In summary, the ground water data collected to date indicates that metals contamination of ground water at the McCarl site is limited to dissolved selenium at concentrations exceeding the current MCL.

As stated in Section 7.1.1.2, although USEPA has issued a study containing findings and recommendations that the use of a 0.45 micron filter was not useful, appropriate, or reproducible in providing information on metals mobility or in the determination of truly dissolved constituents in ground water systems, the dissolved metals fraction was selected to represent potential ground water contamination and current ground water conditions at the McCarl site. The paper by Puls and Barcelona (USEPA, 1989) generally addresses the transport of colloidal (clay size) materials through sand or sand and gravel aquifer materials. However, the geologic conditions at the McCarl site are much different and more complex than those presented in the study. The glacial till beneath the site primarily consists of fine grained materials (clay and silt) with discontinuous lenses of silty or clayey sand. It is, therefore, concluded that the passage of suspended colloidal materials through these deposits is limited because the formation primarily consists of similar size materials. Therefore, the dissolved metals fraction was selected to represent potential ground water contamination and current ground water conditions at the McCarl site for the following reasons:

- Monitoring wells completed in low-yield, clay-rich sediments often result in ground water samples containing filterable solids which are not representative of true aquifer or perched water conditions (Kent et al 1988);

- Metals absorbed to sediment entering a monitoring well may adversely impact the analysis for total metals by desorbing during the field preservation process, therefore constituents of interest that may occur naturally in the formation matrix may be dissolved when acidified and result in a sample that is not representative of the water contained in the aquifer (Kent et al 1988).
- Filtration is necessary to analyze samples for inorganic constituents which are acidified before or during analysis. Acidification may release ions held on particles and alter the constituent chemistry of the solution (EPA, 1987).
- Installation of monitoring wells inhibits the capacity of an aquifer or perched water bearing unit to filter sediment from the ground water in the area of the monitoring well borehole.

In addition, the User's Guide to the Contract Laboratory Program cautions that if the sample contains a significant particulate fraction, acidification without filtration could result in deceptively high metals values for the water samples (USEPA, 1986). To assess this potential for impact to the total metals results, total suspended solids were collected and analyzed in March 1990 and June 1990. During these two sampling events, 12 of the 26 total metals detections above an MCL occurred. During these same sampling events in wells that exhibited a total metal above an MCL, total suspended solids ranged from 130 mg/L to 1940 mg/L with an average of 690 mg/L.

It is therefore concluded that the total metals concentrations observed in the ground water do not represent metals contamination of the ground water at the McCarl site. The areal and vertical extent of ground water contamination is generally defined by dissolved selenium concentrations in monitoring wells MC-2, MC-3, MC-5, MC-6, and MC-7 (see Figure 29). None of the deep water bearing unit wells (MC-3C, MC-4C, and MC-6C) exhibited concentrations of selenium in the total or dissolved fraction above the MCL. However, it should be pointed out that both MC-3C (125 ug/l in June 1990) and MC-6C (130 ug/l in August 1990) exhibited chromium above the current MCL in the total metals fraction. However, the concurrent dissolved chromium fractions were both non-detectable (ND(5) well MC-3C and ND(10) MC-6C). This indicates that the deep water bearing zone has not been impacted by contaminants identified in the site soils.

7.2 FEDLER PROPERTY

No contamination by organic compounds or metals was discovered at the alleged Fedler "farm dump" and drainage ditch heads, based on the investigation conducted by Jacobs Engineering on behalf of USEPA and the analytical data generated by USEPA and Du Pont for these areas. Organic compounds were generally absent and metals were within normal background ranges, as reported in the literature and observed in the area. Data related to the Fedler property are summarized and discussed in Section 4.0.

8.0 CONCLUSIONS

The following conclusions have been reached on the basis of the observations made and data collected during the Remedial Investigation at the Baier site and the McCarl site.

8.1 BAIER SITE

- Waste material generated as a result of the paint manufacturing process was disposed and is evident at the site.
- The waste material and surrounding soils contain a variety of organic and inorganic chemicals with total xylenes, toluene, ethylbenzene, arsenic, barium, cadmium, chromium, lead, selenium, and zinc being the primary constituents.
- The primary contaminants of concern are lead (soils) and toluene, xylene, ethylbenzene, and dissolved selenium (ground water). Secondary contaminants of concern in ground water include acetone, 2-butanone, and 4-methyl-2-pentanone.
- The areal extent of lead contamination defines the surface area of contamination at the site.
- In general, metals contamination rapidly attenuates with depth and has dropped to a level of 350 ppm lead or background by four feet below ground surface or the waste/soil interface.
- Isolated areas of the upper water bearing unit beneath the site have been impacted by site-related contaminants. One isolated area has been impacted by volatile organics (primarily toluene, ethylbenzene, xylene and secondarily, acetone, 2-butanone, and 4-methyl-2-pentanone) and a second isolated area has been impacted by dissolved selenium.
- There is no evidence that the deeper water bearing unit beneath the site (waters contained in the unweathered till) has been impacted by site activities.
- High concentrations of lead appear to be the primary risks to human health at the site. The other contaminants of concern do not pose public health concerns based on their concentrations at the site.
- There has been no documented impact to the environment or ecology related to the contaminants of concern at the site.
- There are approximately 8,800 cy of contaminated soil at the Baier site based on a level of 350 ppm lead.

- The head of the drainage ditch located on the Fedler property adjacent to the site exhibited elevated lead levels and may contain between 18 and 50 cubic yards of potentially lead contaminated soil/sediment.

8.2 MCCARL SITE

- Waste material generated as a result of the paint manufacturing process was only minimally evident at the site.
- Site soils contain a variety of organics including toluene, xylene, and ethylbenzene and inorganics with metals contamination being far more widespread than organics contamination.
- The primary contaminants of concern are lead (soils) and dissolved selenium (ground water).
- The areal extent of lead concentration defines the surface area of contamination at the site.
- In general, metals contamination rapidly attenuates with depth and has dropped to a level of 350 ppm lead or background by four feet below ground surface.
- Data generated to date indicate the upper water bearing unit beneath the McCarl site has not been impacted by organics contamination.
- The upper water bearing unit beneath the McCarl site has been impacted by and contains elevated levels of total and dissolved selenium above the current MCL.
- There is no evidence that the deeper water bearing unit beneath the McCarl site (waters contained in the unweathered till) has been impacted by site activities.
- High concentrations of lead appear to be the primary risks to human health at the site. Other contaminants of concern do not pose public health concerns based on their concentrations at the site.
- There has been no documented impact to the environment or ecology related to the contaminants of concern at the site.
- There are approximately 2,100 cy of contaminated soils at the McCarl site based on a level of 350 ppm lead.

8.3 FEDLER PROPERTY

- No contamination by organic compounds or metals was discovered at the alleged Fedler "farm dump" or drainage ditch heads located along the access road.

8.4 DATA LIMITATIONS AND RECOMMENDATIONS FOR FURTHER WORK

The RI/FS activities conducted at the Baier site and McCarl site, Lee County, Iowa, were all performed in general accordance with the EPA approved project documents, dated March 19, 1990. However, as with any large data gathering activity, data limitations are inherent in the data gathering process. A review of the data collected to date indicates that data quantity and quality are sufficient for the Baier site and McCarl site. Therefore, no additional data were required at this time to complete the preparation of the risk assessment, ecological assessment, and the feasibility study.

8.5 RECOMMENDED REMEDIAL ACTION ALTERNATIVES

A preliminary screening of potential remedial action alternatives was conducted during the preparation of the RI/FS project plans and refined during the RI field work and early stages of the Feasibility Study. Based on the current knowledge of site conditions and the, nature and extent of contamination, the remedial action scenarios which will be further evaluated in detail during the FS include:

- No action;
- Capping of the contaminated soils to prevent direct contact and minimize future infiltration;
- Excavation of contaminated soils and disposal in a RCRA landfill;
- Solidification of contaminated soils at each site;
- Soil washing treatment technologies for contaminated soils;
- In-situ bioremediation of soil and ground water contamination;

- Incineration or other thermal destruction technologies for contaminated soils;
- Extraction treatment and NPDES discharge of contaminated ground water at the Baier site and McCarl site;
- Collection of contaminated ground water and disposal into a local publicly-owned treatment works; and
- Some combination of the above.

On the basis of the above findings, a companion feasibility study for the Baier site and McCarl site was prepared.

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TABLE 1-1

CHRONOLOGY OF DISPOSAL AND TECHNICAL ACTIVITIES CONDUCTED AT THE BAIER SITE AND MCCARL SITE

Date	Event
04/49 - 11/53	Baier site utilized by Charles Knoch for the disposal of paint waste generated by E. I. Du Pont de Nemours, Fort Madison, Iowa.
11/52 - 11/53	McCarl site utilized by Charles Knoch for the disposal of paint waste generated by E.I. Du Pont De Nemours, Fort Madison, Iowa, when the Baier site was inaccessible.
11/53	Du Pont terminates agreement with Charles Knoch for waste hauling services.
11/79	Du Pont responds to Eckhardt subcommittee survey.
09/80	Ecology & Environment (E&E) Field Investigation Team (FIT) conducts a preliminary site assessment at the Baier site.
10/80	E&E FIT presents the results of their preliminary site assessment and EPA requests E&E to conduct a field investigation at the Baier site.
04/83	E&E FIT conducts a field investigation at the Baier site. Soil samples and surface water samples are collected for chemical analysis.
1984	Du Pont identifies the McCarl site in a 3007 response to USEPA.
01/85	Lee County Health Department samples two residential wells just west of the McCarl site (Sadie King and John Glascow residences).
04/85	Iowa Department of Water, Air and Waste Management conducts a preliminary assessment of the McCarl site and recommends further work at the site.
07/85	E&E FIT installs three ground water monitoring wells at the Baier site.
08/85	E&E FIT conducts the initial round of ground water sampling at the Baier site.
03/86	E&E FIT resamples the ground water monitoring wells at the Baier site.

TABLE 1-1
(Continued)

CHRONOLOGY OF DISPOSAL AND TECHNICAL ACTIVITIES CONDUCTED AT THE BAIER SITE AND MCCARL SITE

Date	Event
07/86	E&E FIT conducts an initial site investigation at the McCarl site. Three ground water monitoring wells are installed. Ground water, surface water, and soil samples are collected for chemical analysis.
04/87	E&E FIT conducts a ground water sampling event at the McCarl site. Du Pont obtains splits of the samples collected.
06/88	The Du Pont (County Road X23) site (Baier site and McCarl site) is included in the "Proposed Update 7 Sites" for inclusion on the National Priorities List (NPL).
07/88	Du Pont collects ground water samples from the wells at the Baier site and McCarl site.
02/89	Du Pont meets with USEPA regarding the Baier site and McCarl site. USEPA provides Du Pont with a draft "Administrative Order On Consent".
03/89	Du Pont responds to USEPA after reviewing the draft Administrative Order on Consent and states that they remain interested in trying to come to some mutually acceptable and environmentally satisfactory resolution of the issues associated with the Baier and McCarl sites but find the Order unacceptable.
04/89	Du Pont retains Woodward-Clyde Consultants (WCC) as its technical consultant.
05/1/89	WCC conducts initial site visits to the Baier site and McCarl site.
05/12/89	Du Pont and WCC attend a meeting with USEPA to present the scope of work for the Initial Site Assessments and view a videotape of the site visit.

TABLE 1-1
(Continued)

CHRONOLOGY OF DISPOSAL AND TECHNICAL ACTIVITIES CONDUCTED AT THE BAIER SITE AND MCCARL SITE

Date	Event
05/26/89 (week ending)	WCC conducts initial site assessments at the Baier site and McCarl site. Activities included hand augering/probing, test pit excavation, and soil/waste, and ground water sample collection.
05/31/89	Du Pont, USEPA, and WCC participate in a conference call in which the preliminary findings from the initial site assessments were provided to USEPA. In addition, subsequent project scope and direction was also discussed.
06/09/89	WCC initiated preparation of a "Focused Ground Water Investigation Work Plan and an Engineering Evaluation and Cost Analysis (EECA) scope of work which included a preliminary evaluation of potential response actions. [Note: EECA was subsequently completed as the Removal Action Workplan (RAW).]
06/27/89	WCC transmits draft "Work Plan for the Focused Ground Water Investigation, Baier Site and McCarl Site" and "Addendum to the Abbreviated Sampling and Analysis Plan" to Du Pont.
07/05/89	USEPA issues a Unilateral Administrative Order.
07/12/89	WCC transmits final "Work Plan for the Focused Ground Water Investigation, Baier Site and McCarl Site" and "Health and Safety Plan and Addendum I to the Health and Safety Plan" to Du Pont.
07/16/89	WCC mobilizes field crew(s) to Fort Madison, Iowa to conduct additional source area characterization at the Baier site and the focussed ground water study at the Baier site and McCarl site.
08/89	WCC conducts a quarterly ground water sampling event on the existing and newly installed ground water monitoring wells at the Baier site and McCarl site.

TABLE 1-1
(Continued)

CHRONOLOGY OF DISPOSAL AND TECHNICAL ACTIVITIES CONDUCTED AT THE BAIER SITE AND MCCARL SITE

Date	Event
09/89	WCC conducts a verification ground water sampling event on the newly installed ground water monitoring wells at the Baier site and McCarl site.
10/89	Du Pont submits RAW for the Baier site to USEPA.
12/89	WCC conducts a quarterly ground water sampling event on the monitoring wells at the Baier site and McCarl site.
01/24/90	Du Pont, WCC, and Stinson Mag meet with USEPA. USEPA agrees to defer the Baier site removal and Du Pont agrees to undertake a RI/FS at the Baier site and McCarl site.
01/29/90	Du Pont submits a proposed RI/FS schedule to USEPA.
02/07/90	USEPA issues an Amendment to the July 5, 1989 Unilateral Administrative Order.
02/07/90	WCC initiates preparation of RI/FS Work Plan and supporting documents.
03/03/90	Du Pont completes the installation of continuous fencing around the Baier site.
03/19/90	WCC submits draft RI/FS Work Plan and supporting documents to USEPA.
04/03/90	USEPA, DuPont, WCC, and Jacobs Engineering participate in a technical review conference on the draft Work Plan and associated planning documents.
04/20/90	USEPA transmits comments on the draft RI/FS Work Plan and companion project documents.
04/23/90	WCC initiates RI/FS field activities.
05/04/90	WCC on behalf of DuPont transmits responses to the USEPA comments on the draft RI/FS Work Plan and companion documents.

TABLE 1-1
(Continued)

CHRONOLOGY OF DISPOSAL AND TECHNICAL ACTIVITIES CONDUCTED AT THE BAIER SITE AND MCCARL SITE

Date	Event
05/22/90	DuPont receives "final" RI/FS Work Plan approval from USEPA.
07/10/90	USEPA, DuPont, WCC, and Jacobs Engineering participate in a meeting to discuss the progress of the RI/FS and the general RI/FS process.
08/14/90	USEPA, DuPont, WCC, and Jacobs Engineering participate in a meeting to discuss progress of the RI/FS, preliminary analytical data, preliminary risk assessment results, and the schedule for completion of field activities.
10/19/90	WCC on behalf of DuPont submits draft RI/FS and Risk Assessment Reports to USEPA.

TABLE 1-2
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES (ug/L)

Monitoring Well	Date	Arsenic (50/NC)	Barium (1000/5000)	Cadmium (10/5)	Chromium (50/100)	Mercury (2/NC)	Nickel (NE/NE)	Lead (50/NC)	Selenium (10/50)
MW-A	7/85	NA/NA	660/NA	7/NA	190/NA	0.3/NA	120/NA	30/NA	ND/NA
	3/86	ND/ND	190M/20M	ND/ND	42/9.7M	0.44/ND	35M/ND	38/ND	ND/ND
	7/88	ND/ND	760/ND	2/ND	40/ND	ND/ND	150/ND	10/ND	ND/ND
MW-B	7/85	ND/ND	330/NA	ND/NA	190/NA	0.4/NA	60/NA	21/NA	ND/NA
	3/86	30/ND	430/17M	ND/ND	49/6.3M	ND/ND	45/7.2M	40/ND	ND/ND
	7/88	ND/ND	190/ND	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
MW-C	7/85	ND/NA	440/77	ND/NA	110/NA	0.4/NA	60/NA	26/NA	ND/NA
	3/86	ND/ND	290/75M	ND/ND	33/ND	ND/0.38	38M/ND	16/ND	ND/ND
	7/88	NA/ND	240/77	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	100/40

Notes:

1) ND = Not detected
2) NA = Not available
3) No volatile organics or semi-volatile organics detected
4) M = Compound is qualitatively identified; however, quantitation value is less than contract required detection limit (CLP data) or value is less than limit of quantitation (EPA data).
5) Current/proposed Maximum Contaminant Level (MCL) given in parenthesis below each individual metal (ug/l).
6) NE = Not established
7) NC = No change
8) Monitoring wells MW-A, MW-B, and MW-C were installed by EPA FIT team.

TABLE 1-3
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES (ug/L)

Well	Date	Arsenic (50/NC)	Barium (1000/5000)	Cadmium (10/5)	Chromium (50/100)	Mercury (2/NC)	Nickel (NE/NE)	Lead (50/NC)	Selenium (10/50)
MC-1	7/86 (E)	NA/NA	240/NA	11/NA	84/NA	NA/NA	75/NA	11J/NA	ND/NA
	7/86 (D)	20/NA	NA/NA	ND/NA	90/NA	ND/NA	120/NA	140/NA	ND/NA
	4/87 (E)	ND/ND	220/130M	ND/ND	ND/ND	ND/0.3J	ND/ND	13/ND	ND/ND
	4/87 (D)	ND/ND	NA/NA	ND/ND	ND/ND	NA/NA	ND/ND	ND/ND	NA/NA
	7/88 (D)	ND/ND	400/80	2/ND	10/ND	ND/ND	ND/ND	ND/ND	ND/ND
MC-2	7/86 (E)	ND/NA	190M/NA	ND/NA	ND/NA	NA/NA	16M/NA	ND/NA	39/NA
	7/86 (D)	230/NA	NA/NA	50/NA	840/NA	ND/NA	820/NA	500/NA	ND/NA
	4/87 (E)	ND/ND	420/320	ND/ND	21/ND	0.4J/.03J	ND/ND	10/5.6	32/NA
	4/87 (D)	10/ND	NA/NA	ND/ND	ND/ND	NA/NA	ND/ND	ND/ND	NA/NA
	7/88 (D)	ND/ND	410/270	2/ND	ND/ND	ND/ND	ND/ND	ND/ND	50/60
MC-3	7/86 (E)	ND/NA	80/NA	ND/NA	ND/NA	NA/NA	ND/NA	ND/NA	ND/NA
	7/86 (D)	ND/NA	NA/NA	ND/NA	ND/NA	ND/NA	ND/NA	ND/NA	ND/NA
	4/87 (E)	ND/ND	260/230	ND/ND	8.3M/ND	ND/ND	ND/ND	27/ND	64/ND
	4/87 (D)	ND/ND	NA/NA	ND/ND	ND/ND	NA/NA	ND/ND	ND/ND	NA/NA
	7/88 (D)	ND/ND	330/200	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	60/70

Notes:

1) Antimony detected at a level of 320 ug/l by EPA in well MC-1 during July 1986.
2) (E) = EPA, (D) = Du Pont
3) ND = Not detected
4) NA = Not available
5) M = Compound qualitatively identified; however, quantitation value is less than contract required detection limit (CLP) data) or value is less than limit of quantitation (EPA data).
6) Current/Proposed Maximum Contaminant Level (MCL) given in parenthesis below each individual metal (ug/l).
7) NE = Not established
8) NC = No change

TABLE 2-1

DEPTH TO SOIL/WASTE CONTACT[1]
BAIER SITE
MAY 1989

LOCATION[1]	INTRUSIVE METHOD	DEPTH TO SOIL/WASTE CONTACT (in.)	HNU READING (ppm)
HA-1	Hand auger	12	NR[2]
HA-2	Hand auger	2	NR
HA-3	Hand auger	8[3]	NR
HA-4	Hand auger	14[3]	300
HA-5	Hand auger	20	200
HA-6	Hand auger	3[3]	10
HA-7	Hand auger	0[4]	Background
HA-8	Hand auger	0[4]	Background
HA-9	Hand auger	8[3]	Background
HA-10	Hand auger	12	300
HA-11	Hand auger	0[4]	5-10
HA-12	Hand auger	12	100-150
HA-13	Hand auger	16	200
HA-14	Hand auger	18	320
HA-15	Hand auger	12	320
HA-16	Hand auger	0[4]	NR
HA-17	Hand auger	8	Background
HA-18	Hand auger	12	Background
HA-19	Hand auger	0[4]	Background
HA-20	Hand auger	0[4]	Background
HA-21	Hand auger	12	300
HA-22	Hand auger	8	2-5
TP-01	Backhoe	6-8	10-20
TP-02	Backhoe	18	100
TP-03	Backhoe	24	300
TP-04	Backhoe	36[3]	>250

Notes:

[1] See Figure 2 for locations.
[2] NR-HNu reading was not recorded.
[3] Excavation was terminated prior to reaching the waste/soil contact.
[4] Waste was not found.

TABLE 2-2

DEPTH TO SOIL/WASTE CONTACT[1]
MCCARL SITE
MAY 1989

LOCATION	INTRUSIVE METHOD	DEPTH TO SOIL/WASTE CONTACT (in.)	HNU READING (ppm)
MA-01	Hand auger	6	Background
MA-02	Hand auger	0[3]	Background
MA-03	Hand auger	0[3]	NR[2]
MA-04	Hand auger	8	NR
MA-05	Hand auger	0[3]	NR
MA-06	Hand auger	3	NR
MA-07	Hand auger	0[5]	NR
MA-08	Hand auger	0[5]	
TP-05	Backhoe	2-4[4]	Background
TP-06	Backhoe	0	Background
TP-07	Backhoe	0[5]	Background
TP-08	Backhoe	12	NR
TP-09	Backhoe		50-300

Notes:

[1] See Figure 8 for locations.
[2] NR - HNu reading was not recorded.
[3] Waste was not found.
[4] Small amounts of waste-like material observed.
[5] Construction debris and ash was found during trenching activities.

TABLE 3-1

GENERALIZED SECTIONS OF STRATIGRAPHIC UNITS

Geologic Age	Stratigraphic Unit	Thickness (Feet)	Descriptions
Quaternary	Loess	0-10	Wind blown deposits of silt, clayey silt and silty clay
	Weathered Till	0-60	Glacial deposits of light brown, grayish-brown, orangish-brown to reddish brown silty clay and clay with lesser amount of sand, gravel, cobbles, and boulders
	Unweathered Till	50-100	Glacial deposits of light to dark gray silty clay and clay with lesser amounts of sand, gravel, cobbles, and boulders
	Buried Alluvium	0-50	Channel deposits of clay, silt, sand, and gravel
Mississippian (lower)	Warsaw Keokuk Burlington Hampton Starrs Cave	100-200	Shale and dolomite Dolomite, limestone and shale Dolomite and limestone Limestone and dolomite Limestone

TABLE 3-2
PLIESTOCENE STRATIGRAPHY

PLIESTOCENE SERIES	ILLINOIAN STAGE	GLASFORD FORMATION Kellerville Till Member supergalcial and sub-glacial-basal till facies.	
	YARMOUTH STAGE	WOLF CREEK FORMATION (including unnamed, undifferentiated sediments)	YARMOUTH Paleosol
	PRE-ILLINOIAN STAGES undifferentiated	Hickory Hills Till Member	
			Dysart Paleosol
		Aurora Till Member	
			Franklin Paleosol
		Winthrop Till Member	
			Westburg Paleosol
		ALBURNETT FORMATION unnamed sediments, unnamed till members.	

Note: Taken from publication by Iowa Geological Survey entitled "Illinoian and Pre-Illinoian Stratigraphy of Southeast Iowa and Adjacent Illinois", Technical Information Services Number 11, May 1980.

TABLE 3-3

WATER SUPPLY WELLS

Well Identification	Owner	Well Depth	Aquifer	Well Usage	Approximate Distance From Baier	Approximate Distance From McCarl
A-1	Johnny Glascow	±300′	bedrock	unknown	±1.2 miles	±500′
B-1	D. G. Jody	unknown	unknown	unknown	±2.5 miles	2 miles
C-1	Jennings	253′	bedrock	domestic	±2.5 miles	2 miles
D-1	Tom Fedler	unknown	unknown	unknown	2.4 miles	±2 miles
E-1	unknown	unknown	unknown	unknown	2.3 miles	±1.9 miles
F-1	Kenneth Swartz	unknown	unknown	livestock domestic	2.2 miles	1.9 miles
G-1	Anna Thompson	200′-300′	bedrock	domestic	2.3 miles	1.8 miles
H-1	unknown	unknown	unknown	unknown	2.2 miles	1.9 miles
I-1	Watzhaver	±300′	bedrock	domestic	2.2 miles	1.9 miles
J-1	Buffington	365′	bedrock	domestic	2.1 miles	1.9 miles
K-1	Paul Sterkarjuergen	unknown	unknown	livestock	2.1 miles	1.9 miles
L-1	Jerry Graham	no well surface pond	--	unknown	1.9 miles	1.8 miles
M-1	Wilma Smith	145′	till	domestic livestock	1.5 miles	1.3 miles
N-1	Dr. Robert Todd	spring fed well	--	unknown	1.8 miles	1.2 miles

TABLE 3-3
(Continued)
WATER SUPPLY WELLS

Well Identification	Owner	Well Depth	Aquifer	Well Usage	Approximate Distance From Baier	Approximate Distance From McCarl
O-1	Ralph Ritter	unknown	unknown	domestic	1.5 miles	1.2 miles
P-1	J. McCauley	±370′	bedrock	domestic	1.1 miles	1.6 miles
Q-1	R. Hawkins	shares well with J. McCauley	bedrock	domestic	1.1 miles	1.6 miles
R-1	Barry & Julie Nizzi	55′	till	domestic	0.96 mile	1.4 miles
S-1	Tim B. Parker	25′	till	domestic	0.95 mile	1.2 miles
T-1	L. E. Jones	306′	bedrock	unknown	0.9 mile	1.1 miles
U-1	T. A. Wolf	unknown	unknown	unknown	0.95 mile	1.0 mile
V-1	Jean Vogel	300′	bedrock	domestic	0.9 mile	1.0 mile
W-1	Conrad	365′	bedrock	domestic	1.0 mile	0.95 mile
X-1	Ron & Karen Mace	unknown	unknown	unknown	1.0 mile	0.96 mile
Y-1	unknown	unknown	unknown	unknown	1.3 miles	1.0 mile
A-2	Tom Tincher	unknown	unknown	unknown	3.2 miles	2.1 miles
B-2	Gerald Fedler	unknown	unknown	unknown	2.9 miles	1.8 miles
C-2	Carl Fedler	unknown	unknown	unknown	2.6 miles	1.5 miles

TABLE 3-3
(Continued)
WATER SUPPLY WELLS

Well Identification	Owner	Well Depth	Aquifer	Well Usage	Approximate Distance From Baier	Approximate Distance From McCarl
D-2	Ordway	unknown	unknown	unknown	2.5 miles	1.4 miles
E-2	unknown	unknown	unknown	unknown	2.2 miles	1.1 miles
F-2	unknown	unknown	unknown	unknown	1.6 miles	1.2 miles
G-2	Busard	unknown	unknown	unknown	1.3 miles	0.7 mile
H-2	Hall Towing	unknown	unknown	domestic	1.6 miles	2.0 miles
I-2	Dale Suppe	unknown	unknown	unknown	1.5 miles	2.1 miles
J-2	John Flach	unknown	unknown	unknown	1.4 miles	2.1 miles
K-2	D. P. Strunk	unknown	unknown	unknown	1.3 miles	2.2 miles
L-2	Elbert Trip	300′	bedrock	domestic	1.0 mile	2.0 miles
M-2	Clem Judy	230′	bedrock	domestic	1.2 miles	2.0 miles
N-2	Harry Gram	60′	till	domestic	1.2 miles	0.8 mile
O-2	unknown	unknown	unknown	unknown	1.3 miles	0.7 mile
P-2	unknown	unknown	unknown	unknown	1.3 miles	0.6 mile
Q-2	Sallen	200′	bedrock	livestock	1.2 miles	0.4 mile
R-2	Albert Fraise	unknown	unknown	unknown	2.2 miles	1.0 mile
S-2	Henry Becerra	400′	bedrock	domestic	2.7 miles	1.6 miles

TABLE 3-3
(Continued)
WATER SUPPLY WELLS

Well Identification	Owner	Well Depth	Aquifer	Well Usage	Approximate Distance From Baier	Approximate Distance From McCarl
T-2	unknown	unknown	unknown	unknown	2.7 miles	1.5 miles
U-2	Kemp	unknown	unknown	unknown	3.0 miles	1.6 miles
V-2	R. Vliant	unknown	unknown	unknown	3.0 miles	1.6 miles
W-2	D. L. Holterhaus	unknown	unknown	unknown	3.0 miles	1.8 miles
X-2	Wiggans	unknown	unknown	unknown	3.2 miles	1.9 miles
Y-2	unknown	unknown	unknown	unknown	3.2 miles	1.9 miles
Z-2	Phillips	±400′	bedrock	domestic	3.4 miles	2.0 miles
AA-2	Brian Bennett/ Robert Marsheim	±300′	bedrock	unknown	3.2 miles	2.0 miles
BB-2	Bell	10-15′	till	domestic	3.0 miles	2.0 miles
CC-2	unknown	255′	bedrock	unknown	2.0 miles	2.9 miles
DD-2	unknown	330′	bedrock	unknown	3.3 miles	2.2 miles
EE-2	unknown	307′	bedrock	unknown	2.6 miles	1.9 miles
FF-2	unknown	112′	bedrock	unknown	2.5 miles	1.9 miles
GG-2	unknown	314′	bedrock	unknown	2.6 miles	1.6 miles
HH-2	unknown	300′	bedrock	unknown	2.5 miles	1.9 miles

TABLE 3-3
(Continued)
WATER SUPPLY WELLS

Well Identification	Owner	Well Depth	Aquifer	Well Usage	Approximate Distance From Baier	Approximate Distance From McCarl
II-2	unknown	360′	bedrock	unknown	2.7 miles	4.0 miles
JJ-2	unknown	164′	till bedrock	unknown	2.5 miles	3.8 miles

Note: Information presented in this table was obtained from the following references:

* Internal Memorandum Ecology and Environment, Inc. August, 1986. Table 2. pp 7.

TABLE 3-4

GROUND WATER QUALITY DATA
GLACIAL TILL AQUIFER BENEATH THE SITES

Average (A) and Range (R)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (As Ca CO_3)
A	103	36	40	506	74	2.7	0.4	547	406
R	77-150	24-61	13-88	304-739	11-393	0.5-7.5	0.2-0.7	357-982	292-625

Notes: Taken from publication by Iowa Geological Survey entitled "Ground Water Resources, Lee County," Open File Report 80-56 WRD, 1980.

TABLE 3-5

GROUND WATER SURFACE ELEVATION IN FEET
(NGVD)

Well ID	Top of Casing Elevation	08/89	09/89	12/89	03/90	06/25/90	07/11/90	08/06/90	08/22/90
Baier Site									
MW-A	705.68	672.15	NA	671.77	674.97	680.72	682.38	682.40	682.18
MW-B	699.85	670.57	NA	669.64	672.36	672.32	670.41	672.85	673.80
MW-C	707.95	674.90	NA	673.41	673.39	673.16	673.53	673.62	673.93
MW-D1	707.57	678.13	677.84	NA	NA	NA	678.77	NA	680.97
MW-D2	707.78	612.34	612.49	NA	NA	NA	613.28	NA	615.38
MW-E	694.44	664.81	664.59	663.85	663.55	665.81	665.91	665.67	665.86
MW-F	692.50	666.31	666.44	665.61	665.08	669.69	669.78	668.42	668.18
MW-F2	692.91	NI	NI	NI	NI	612.53	613.46	614.26	614.86
MW-G	704.95	646.78	656.22	655.72	664.75	664.85	654.19	659.97	663.62
MW-H	705.76	680.29	681.08	680.81	680.77	683.03	683.59	683.74	683.85
MW-I	705.64	675.84	675.33	674.65	674.54	673.84	673.79	673.83	673.76
MW-J	704.16	NI	NI	NI	NI	668.98	668.99	668.28	668.22
MW-K1	705.61	NI	NI	NI	NI	661.28	660.46	660.53	660.89
MW-K2	705.85	NI	NI	NI	NI	596.65	596.66	NA	NA
MW-L1	708.11	NI	NI	NI	NI	NA	NA	NA	663.41
MW-L2	708.20	NI	NI	NI	NI	NA	NA	NA	611.60
P-1	660.30	NI	NI	NI	NI	652.55	651.32	653.36	650.08
P-2	646.86	NI	NI	NI	NI	638.12	DRY	DRY	DRY
P-3	651.60	NI	NI	NI	NI	645.55	644.76	643.69	643.31
P-4	643.19	NI	NI	NI	NI	638.25	636.88	635.94	634.60

TABLE 3-5
(Continued)
GROUND WATER SURFACE ELEVATION IN FEET
(NGVD)

Well ID	Top of Casing Elevation	08/89	09/89	12/89	03/90	06/25/90	07/11/90	08/06/90	08/22/90
McCarl Site									
MC-1	716.72	691.70	NA	690.95	694.51	695.20	694.94	694.74	694.86
MC-2	715.56	685.74	NA	687.35	687.16	685.84	685.72	685.56	685.86
MC-3	713.07	673.63	NA	671.84	674.16	673.49	666.44	671.17	672.95
MC-3C	713.98	NI	NI	NI	NI	653.86	653.92	653.95	654.43
MC-4A	714.54	694.76	694.69	694.38	694.78	696.69	695.37	695.12	695.14
MC-4B	714.65	DRY	DRY	DRY	DRY	DRY	DRY	DRY	NA
MC-4C	714.26	NI	NI	NI	NI	616.46	618.88	632.33	634.69
MC-5	711.76	688.49	688.73	687.58	686.51	686.32	686.50	686.53	686.85
MC-6	712.85	685.53	686.75	685.99	685.28	685.45	685.18	685.01	685.45
MC-6C	714.51	NI	NI	NI	NI	626.97	627.30	633.76	635.49
MC-7	694.16	NI	NI	NI	NI	DRY	656.39	658.24	660.30

Notes:

NA = Not Available
NI = Not Installed

TABLE 3-6

ESTIMATED TRANSMISSIVITY (T), PERMEABILITY (K), AND STORAGE COEFFICIENTS (S) FOR THE McCARL AND BAIER SITES

		Estimated Values				
			T			
Well ID	Test Conditions	S (Dimensionless)	(ft^2/sec)	gpd/ft	K (ft/sec)	K (cm/sec)
McCarl Site						
MC-3	R	1.0×10^{-1}	2.0×10^{-3}	1300	3.0×10^{-4}	9.0×10^{-3}
MC-3C	F		4.0×10^{-3}	2600	8.0×10^{-5}	2.5×10^{-3}
MC-3C	R					
MC-4A	R		7.0×10^{-4}	450	5.0×10^{-5}	1.5×10^{-3}
MC-4C	F		7.0×10^{-3}	4500	2.0×10^{-4}	6.0×10^{-3}
MC-4C	R					
MC-6C	F		5.0×10^{-3}	3230	1.0×10^{-4}	3.0×10^{-3}
MC-6C	R					
Baier Site						
MW-F2	F	1.0×10^{-3}	1.0×10^{-3}	650	8.0×10^{-5}	2.5×10^{-3}
MW-F2	R					
MW-J	F	1.0×10^{-1}	2.0×10^{-4}	130	4.0×10^{-5}	1.0×10^{-3}
MW-J	R					
MW-K1	F	1.0×10^{-1}	1.0×10^{-3}	650	1.0×10^{-4}	3.0×10^{-3}
MW-K1	R					
MW-K2	F	1.0×10^{-1}	2.0×10^{-4}	130	9.0×10^{-6}	3.0×10^{-4}
MW-K2	R					

Notes: F = Falling Head Test
R = Rising Head Test

TABLE 4.1-1

ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
MAY 1989
(mg/kg)

Analyte	HA-19[1] (0-6)[2]	HA-19[7] (12-24)	HA-20 (0-6)	HA-21 (18-24)	HA-22 (14-24)	HA-22D (14-24)
Volatile Organics						
Toluene	NC[3]	ND(0.006)	ND(0.006)	15.0J	ND(0.006)	ND(0.006)
Ethylbenzene	NC	ND(0.006)	ND(0.006)	78.0	ND(0.006)	ND(0.006)
Total Xylenes	NC	ND(0.006)	ND(0.006)	450	ND(0.006)	ND(0.006)
Methylene Chloride	NC	0.003J	0.007	44.0BJ[5,6]	0.004J	0.008
Acetone	NC	ND(0.012)	ND(0.012)	ND(130)	0.002BJ	ND(0.012)
Metals						
Cadmium	ND(0.91)[4]	ND(0.96)	ND(1.0)	1.4	ND(0.97)	ND(0.97)
Chromium	8.7	16.3	12.5	27.7	17.6	19.0
Arsenic	4.0	6.5	4.0	5.2	5.8	6.3
Selenium	0.32B[8]	ND(0.24)	ND(0.26)	0.33B	ND(0.24)	ND(0.24)
Lead	20.3	13.2	14.3	124	102	42.3
pH	5.06	5.17	6.72	4.96	4.75	4.98

Notes:
[1] Refer to Figure 2 for sample locations.
[2] Sample interval below ground surface (inches).
[3] NC - Not collected from this interval.
[4] ND ( ) - Not detected at concentration indicated in parenthesis.
[5] B (Volatile Organics) - Analyte is found in associated blank as well as sample.
[6] J - Indicates an estimated value.
[7] HA - 19 volatile organic sample interval 18-24 inches.
[8] B (Metals) - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limits (IDL).

TABLE 4.1-1
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
MAY 1989
(mg/kg)

Analyte	SR-01[1] (0-6)[2]	TP-02 (6-12)	TP-03 (24-36)	TP-01 (12-18)	TP-04[7] (~36)
Volatile Organics					
Toluene	ND(0.006)[4]	ND(12)	88.0	NC	ND(140)
Ethylbenzene	ND(0.006)	35.0	280.0	NC	240
Total Xylenes	ND(0.006)	210	1400	NC	4000
Methylene Chloride	0.006J	11.0BJ[5,6]	30.0BJ	NC	73.0BJ
Acetone	ND(0.012)	ND(24)	ND(120)	NC	ND(280)
Metals					
Cadmium	ND(1.4)	NC[3]	83.1	ND(0.99)	NC
Chromium	10.6	NC	297	18.2	NC
Arsenic	4.3	NC	12.9	18.4	NC
Selenium	ND(0.71)	NC	15.0	0.52B[8]	NC
Lead	16.2	NC	4650	68.3	NC
pH	7.8	NC	6.4	6.8	NC

Notes:
[1] Refer to Figure 2 for sample locations.
[2] Sample interval below ground surface (inches).
[3] NC - Not collected from this interval.
[4] ND ( ) - Not detected at concentration indicated in parenthesis.
[5] B (Volatile Organics) - Analyte is found in associated blank as well as sample.
[6] J - Indicates an estimated value.
[7] TP-04 is a waste sample, all others soil samples.
[8] B (Metals) - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

TABLE 4.1-2

ANALYTICAL DATA SUMMARY
BAIER SITE WASTE SAMPLES
MAY 1989
(mg/kg)

Analyte	HA-21[1] (0-6)[2]	HA-22 (0-6)	HA-22D (0-6)	TP-01 (0-6)	TP-02 (0-6)	TP-03 (0-6)	TP-03 (10-16)
Metals							
Cadmium	36.7	128	237	310	298	161	1410
Chromium	584	613	1,140	1830	1030	807	1680
Arsenic	4.4	2.2B[3]	3.2B	23.4	6.7	3.4	8.3
Selenium	5.8	17.5	26.1	50.7	43.4	29.2	361
Lead	7,460	38300	39600	19700	27800	18900	23000
pH	6.27	5.68	5.89	6.3	7.0	7.4	7.2

Notes:

[1] Refer to Figure 2 for sample locations.

[2] Sample interval below ground surface (inches).

[3] B - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

TABLE 4.1-3
ANALYTICAL DATA SUMMARY
TCLP RESULTS
BAIER SITE WASTE SAMPLES
MAY 1989
(mg/l)

Analyte[1]	TP-01[2] (0-6)[3]	TP-03 (0-24)	TP-04 (0-36)
Volatile Organics			
Toluene	ND(0.005)[4]	ND(0.005)	0.58
Ethylbenzene	ND(0.005)	ND(0.005)	0.50
Total Xylenes	ND(0.005)	0.010	11.0
Semi-Volatile Organics			
2,4-Dimethylphenol	ND(0.0125)	ND(0.0125)	0.055
Naphthalene	ND(0.0125)	ND(0.0125)	0.140
2-Methylnaphthalene	ND(0.0125)	ND(0.0125)	0.013
Metals			
Barium	2.3	6.2	12.0
Cadmium	1.4	1.4	1.7
Chromium	0.36	0.36	0.21
Lead	57.0	8.4	87.0

Notes:

[1] Only detected compounds reported.
[2] Refer to Figure 2 for sample locations.
[3] Composite interval (inches).
[4] ND( ) - Not detected at concentration indicated in parenthesis.

TABLE 4.1-4
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
SHALLOW BORINGS
JULY 1989
(mg/kg)

ANALYTE	BS-01 (4.3-5.3)[1] 2-3[2]	BS-01 (6.3-7.3) 4-5	BS-02 (5.75-6.75) 2-3	BS-02 (7.75-8.75) 4-5	BS-03 (7.25-8.25) 2-3	BS-03 (9.25-10.25) 4-5
Volatile Organics[3]						
Toluene	2.1J[4]	3.3J	0.29J	1.5J	5.2	9.1
Ethylbenzene	7.9	9.6	0.68	4.5J	19.0	33.0
Total Xylenes	33.0	42.0	7.4	20.0	91.0	120.0
2-Butanone	ND(10)[5]	ND(10)	0.4J	ND(10)	ND(10)	ND(10)
Metals						
Cadmium	ND(1.0)	16.6	1.7	1.4	3.9	4.5
Chromium	28.7	31.1	28.9	23.9	68.9	83.0
Arsenic	8.6	7.1	4.9	5.5	10.2	8.1
Selenium	0.91	1.1	ND(0.51)	ND(0.48)	0.91	0.77
Lead	14.8	50.3	91.0	87.5	357	254
pH	4.7	5.1	6.1	6.4	5.8	6.4
Moisture Content	22.9%	24.1%	20.9%	17.1%	23.2%	22.1%

Notes:

[1] Depth below ground surface (feet).
[2] Depth below waste/soil interface (feet).
[3] Only detected volatile organics are listed.
[4] J denotes an estimated concentration
[5] ND () - not detected at concentration indicated in parenthesis.

TABLE 4.1-4
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
SHALLOW BORINGS
JULY 1989
(mg/kg)

ANALYTE	BS-04 (4-5)[1] 1-2-3[2]	BS-04 (6-7) 4-5	BS-05 (3-4) 2-3	BS-05 (5-6) 4-5	BS-06 (3.25-4.25) 2-3	BS-06D (3.25-4.25) 2-3	BS-06 (5.25-6.25) 4-5	BS-06D[7] (5.25-6.2) 4-5
Volatile Organics[3]								
Toluene	0.12J[4]	0.31J	3.9J	1.4J	5.9	4.5J	1.1J	ND(5)
Ethylbenzene	0.47J	1.0	14.0	20.0	32.0	20.0	6.3	9.7
Total Xylenes	2.9	5.6	57.0	67.0	150.0	85.0	28.0	43.0
2-Butanone	ND(1)[5]	0.34J	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
1,1,1-Trichlorethane	0.17J	0.19J	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Metals								
Cadmium	ND(1.0)	ND(0.93)	ND(1.0)	ND(0.92)	ND(1.0)	NA[6]	ND(0.94)	NA
Chromium	36.9	14.0	16.6	14.2	22.2	NA	15.9	NA
Arsenic	8.4	3.8	6.5	3.2	9.5	NA	7.2	NA
Selenium	ND(0.51)	ND(0.47)	0.51	ND(0.46)	ND(0.52)	NA	0.47	NA
Lead	26.7	13.6	6.1	12.7	24.6	NA	11.4	NA
pH	6.3	6.9	6.4	7.0	5.1	NA	6.5	NA
Moisture Content	21.3%	14.2%	21.6%	12.7%	22.4%	NA	15.2%	NA

Notes:

[1] Depth below ground surface (feet).
[2] Depth below waste/soil interface (feet).
[3] Only detected volatile organics are listed.
[4] J denotes an estimated concentration
[5] ND () - not detected at concentration indicated in parenthesis.
[6] NA - not available.
[7] D - duplicate sample.

TABLE 4.1-4
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
SHALLOW BORINGS
JULY 1989
(mg/kg)

ANALYTE	BS-07 (4-5)[1] 2-3[2]	BS-07D (4-5) 2-3	BS-07 (6-7) 4-5	BS-07D[7] (6-7) 4-5	BS-08 (2.75-3.75) 2-3	BS-08 (4.75-5.75) 4-5
Volatile Organics[3]						
Toluene	14.0J[4]	NA[6]	21.0	NA	NA	2.9J
Ethylbenzene	59.0	NA	85.0	NA	NA	19.0
Total Xylenes	250.0	NA	350.0	NA	NA	70.0
Metals						
Cadmium	ND(0.95)	ND(1.1)	ND(0.94)	ND(0.95)	60.1	2.0
Chromium	35.8	34.9	21.0	24.6	107	28.8
Arsenic	7.5	7.5	5.5	4.5	7.3	12.6
Selenium	0.84	ND(0.53)	0.52	ND(0.48)	14.1	0.79
Lead	144	40.9	30.4	29.6	1840	63.8
pH	5.4	6.0	6.9	7.1	5.8	5.0
Moisture Content	16.2%	25.1	14.6%	16.1	26%	26.3%

NOTES:
[1] Depth below ground surface (feet).
[2] Depth below waste/soil interface (feet).
[3] Only detected volatile organics are listed.
[4] J denotes an estimated concentration.
[5] ND () - not detected at concentration indicated in parenthesis.
[6] NA - not available.
[7] D - duplicate sample.

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TABLE 4.1-5
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
BACKGROUND BORING
JULY 1989
(mg/kg)

ANALYTE	BB-01 (9-10)[1]	BB-01 (14-15)	BB-01 (19-20)	NATIONAL BACKGROUND RANGES[2]	NATIONAL BACKGROUND AVERAGES[2]
Volatile Organics					
1,1,1-Trichlorethane	0.0047J[4]	0.0035J	0.0058	NE[3]	NE
Metals					
Cadmium	ND(0.97)[5]	ND(0.91)	ND(0.90)	0.01-0.7	0.06
Chromium	19.9	14.9	8.8	1-1000	100
Arsenic	6.4	14.5	4.2	1-50	5
Selenium	ND(0.48)	ND(0.45)	0.45	0.1-2	0.3
Lead	29.3	12.8	6.5	2-200	10
pH	6.6	7.2	8.2	-	-
Moisture Content	17.2%	11.7%	11.3%	-	-

NOTES:
[1] Depth below ground surface (feet).
[2] USEPA 1983, Hazardous Waste Land Treatment.
[3] NE - not established.
[4] J denotes an estimated concentration.
[5] ND () - not detected a concentration indicated in parenthesis.

TABLE 4.1-6
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
DEEP BORINGS
JULY 1989
(mg/kg)

ANALYTE	BD-01 (6.5-7.5)[1] 2-3[2]	BD-01 (8.5-9.5) 4-5	BD-01 (13.5-14.5) 9-10	BD-01D[6] (13.5-14.5) 9-10	BD-01 (18.5-19.5) 14-15	BD-01D (18.5-19.5) 14-15	BD-01 (23.5-24.5) 19-20	BD-01D (23.5-24.5) 19-20
Volatile Organics[3]								
Toluene	0.78	3.8J[4]	0.75	2.8J	4.0J	7.3	1.0J	ND(5)
Ethyl Benzene	1.5	17.0	3.6	14.0	17.0	36.0	4.8J	7.5
Total Xylene	6.1	63.0	15.0	53.0	61.0	130.0	19.0	29.0
Acetone	1.1	ND(10)	4.2	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(1)[5]	ND(10)	0.64J	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(1)	ND(10)	0.91J	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Metals								
Cadmium	NA	ND(0.99)	ND(0.96)	ND(1.0)	ND(0.95)	ND(0.93)	ND(0.98)	ND(0.93)
Chromium	NA	17.6	19.6	19.0	12.7	13.0	11.6	11.3
Arsenic	NA	7.2	7.4	7.8	3.3	7.7	7.2	2.2
Selenium	NA	ND(0.5)	ND(0.48)	ND(0.5)	0.48	0.47	ND(0.49)	0.46
Lead	NA	15.0	7.8	8.6	6.3	13.3	6.7	16.3
pH	NA	5.7	6.4	6.5	8.2	8.5	8.4	8.6
Moisture Content	NA	19.5%	16.6%	19.7%	16.0%	14.3%	18.0%	13.6%

NOTES:
[1] Depth below ground surface (feet).
[2] Depth below waste/soil interface (feet).
[3] Only detected volatile organics are listed.
[4] J denotes an estimated concentration.
[5] ND () - not detected at concentration indicated in parenthesis.
[6] D - duplicate sample.

TABLE 4.1-6
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE SOIL SAMPLES
DEEP BORINGS
JULY 1989
(mg/kg)

ANALYTE	BD-02 (5-6)[1] 2-3[2]	BD-02 (7-8) 4-5	BD-02 (12-13) 9-10	BD-02 (17-18) 14-15	BD-02 (22-23) 19-20
Volatile Organics[3]					
Toluene	0.96	21.0	8.8	1.8J	ND(0.5)
Ethyl Benzene	1.4	38.0	28.0	4.3J	0.21J
Total Xylene	5.3	160.0	120.0	22.0	0.95
Acetone	1.7	ND(10)	ND(10)	ND(10)	10.0
2-Butanone	0.42J[4]	ND(10)	ND(10)	ND(10)	ND(1)
1,1,1,-Trichlorethane	1.4	ND(5)	ND(5)	ND(5)	0.24J
4-Methyl-2-Pentanone	0.6J	1.9J	1.3J	ND(10)	0.35J
Metals					
Cadmium	ND(1.0)[5]	ND(1.1)	ND(1.1)	ND(0.94)	ND(0.92)
Chromium	18.0	35.7	19.4	10.3	11.5
Arsenic	7.1	6.0	5.7	7.7	6.2
Selenium	ND(0.51)	ND(0.53)	ND(0.53)	ND(0.47)	0.46
Lead	13.6	10.1	20.2	11.6	10.0
pH	5.8	6.7	7.2	8.7	9.0
Moisture Contents	21.4%	24.7%	25.0%	14.8%	13.4%

NOTES:

[1] Depth below ground surface (feet).

[2] Depth below waste/soil interface (feet).

[3] Only detected volatile organics are listed.

[4] J denotes an estimated concentration.

[5] ND () - not detected at concentration indicated in parenthesis.

TABLE 4.1-7
XRF CALIBRATION STANDARDS

	LEAD CONCENTRATION (mg/kg)					
Sample Number	**Analysis No. 1**	**Analysis No. 2**	**Analysis No. 3**	**Analysis Mean**	**Standard Deviation**	**Spike[1] Levels**
WWC #1	85.3	82.8	78.2	82.1	3.6	(50, NS, NS)
WWC #2	141	131	146	139.3	7.6	(100, 10, 10)
WWC #3	314	346	315	325	18.2	(250, 10, 25)
WWC #4	603	577	570	583.3	17.4	(500, 20, 50)
WWC #5	860	935	864	886.3	42.2	(750, 30, 75)
WWC #6	1,090	1,120	1,170	1,126.7	40.4	(1,000, 50, 100)
WWC #7	1,760	1,630	1,740	1,710	7.0	(1,500, 75, 100)
WWC #8	2,920	3,020	2,680	2,873.3	174.7	(2,500, 100, 250)
WWC #9	3,750	4,050	4,170	3,990	216	(4,000, 150, 300)
WWC #10	4,430	5,620	5,600	5,216	681.3	(5,000, 150, 500)

Notes: Spike levels = lead, cadmium, chromium in mg/kg added to sample.

TABLE 4.1-8
BAIER SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	1	2	3	4	5	6	7	8	9	10
COLUMN A	*	124	351	282.2	822/823	*	*	*	*	*
	*	230.6	213.2	14.97	275.7	*	*	*	*	*
	*	308	287.6	246.2	231	*	*	*	*	*
B	*	181.7	322.9	*	*	120.6	*	*	*	*
	*	159.1	216	*	*	250.5	*	*	*	*
	*	214.5	177.2	*	*	228.8	*	*	*	*
C	*	227.6	614.1	*	*	522/523	144.5	151.1	*	*
	*	222.2	205.7	*	*	182	226.5	257.8	*	*
	*	219.6	157.9	*	*	219.8	262	258.5	*	*
D	*	111.5	9758	*	*	*	350.5	118.6	183.8	*
	*	267.3	>10000	*	*	*	162.7	191	240	*
	*	269	316.6	*	*	*	206.1	171.6	250.3	
E	*	138.2	>10000	*	*	*	*	*	206.1	32.96
	*	223.6	7174	*	*	*	*	*	223.8	183.6
	*	240.4	1409	*	*	*	*	*	218.6	203.1
F	*	128.7	402.4	*	*	*	*	*	785.1	127.4
	*	233	376.4	*	*	*	*	*	199	252.6
	*	286.5	200.6	*	*	*	*	*	212.1	212.4

TABLE 4.1-8
(Continued)
BAIER SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW COLUMN	1	2	3	4	5	6	7	8	9	10
G	*	204.9	3962	*	*	9693	*	*	145	145.4
	*	238.4	3677	*	*	209.2	*	*	208.9	174.6
	*	227.6	785.9	*	*	201.1	*	*	225.8	218.2
H	*	79.76	91.67	*	*	2270/2030	*	714.7	197.4	127.4
	*	178.2	206.3	*	*	363.2	*	212.4	141.7	212.4
	*	230.3	225.4	*	*	211.1	*	206.3	218.2	204
I	*	*	117.3	497.9	>10000	*	*	*	*	*
	*	*	207.4	172.5	198.4	*	*	*	*	*
	*	*	283.7	220.7	198.8	*	*	*	*	*
J	*	52.93	124.8	*	*	*	*	*	*	*
	*	66/109	153.5	*	*	*	*	*	*	*
	*	235.5	127.7	*	*	*	*	*	*	*
K	*	85.29	9889	*	*	*	*	*	*	*
	*	214.7	7126	*	*	*	*	*	*	*
	*	160.2	3823	*	*	*	*	*	*	*
L	*	*	2269	*	*	*	*	*	*	*
	*	*	177.8	*	*	*	*	*	*	*
	*	*	197.2	*	*	*	*	*	*	*

TABLE 4.1-8
(Continued)
BAIER SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	1	2	3	4	5	6	7	8	9	10
COLUMN M	*	220.2	*	*	*	*	*	*	*	*
	*	174.4	*	*	*	*	*	*	*	*
	*	237.3	*	*	*	*	*	*	*	*
N	601.3	1514	136.2	*	*	*	*	*	*	358.8
	115.8	155.9	150.8	*	*	*	*	*	*	205
	*	238.4	209.3	*	*	*	*	*	*	224.8
O	*	180.3	50.84	*	*	*	*	*	*	*
	*	253.7	222.9	*	*	*	*	*	*	*
	*	251.4	215.9	*	*	*	*	*	*	*
P	*	*	ND	*	*	*	*	*	*	*
	*	*	252.4	*	*	*	*	*	*	*
	*	*	213.8	*	*	*	*	*	*	*
Q	*	*	349.7	9955	>10000	*	*	*	*	*
	*	*	239.4	263.7	>10000	*	*	*	*	*
	*	*	282.7	220.8	6406	*	*	*	*	*

TABLE 4.1-8
(Continued)
BAIER SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	1	2	3	4	5	6	7	8	9	10
COLUMN R	*	*	*	171.9	3646	>10000	>10000	*	*	*
	*	*	*	199.5	942/884	181.5	>10000	*	*	*
	*	*	*	235.0	231	217.1	404.3	*	*	*
S	*	*	*	*	230.5	404/396	291.6	211.1	85.33	111.9
	*	*	*	*	196.2	214.7	173.3	247.4	163.4	138.5
	*	*	*	*	NA	226.1	189.1	240.6	222.1	205.5
T	*	*	*	*	*	*	*	*	131.5	102.9
	*	*	*	*	*	*	*	*	299.0	149.1
	*	*	*	*	*	*	*	*	170	255.9

Notes: * No sample collected for field screening.

Sample collected at 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot intervals, respectively.

TABLE 4.1-9
BAIER SITE
XRF VERIFICATION ANALYSIS
VERSUS
XRF FIELD ANALYSIS
(mg/kg)

Sample No.	XRF Analysis	Laboratory Analysis
B-A4-3	246.2	34.0
B-D7-3	206.1	20.0
B-D8-2	191	24.0
B-D8-3	171.6	28.0
B-F9-2	199	26.0
B-F9-3	212.1	32.0
B-G9-2	208.9	32.0
B-H3-2	206.3	ND(20)
B-H8-2	212.4	27.0
B-J3-2	153.5	21.0
B-L3-3	197.2	66.0
B-M2-2	174.4	32.0
B-N3-3	209.3	32.0
B-02-1	180.3	106
B-R5-3	231	59.0
B-R7-1	>10,000	16,700
B-S7-1	291.6	341
B-S8-2	247.4	21.0

TABLE 4.1-10

SOIL GAS VERIFICATION ANALYSIS
VERSUS
SOIL GAS FIELD ANALYSIS
(mg/kg)

BAIER SITE

Sample No.	Analyte	Soil Gas Analysis	Laboratory Analysis
B-C-8	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)
B-E-2	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)
B-K-2	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)

MCCARL SITE

Sample No.	Analyte	Soil Gas Analysis	Laboratory Analysis
M-L-11	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)
M-F-7	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)
M-C-12	Toluene	ND (0.01)	ND (0.05)
	Xylene, Total	ND (0.01)	ND (0.1)
	Ethylbenzene	ND (0.01)	ND (0.05)

TABLE 4.1-11
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	**B-D3-1.5-2**	**B-D3-3.5-4**	**B-D3-5.5-6**	**B-D3-5.5-6D**
Volatile Organics				
Toluene	ND(0.006)	ND(0.57)	ND(1.2)	1.0
Ethylbenzene	ND(0.006)	ND(0.57)	7.8	6.2
Total Xylenes	ND(0.006)	6.4	67	47
Acetone	0.015	ND(1.1)	6.2	3.8

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

Only detected volatile organics are listed. All samples analyzed for CLP volatile organics per the contract laboratory statement of work.

TABLE 4.1-11
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	B-F3-1.5-2	B-F3-3.5-4	B-F3-5.5-6
Volatile Organics			
Toluene	ND(0.006)	1.5J	1.5J
Ethylbenzene	ND(0.006)	11	7.3
Total Xylenes	ND(0.006)	44	34
Methylene Chloride	0.004J	ND(1.9)	ND(1.9)
Acetone	0.010J	1.5BJ	ND(3.7)
2 Butanone	ND(0.013)	ND(3.9)	1.3BJ

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

Only detected volatile organics are listed. All samples analyzed for CLP volatile organics per the contract laboratory statement of work.

TABLE 4.1-11
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
AUGUST 1990
(mg/kg)

Analyte	B-R5-1.5-2	B-R5-3.5-4	B-R5-5.5-6
Volatile Organics			
Toluene	ND(0.5)	ND(0.5)	4.8
Ethylbenzene	ND(0.5)	ND(0.5)	14
Total Xylenes	2.4	ND(0.5)	58
Acetone	1.3	2.1	12

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

Only detected volatile organics are listed. All samples analyzed for CLP volatile organics per the contract laboratory statement of work.

TABLE 4.1-11
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	B-R7-1.5-2	B-R7-3.5-4	B-R7-5.5-6
Volatile Organics			
Toluene	290	2.3	ND(0.63)
Ethylbenzene	520	8.9	2.7
Total Xylenes	2600	44	12

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

Only detected volatile organics are listed. All samples analyzed for CLP volatile organics per the contract laboratory statement of work.

TABLE 4.1-12
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	**B-E3-0-2**	**B-E3-2-4**	**B-E3-4-6**
Metals			
Arsenic	7.7	8.2	3.6
Cadmium	6.3	2.0	ND(0.69)
Chromium	41.3	28.7	14.7
Lead	171	65.0	22.1
Selenium	3.5	0.76B	0.39B
Zinc	324	249	35.5
Semi-volatile Organics			
Benzoic Acid	0.41J	0.39J	0.17J
Naphthalene	ND(0.42)	ND(0.43)	0.39J
Di-n-Butylphthalate	0.044J	0.087J	ND(1.5)
bis(2-Ethylhexyl) Phthalate	0.24J	0.14J	ND(1.5)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.1-12
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	B-G3-0-2	B-G3-2-4	B-G3-4-6
Metals			
Arsenic	4.7	6.3	4.8
Cadmium	15.9	ND(1.2)	ND(1.2)
Chromium	34.9	20.4	13.6
Lead	488	20.0	18.0
Selenium	3.2	0.59B	ND(0.47)
Zinc	578	115	50.7
Semi-volatile Organics			
Benzoic Acid	0.42J	ND(2.0)	ND(1.8)
Di-n-Butylphthalate	0.10BJ	0.064BJ	ND(0.38)
bis(2-Ethylhexyl) Phthalate	0.43	ND(0.41)	ND(0.38)
Di-n-Octyl Phthalate	0.57J	ND(0.41)	ND(0.38)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.1-12
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	B-K3-0-2	B-K3-2-4	B-K3-4-6	B-L3-0-2
Metals				
Arsenic	4.0	4.3	6.3	7.7
Cadmium	5.4	2.3	2.2	ND(1.3)
Chromium	15.1	12.6	17.3	19.7
Lead	59.9	40.0	22.5	12.5
Selenium	0.75	0.75	ND(0.58)	ND(0.51)
Zinc	105	72.6	51.3	50.1
Semi-volatile Organics				
Benzoic Acid	NA	NA	NA	0.13J

Notes:
ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.
NA - not analyzed. (Note: No semi-volatile organic analyses conducted on samples from grid B-K3).

TABLE 4.1-12
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	**B-Q5-0-2**	**B-Q5-2-4**	**B-Q5-4-6**	**B-Q5-4-6D**
Metals				
Arsenic	3.7	8.1	5.8	4.2
Cadmium	510	413	236	242
Chromium	1320	980	1220	1280
Lead	19,500	28,100	19,700	16,600
Selenium	53.5	36.8	75.1	55.1
Zinc	29,800	32,000	29,700	26,600
Semi-volatile Organics				
Naphthalene	57J	120J	650J	410J
2-Methylnaphthalene	ND(320)	48J	ND(1500)	94J

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.1-12
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	B-R7-0-2	B-R7-2-4	B-R7-4-6	B-R7-4-6D
Metals				
Arsenic	10.5	9.1	10.7	3.4
Cadmium	189	7.8	1.5	ND(1.3)
Chromium	528	37.0	22.1	18.4
Lead	37,100	246	67.4	99.2
Selenium	11.8	ND(5.3)	ND(0.51)	ND(0.51)
Zinc	16,500	456	75.5	63.1
Semi-volatile Organics				
Benzoic Acid	ND(11)	6.0J	1.3J	1.2J
Naphthalene	ND(2.3)	8.3J	0.26J	0.19J
2-Methylnaphthalene	ND(2.3)	ND(25)	0.048J	ND(0.42)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.1-13
ANALYTICAL DATA SUMMARY
BAIER SITE
DITCH SEDIMENT SAMPLES
MAY 1990
(mg/kg)

Analyte	B-SED-1	B-SED-2	B-SED-3	B-SED-4
Volatile Organics				
Toluene	ND(0.007)[1]	0.006	0.002J	0.004J
Total Xylene	ND(0.007)	ND(0.006)	ND(0.005)	ND(0.006)
Ethylbenzene	ND(0.007)	ND(0.006)	ND(0.005)	ND(0.006)
Methylene Chloride	ND(0.007)	0.003J	0.002J	0.002J
Acetone	0.014B[4]	0.021B	0.005BJ	0.014B
2-Butanone	ND(0.014)	ND(0.013)	ND(0.011)	0.031
Semi-volatile Organics				
Benzoic Acid	0.13BJ[3]	0.15BJ	0.088BJ	0.12BJ
bis-(2-Ethylhexyl) Phthalate	0.1J	ND(0.42)	ND(0.36)	ND(0.41)
Di-n-Octyl Phthalate	ND(0.45)	ND(0.42)	ND(0.36)	0.045J
Metals				
Arsenic	6.1	4.7	7.7	5.3
Cadmium	1.2B[5]	1.0B	3.9	ND(0.75)
Chromium	13.5	15.5	24.8	12.2
Lead	25.4	18.4	210	37.6
Selenium	ND(0.27)	ND(2.6)	ND(0.28)	ND(0.25)
Zinc	87.0	114	269	72

TABLE 4.1-13
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
DITCH SEDIMENT SAMPLES
MAY 1990
(mg/kg)

Analyte	B-SED-5	B-SED-6	B-SED-6D	B-SED-7	B-SED-8
Volatile Organics					
Toluene	ND(0.006)[1]	ND(0.006)	0.003J	NA	NA
Total Xylene	ND(0.006)	ND(0.006)	ND(0.008)	NA	NA
Ethylbenzene	ND(0.006)	ND(0.006)	ND(0.008)	NA	NA
Methylene Chloride	0.002J[3]	0.003J	0.004J	NA	NA
Acetone	0.009B[4]J	0.01BJ	0.025B	NA	NA
2-Butanone	ND(0.012)	ND(0.012)	ND(0.017)	NA	NA
Semi-volatile Organics					
Benzoic Acid	ND(2.0)	0.08BJ	ND(2.7)	NA	NA
bis-(2-Ethylhexyl) Phthalate	0.1J	ND(0.39)	0.13J	NA	NA
Di-n-Octyl Phthalate	ND(0.41)	ND(0.39)	ND(0.55)	NA	NA
Metals					
Arsenic	6.7	5.9	5.9	4.7	5.5
Cadmium	13.4	ND(0.72)	ND(0.75)	ND(1.3)	ND(1.3)
Chromium	95.0	13.4	11.6	16.4	13.9
Lead	1190	8.9	11.7	37.2	62.5
Selenium	5.5	ND(2.4)	ND(0.25)	2.0	1.7
Zinc	1310	37.3	70.7	71.8	88.8

TABLE 4.1-13
(Continued)
ANALYTICAL DATA SUMMARY
BAIER SITE
DITCH SEDIMENT SAMPLES
MAY 1990
(mg/kg)

Analyte	PZ-3-S1 (B-SED-9)	PZ-3-S2 (B-SED-10)	BFD + 10[9] (B-SED-11)	BFD + 100[9] (B-SED-12)	Background Ranges Baier 1989[6]	National Background Ranges[7]
Volatile Organics						
Toluene	ND(0.5)	ND(0.5)	ND(0.005)	ND(0.005)	NE[2]	NE
Total Xylene	ND(0.5)	ND(0.5)	ND(0.005)	ND(0.005)	NE	NE
Ethylbenzene	ND(0.5)	ND(0.5)	ND(0.005)	ND(0.005)	NE	NE
Methylene Chloride	ND(0.5)	ND(0.5)	ND(0.024)	ND(0.024)	NE	NE
Acetone	1.6	1.7	ND(0.012)	ND(0.28)	NE	NE
2-Butanone	ND(1.0)	ND(1.0)	ND(0.01)	ND(0.01)	NE	NE
Semi-volatile Organics						
Benzoic Acid	NA	NA	ND(960)	ND(960)	NE	NE
bis-(2-Ethylehexyl) Phthalate	NA	NA	ND(200)	ND(200)	NE	NE
Di-n-Octyl Phthalate	NA	NA	ND(200)	ND(200)	NE	NE
Metals						
Arsenic	2.5	4.8	ND(10)	ND(10)	4..2-14.5	1-50
Cadmium	1.8	1.2	35.0	ND(1)	ND(0.9)-ND(0.97)	0.01-0.7
Chromium	12.3	7.5	57.0	14.0	8.8-19.9	1-1000
Lead	34.0	8.3	880	21.0	6.5-29.3	2-200
Selenium	ND(0.67)	ND(0.61)	ND(10)	ND(10)	ND(045)-0.45	0.1-2.0
Zinc	44.2	20.4	870	59.0	ND	10-300

Notes:

1. ND() - not detected at concentration indicated in parenthesis.
2. NE - not established.
3. J - indicates an estimated value.
4. B(organics) - indicates analyte found in the associated blank as well as the sample.
5. B(inorganics) - indicates reported value is less than the contract required detection limit (CRDL), but greater than the instrument detection (IDL).
6. Background sample collected during the July 1989 field investigation.
7. USEPA 1983, Hazardous Waste Land Treatment.
8. NA - not analyzed.
9. Samples collected and analyzed by Jacobs Engineering Group on behalf of USEPA.

TABLE 4.2-1(A)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-A
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(10)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(10)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(10)
Acetone	ND(10)	ND(10)	ND(10)	ND(20)
Methylene Chloride	5B	2BJ	ND(5)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(20)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(20)
Carbon Disulfide	ND(5)	NA	ND(5)	ND(10)
1,1,1-trichloroethane	67	5	3J	96
Benzene	ND(5)	ND(5)	ND(5)	ND(10)
Chloroform	ND(5)	ND(5)	ND(5)	ND(10)
Semi-Volatile Organics				
Naphthalene	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl)Phthalate	10B	3BJ	NA	NA
Benzoic Acid	2J	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

TABLE 4.2-1(B)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-B
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
Methylene Chloride	ND(5)	2BJ	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics				
Naphthalene	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl)Phthalate	4BJ	7BJ	NA	NA
Benzoic Acid	ND(52)	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

TABLE 4.2-1(C)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-C
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
Methylene Chloride	ND(5)	8B	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1 trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics				
Naphthalene	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl)Phthalate	4BJ	2BJ	NA	NA
Benzoic Acid	ND(51)	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

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Du Pont

TABLE 4.2-1(D)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-D1
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	JULY 1990	AUGUST 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	5BJ	ND(10)
Methylene Chloride	ND(5)	ND(5)	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1-Trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics				
Naphthalene	ND(11)	ND(12)	ND(10)	NA
bis(2-ethylhexyl)Phthalate	11B	4BJ	ND(10)	NA
Benzoic Acid	ND(53)	ND(58)	ND(50)	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
Well not sampled in December 1989 or March 1990 because of access restrictions to the Fedler property.
July and August 1990 samples collected by USEPA and samples split by WCC on behalf of DuPont.

TABLE 4.2-1(E)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-D2
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	JULY 1990	AUGUST 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	11
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	4BJ	ND(10)
Methylene Chloride	ND(5)	ND(5)	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	2J	ND(5)	ND(5)	ND(5)
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics				
Naphthalene	ND(10)	ND(11)	ND(10)	NA
bis(2-ethylhexyl)Phthalate	4BJ	11B	ND(10)	NA
Benzoic Acid	ND(50)	ND(53)	ND(52)	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
Well not sampled in December 1989 or March 1990 because of access restrictions to the Fedler property.
July and August 1990 samples collected by USEPA and samples split by WCC on behalf of DuPont.

TABLE 4.2-1(F)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-E
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Methylene Chloride	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	2J	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics					
Naphthalene	ND(10)	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl) Phthalate	6BJ	8BJ	23	NA	NA
Benzoic Acid	ND(51)	ND(52)	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-1(G)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-F
(UG/L)

ANALYTE	**AUGUST 1989**	**SEPTEMBER 1989**	**DECEMBER 1989**	**MARCH 1990**	**JUNE 1990**
Volatile Organics					
Toluene	4600	5000	31000	3500	4900
Ethylbenzene	12000	10000	680000E	9900	11000
Total Xylenes	37000	30000	840000E	34000	42000
Acetone	10000	26000	44000	24000	20000
Methylene Chloride	2000B	ND(1000)	ND(2500)	ND(1700)	ND(2500)
2-Butanone	12000	16000	25000	15000	ND(5000)
4-methyl-2-pentanone	25000	36000	ND(5000)	35000	33000
Carbon Disulfide	ND(1300)	ND(1000)	ND(2500)	ND(1700)	ND(2500)
1,1,1-trichloroethane	ND(1300)	ND(1000)	ND(2500)	ND(1700)	ND(2500)
Benzene	ND(1300)	230J	ND(2500)	ND(1700)	ND(2500)
Chloroform	ND(1300)	ND(1000)	ND(2500)	ND(1700)	ND(2500)
Semi-Volatile Organics					
Naphthalene	1500	520J	ND(5000)	420J	NA
bis(2-ethylhexyl) Phthalate	240BJ	230BJ	ND(5000)	ND(1000)	NA
Benzoic Acid	ND(5100)	ND(5200)	ND(25000)	280J	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
E - concentration exceeded the calibration range of the instrument for this analysis.

TABLE 4.2-1(H)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-F2
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (initial-D)	JUNE 1990 (verification)	JUNE 1990 (verification-D)
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	12	13	2J	7
Semi-Volatile Organics				
Benzoic Acid	ND(52)	ND(54)	ND(52)	ND(52)
bis(2-Ethylhexyl)Phthalate	ND(10)	ND(11)	ND(10)	ND(10)
Naphthalene	ND(10)	ND(11)	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(11)	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(11)	ND(10)	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
D - indicates duplicate sample.

TABLE 4.2-1(I)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-G
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	9	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	5BJ
Methylene Chloride	5B	ND(5)	2BJ	ND(5)	1J
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	10	ND(5)
Semi-Volatile Organics					
Naphthalene	16	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl) Phthalate	8BJ	5BJ	4BJ	NA	NA
Benzoic Acid	ND(80)	ND(52)	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

TABLE 4.2-1(J)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-H
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	4J	ND(10)
Methylene Chloride	6B	ND(5)	2BJ	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics					
Naphthalene	ND(10)	ND(10)	ND(10)	NA	NA
bis(2-ethylhexyl) Phthalate	11B	5BJ	4BJ	NA	NA
Benzoic Acid	3J	ND(52)	ND(50)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-1(K)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-I
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	4J	ND(10)
Methylene Chloride	6B	ND(5)	2BJ	ND(5)	ND(5)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-methyl-2-pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)	ND(5)	2J
1,1,1-trichloroethane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Chloroform	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics					
Naphthalene	ND(10)	ND(10)	ND(5)	NA	NA
bis(2-ethylhexyl) Phthalate	19B	5BJ	4BJ	NA	NA
Benzoic Acid	ND(52)	ND(50)	ND(25)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile and semivolatile compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-1(L)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MW-J
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Volatile Organics		
Toluene	ND(50)	ND(25)
Ethylbenzene	460	320
Total Xylenes	530	340
1,2-Dichloropropane	ND(50)	NDND(25)
Methylene Chloride	ND(50)	ND(25)
Benzene	ND(50)	ND(25)
Acetone	ND(100)	ND(50)
2-Butanone	ND(100)	ND(50)
4-Methyl-2-Pentanone	ND(100)	ND(50)
Carbon Disulfide	ND(50)	ND(25)
Semi-Volatile Organics		
Benzoic Acid	ND(110)	ND(100)
bis(2-Ethylhexyl)Phthalate	ND(22)	ND(20)
Naphthalene	ND(22)	ND(20)
Di-n-Octyl-Phthalate	ND(22)	ND(20)
Butylbenzylphthalate	ND(22)	ND(20)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-1(M)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-K1
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Volatile Organics		
Toluene	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	ND(5)	ND(5)
Acetone	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(53)	ND(120)
bis(2-Ethylhexyl)Phthalate	8J	8BJ
Naphthalene	ND(11)	ND(25)
Di-n-Octyl-Phthalate	ND(11)	ND(25)
Butylbenzylphthalate	ND(11)	ND(25)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-2(M)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-K1
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)	
	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals				
Arsenic	52.0B	5.9B	9.7B	8.1B
Barium	2090	18.3B	190B	53.4B
Cadmium	ND(10)	ND(5.0)	ND(3.0)	ND(3.0)
Chromium	175	ND(5.0)	22.3	ND(5.0)
Lead	213	ND(1.0)	11.1	ND(2.0)
Selenium	ND(20)	9.9	46.0B	33.7
Secondary Drinking Water Metals				
Aluminum	155000	157B	9880	126B
Copper	214	ND(4.0)	29.3	ND(4.0)
Iron	219000	119	14000	257
Manganese	8290	237	990	527
Zinc	799	ND(1.0)	85.3	10.8B

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(N)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-K2
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)		AUGUST 1990	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals (reverification)						
Arsenic	71.3	1.3B	5.3B	1.1B	ND(5.0)	ND(5.0)
Barium	2800	88.5B	135B	87.7B	110	120
Cadmium	20.8	ND(5.0)	ND(3.0)	ND(3.0)	ND(5.0)	ND(5.0)
Chromium	1190	ND(5.0)	21.2	ND(5.0)	44	ND(10)
Lead	425	ND(1.0)	6.2	ND(2.0)	ND(5.0)	ND(5.0)
Selenium	ND(20)	ND(2.0)	1.6B	ND(2.0)	ND(5.0)	ND(5.0)
Secondary Drinking Water Metals						
Aluminum	176000	41.0B	3410	50.8B	1300	ND(100)
Copper	1000	ND(4.0)	29.4	ND(4.0)	ND(10)	ND(10)
Iron	960000	149	15000	207	2500	ND(100)
Manganese	16800	442	906	579	960	960
Zinc	3180	ND(1.0)	57.1	24.3	38	ND(20)

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(O)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-L1
(UG/L)

ANALYTE	**JULY 1990 (initial)** Total	Dissolved	**AUGUST 1990 (verification)** Total	Dissolved
Primary Drinking Water Metals				
Arsenic	6.1B	6.9B	ND(5)	ND(5)
Barium	479	69.9B	110	130
Cadmium	ND(5.0)	ND(5.0)	ND(5)	ND(5)
Chromium	60.4	ND(5.0)	ND(10)	ND(10)
Lead	12.5	ND(1.0)	ND(5)	ND(10)
Selenium	11.8	ND(2.0)	ND(25)	13
Secondary Drinking Water Metals				
Aluminum	8200	30.5B	ND(100)	ND(100)
Copper	45.6	ND(4.0)	ND(20)	ND(20)
Iron	25,400	23.1B	870	ND(100)
Manganese	1080	ND(8.0)	660	520
Zinc	80.0	4.4B	22	23

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
Well installed and sampled by USEPA. Split samples obtained by WCC on behalf of DuPont.

TABLE 4.2-2(P)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-12
(UG/L)

ANALYTE	JULY 1990 (initial)		AUGUST 1990 (verification)	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved
Arsenic	63.7	ND(2.0)	ND(5)	ND(5)
Barium	1180	220	230	120
Cadmium	ND(5.0)	ND(5.0)	ND(5)	ND(5)
Chromium	276	44.8	41	ND(10)
Lead	147	ND(1.0)	ND(10)	ND(10)
Selenium	ND(20)	13.3	ND(5)	ND(5)
Secondary Drinking Water Metals				
Aluminum	84300	ND(25)	ND(100)	ND(100)
Copper	234	ND(4.0)	26	ND(20)
Iron	216000	ND(22)	17800	ND(100)
Manganese	55200	205	550	140
Zinc	588	7.8B	76	ND(20)

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
Well installed and sampled by USEPA. Split samples obtained by WCC on behalf of DuPont.

TABLE 4.2-3(A)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-A
(MG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	735	1660	1200	365
Nitrate/Nitrite	5.4	7.3	4.9	12.4
Sulfate	600	785	813	157
Alkalinity	542	452	416	264
Chloride	12.6	13.3	9.6	12.2
Total Dissolved Solids (TDS)	1770	1660	1740	572
Total Suspended Solids (TSS)	NA	NA	1810	534

Notes:

NA - not analyzed.

TABLE 4.2-3(B)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-B
(MG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	2186	2290	2110	2290
Nitrate/Nitrite	0.13	ND(0.1)	ND(0.1)	ND(0.1)
Sulfate	1770	1770	2120	2000
Alkalinity	370	348	321	388
Chloride	47.9	54.6	50.4	49.8
Total Dissolved Solids (TDS)	3310	3090	3470	3500
Total Suspended Solids (TSS)	NA	NA	1450	345

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(C)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-C
(MG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	691	1110	671	719
Nitrate/Nitrite	2.2	2.3	2.3	2.1
Sulfate	264	273	282	282
Alkalinity	474	506	463	558
Chloride	10.1	11.2	8.3	21.1
Total Dissolved Solids (TDS)	945	856	890	950
Total Suspended Solids (TSS)	NA	NA	1810	2970

Notes:

NA - not analyzed.

TABLE 4.2-3(D)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-D1
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	JUNE 1990
Hardness	657	648	NA
Nitrate/Nitrite	4.2	3.9	NA
Sulfate	210	214	NA
Alkalinity	471	468	NA
Chloride	26.2	27.5	NA
Total Dissolved Solids (TDS)	849	834	NA

Notes:

NA - not analyzed.

TABLE 4.2-1(N)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-K2
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Volatile Organics		
Toluene	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	ND(5)	ND(5)
Acetone	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(50)	ND(50)
bis(2-Ethylhexyl)Phthalate	ND(10)	ND(10)
Naphthalene	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(10)
Di-n-Butylphthalate	2J	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - indicates analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

TABLE 4.2-1(O)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-L1
(UG/L)

ANALYTE	JULY 1990 (initial)	AUGUST 1990 (verification)
Volatile Organics		
Toluene	3J	12
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	2J	ND(5)
Acetone	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(50)	ND(50)
bis(2-Ethylhexyl)Phthalate	6J	ND(10)
Naphthalene	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
Well installed and sampled by USEPA. Split samples obtained by WCC on behalf of DuPont.

TABLE 4.2-1(P)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-L2
(UG/L)

ANALYTE	JULY 1990 (initial)	AUGUST 1990 (verification)
Volatile Organics		
Toluene	4J	ND(5)
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	1J	ND(5)
Acetone	9BJ	ND(10)
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(50)	ND(50)
bis(2-Ethylhexyl)Phthalate	ND(10)	ND(10)
Naphthalene	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
Well installed and sampled by USEPA. Split samples obtained by WCC on behalf of DuPont.

TABLE 4.2-1(Q)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
PIEZOMETER PZ-03
(MG/L)

ANALYTE	**AUGUST 1990** (Initial)
Volatile Organics	
Toluene	ND(5)
Ethylbenzene	ND(5)
Total Xylenes	ND(5)
Acetone	3BJ
Methylene Chloride	ND(5)
2-Butanone	ND(10)
4-Methyl-2-Pentanone	ND(10)
Carbon Disulfide	ND(5)
1,1,1-Trichlorethane	ND(5)
Benzene	ND(5)
Chloroform	ND(5)
Semi-Volatile Organics	
Napthalene	NA
bis(2-Ethylhexyle) Phthalate	NA
Benzoic Acid	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - indicates analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

·TABLE 4.2-1(R)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
WELL MW-FB
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Volatile Organics		
Toluene	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	ND(5)	ND(5)
Acetone	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(52)	ND(51)
bis(2-Ethylhexyl)Phthalate	ND(10)	ND(10)
Naphthalene	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.2-2(A)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-A
(UG/L)

ANALYTE	AUGUST 1989		DECEMBER 1989		MARCH 1990		JUNE 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	4.5B	ND(2.0)	17.4	ND(2.0)	7.2B	ND(1.0)	1.1B	ND(1.0)
Barium	21.1B	52.8B	438	21.6B	436	20.2B	54.0B	44.0B
Cadmium	ND(3.6)	ND(3.6)	6.1	ND(3.0)	3.6B	ND(3.0)	ND(5.0)	ND(5.0)
Chromium	9.88	ND(5.5)	80.0	ND(5.0)	71.1	ND(5.0)	26.5	8.5B
Lead	38.3	ND(1.0)	32.0	ND(10)	27.2	ND(2.0)	1.8B	ND(1.0)
Selenium	ND(10)	3.1B	ND(20)	ND(10)	ND(20)	ND(20)	4.8B	3.7B
Secondary Drinking Water Metals								
	2970	ND(30.7)	37800	ND(27)	27900	ND(22)	1070	ND(25)
	ND(6.0)	ND(6.0)	74.2	ND(5.0)	82.1	ND(4.0)	11.4B	ND(4.0)
Aluminum	3720	ND(22.3)	78300	ND(23)	71100	ND(21)	2500	ND(22)
Copper	549	214	1680	11.7B	1670	19B	75.0	ND(8.0)
Iron	63.9	7.6B	226	ND(2.0)	223	ND(2.0)	74.1	2.5B
Manganese								
Zinc								

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(B)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-B
(UG/L)

ANALYTE **Primary Drinking Water Metals 1990**	**AUGUST 1989**		**DECEMBER 1989**		**MARCH 1990**		**JUNE**	
	Total	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Arsenic	14.0	2.1B	17.6	3.3B	11.9	1.8B	3.9B	2.6B
Barium	228	36.6B	288	23.0B	253	20.4B	87.8B	36.3B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(5.0)	ND(5.0)
Chromium	27.7	ND(5.5)	38.9	ND(5.0)	35.1	ND(5.0)	31.7	ND(5.0)
Lead	10.4	18.0B	13.0B	ND(10)	14.5	ND(20)	ND(10)	ND(10)
Selenium	ND(20)	24.0B	ND(20)	ND(10)	ND(20)	ND(20)	ND(2.0)	ND(2.0)
Secondary Drinking Water Metals								
	9180	ND(30.7)	15300	ND(27)	11500	ND(22)	2840	ND(25)
Aluminum	20.4B	ND(6.0)	34.7	ND(5.0)	29.5	ND(4.0)	13.7B	ND(4.0)
Copper	20100	141	26700	ND(23)	24800	78.7B	6300	833
Iron	1540	690	1540	654	1480	719	899	864
Manganese	74.2	10.3B	65.4	ND(2.0)	61.5	ND(2.0)	40.1	13.1B
Zinc								

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(C)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-C
(UG/L)

ANALYTE

Primary Drinking Water Metals	**AUGUST 1989**		**DECEMBER 1989**		**MARCH 1990**		**JUNE 1990**	
	Total	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Arsenic	4.6B	ND(2.0)	22.9	2.2B	16.5	ND(1.0)	2.4B	ND(1.0)
Barium	180	72.0B	512	68.5B	1160	51.5B	114B	75.7B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(5.0)	ND(5.0)
Chromium	30.7	ND(5.5)	130	ND(5.0)	276	ND(5.0)	22.4	ND(5.0)
Lead	5.5	ND(1.0)	38.6	ND(10)	127	ND(2.0)	4.4B	ND(1.0)
Selenium	28.2	50.4	34.08	47.4	ND(20)	47.9	41.6	49.8
Secondary Drinking Water Metals								
Aluminum	7220	ND(30.7)	47600	ND(27)	95600	ND(22)	3690	ND(25)
Copper	19.0B	ND(6.0)	105	ND(5.0)	26.3	ND(4.0)	21.3B	ND(4.0)
Iron	19500	ND(22.3)	118000	ND(23)	275000	ND(21)	9730	ND(22)
Manganese	451	ND(7.8)	1980	ND(9.0)	4770	ND(10)	208	12.0B
Zinc	84.4	26.7	251	ND(2.0)	611	ND(2.0)	105	25.5

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(D)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-D1
(UG/L)

ANALYTE	AUGUST 1989		SEPTEMBER 1989		JULY 1990		AUGUST 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	3.5B	ND(2.0)	4.3B	ND(1.0)	1.7B	ND(1.0)	ND(5)	ND(10)
Barium	253	158B	432	182B	167B	158B	150	130
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(5.0)	ND(5.0)	ND(5)	ND(5)
Chromium	19.7	ND(5.5)	41.1	ND(8.0)	10.8	5.2B	13	ND(10)
Lead	7.0	1.2B	20.2	ND(1.0)	3.4B	ND(1.0)	ND(10)	ND(10)
Selenium	115	140	94.0	124	148	178	150	130
Secondary Drinking Water Metals								
Aluminum	6270	ND(30.7)	11200	ND(32.0)	2220	ND(25)	3300	ND(100)
Copper	17.7B	ND(6.0)	45.4	ND(6.0)	14.3B	6.1B	ND(20)	ND(20)
Iron	20400	ND(22.3)	39700	ND(28.0)	6600	ND(22)	8000	ND(100)
Manganese	609	214	1330	239	352	135	340	140
Zinc	85.6	12.2B	166	9.7B	64.6	24.0	61	ND(20)

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
Well not sampled in December 1989 or March 1990 because of access restrictions to the Fedler property.
July and August 1990 samples collected by USEPA and samples split by WCC on behalf of DuPont.

TABLE 4.2-2(E)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAILER SITE GROUND WATER SAMPLES
WELL MW-D2
(UG/L)

ANALYTE								
Primary Drinking Water Metals	**AUGUST 1989**		**SEPTEMBER 1989**		**JULY 1990**		**AUGUST 1990**	
	Total	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Arsenic	ND(2.0)	ND(2.0)	ND(1.0)	ND(1.0)	5.2B	ND(1.0)	ND(5)	ND(5)
Barium	83.0	74.4B	102B	85.6	286	146B	290	120
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(5.0)	ND(5.0)	ND(5)	ND(5)
Chromium	18.2	ND(5.5)	21.7	ND(8.0)	37.4	ND(5.0)	38	ND(10)
Lead	ND(1.0)	1.5B	ND(1.0)	ND(1.0)	18.6	ND(1.0)	ND(5)	ND(5)
Selenium	ND(2.0)	ND(2.0)	ND(10.0)	ND(1.0)	ND(20)	3.4B	ND(5)	ND(5)
Secondary Drinking Water Metals								
Aluminum	342	ND(30.7)	458	ND(32.0)	11700	ND(25)	ND(100)	ND(100)
Copper	ND(6.0)	ND(6.0)	6.8B	ND(6.0)	45.2	ND(4.0)	ND(20)	ND(20)
Iron	952	ND(22.3)	976	ND(28.0)	32100	ND(22)	7200	ND(100)
Manganese	145	132	388	289	1210	661	670	650
Zinc	54.5	25.2	45.5	27.9	210	83.6	42	ND(20)

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
Well not sampled in December 1989 or March 1990 because of access restrictions to the Fedler property.
July and August 1990 samples collected by USEPA and samples split by WCC on behalf of DuPont.

TABLE 4.2-2(F)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-E
(UG/L)

ANALYTE	**JUNE 1990**		**AUGUST 1989**		**SEPTEMBER 1989**		**DECEMBER 1989**		**MARCH 1990**	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals										
Arsenic	7.5B	ND(2.0)	ND(1.0)	ND(1.0)	5.4B	ND(1.0)	1.8B	ND(1.0)	ND(1.0)	ND(1.0)
Barium	414	100B	117B	84.8B	500	59.7B	144B	48.7B	78.7B	73.3B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	44.4	ND(5.5)	26.3	ND(8.0)	69.6	ND(5.0)	27.1	ND(5.0)	9.1B	ND(5.0)
Lead	13.5	ND(1.0)	ND(1.0)	ND(1.0)	5.6	ND(10)	5.7	ND(2.0)	ND(2.0)	ND(2.0)
Selenium	ND(2.0)	8.9	ND(10.0)	ND(10.0)	ND(10)	ND(10)	ND(20)	ND(20)	24.7	25.1
Secondary Drinking Water Metals										
Aluminum	11400	ND(30.7)	424	ND(32.0)	6240	ND(27)	1400	ND(22)	762	ND(22)
Copper	36.9	ND(6.0)	7.2B	ND(6.0)	27.2	ND(5.0)	10.4B	ND(4.0)	11.1B	ND(4.0)
Iron	31900	ND(22.3)	1070	ND(28.0)	16700	ND(23)	4140	ND(21)	2660	ND(21)
Manganese	1500	352	436	484	1190	690	593	503	623	547
Zinc	170	22.3	49.2	52.9	64.8	5.0B	48.9	7.5B	60.3	28.0

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(G)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-F
(UG/L)

ANALYTE	**AUGUST 1989**		**SEPTEMBER 1989**		**DECEMBER 1989**		**MARCH 1990**		**JUNE**	
Primary Drinking Water Metals 1990	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	4.4B	ND(2.0)	1.2B	ND(1.0)	ND(2.0)	ND(1.0)	7.2B	3.0B	4.7B	2.3B
Barium	368	255	430	377	546	568	810	702	871	814
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	26.5	ND(5.5)	ND(8.0)	ND(8.0)	7.8B	ND(5.0)	24.8	ND(5.0)	15.8	ND(5.0)
Lead	12.8	ND(1.0)	2.6B	ND(1.0)	3.5B	ND(10)	21.4	ND(2.0)	10.6	ND(2.0)
Selenium	ND(20)	ND(2.0)	ND(10.0)	ND(10.0)	ND(10)	ND(10)	ND(20)	ND(20)	ND(10)	ND(2.0)
Secondary Drinking Water Metals										
Aluminum	5560	ND(30.7)	575	ND(32.0)	1470	ND(27)	6850	ND(22)	4320	ND(22)
Copper	22.1B	ND(6.0)	20.5B	ND(6.0)	43.5	16.3B	50.4	ND(4.0)	44.1	ND(4.0)
Iron	13400	ND(22.3)	1480	ND(28.0)	3120	ND(23)	17800	1690	11000	534
Manganese	1280	789	3990	4020	9340	9520	10500	8920	8740	7160
Zinc	82.5	8.5B	35.2	23.6	22.7	ND(2.0)	97.1	10.1B	70.9	22.9

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(H)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAILER SITE GROUND WATER SAMPLES
WELL MW-F2
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (initial-D)		JUNE 1990 (verification)		JUNE 1990 (verification-D)	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals								
Arsenic	2.9B	ND(1.0)	3.2B	ND(1.0)	6.0B	ND(1.0)	5.7B	ND(1.0)
Barium	144B	134B	156B	ND(5.0)	150B	100B	144B	108B
Cadmium	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	12.3	ND(5.0)	9.2B	ND(1.0)	19.0	ND(5.0)	16.3	ND(5.0)
Lead	2.3B	ND(1.0)	2.4B	ND(2.0)	ND(20)	ND(2.0)	ND(2.0)	ND(2.0)
Selenium	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(1.0)	ND(20)	ND(1.0)	ND(2.0)
Secondary Drinking Water Metals								
Aluminum	1790	ND(25)	2160	ND(25)	3890	ND(22)	3290	ND(22)
Copper	8.7B	ND(4.0)	8.4B	ND(4.0)	14.5B	ND(4.0)	18.1B	ND(4.0)
Iron	6360	37.1B	7610	31.3B	12100	ND(21)	10800	ND(21)
Manganese	567	465	603	469	846	602	825	621
Zinc	66.3	45.9	72.7	55.4	71.3	34.2	94.6	32.4

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
D - indicates a duplicate sample.

TABLE 4.2-2(I)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-G
(UG/L)

ANALYTE	AUGUST 1989		SEPTEMBER 1989		DECEMBER 1989		MARCH 1990		JUNE 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	NA	ND(2.0)	ND(1.0)	ND(1.0)	ND(2.0)	2.6B	ND(1.0)	ND(1.0)	3.9B	ND(1.0)
Barium	NA	206	305	216	225	213	191B	161B	1920	125B
Cadmium	NA	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	NA	ND(5.5)	11.7	ND(8.0)	8.7B	ND(5.0)	5.4B	ND(5.0)	74.9	ND(5.0)
Lead	NA	ND(1.0)	1.7B	ND(1.0)	11.2	ND(10)	ND(2.0)	ND(2.0)	ND(20)	ND(2.0)
Selenium	NA	ND(4.4B)	ND(10.0)	ND(1.0)	2.2B	ND(1.0)	ND(20)	ND(20)	1.4B	ND(2.0)
Secondary Drinking Water Metals										
Aluminum	NA	ND(30.7)	842	ND(32.0)	1050	ND(27)	864	ND(22)	13300	ND(22)
Copper	NA	ND(6.0)	11.4B	ND(6.0)	16.7B	ND(5.0)	7.6B	ND(4.0)	126	ND(4.0)
Iron	NA	ND(22.3)	3740	ND(28.0)	3560	ND(23)	2410	ND(21)	66400	ND(21)
Manganese	NA	2810	2650	2060	596	222	776	1640	4150	2610
Zinc	NA	28.4	34.5	16.8B	52.5	3.3B	23.1	12.9B	222	6.6B

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
NA - not available due to insufficient ground water recharge prior to sampling.

TABLE 4.2-2(J)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAILER SITE GROUND WATER SAMPLES
WELL MW-H
(UG/L)

ANALYTE		AUGUST 1989		SEPTEMBER 1989		DECEMBER 1989		MARCH 1990		JUNE 1990
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	3.3B	ND(2.0)	5.7B	ND(1.0)	11.3	2.3B	2.6B	ND(1.0)	2.2B	ND(1.0)
Barium	303	129B	377	143B	342	113B	152B	87.3B	180B	101B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	57.0	ND(5.5)	44.9	ND(8.0)	79.7	ND(5.0)	21.7	ND(5.0)	26.1	ND(5.0)
Lead	29.4	ND(1.0)	16.8	ND(1.0)	15.1	ND(1.0)	3.6B	ND(2.0)	9.3	ND(2.0)
Selenium	ND(10)	ND(2.0)	ND(10.0)	ND(1.0)	ND(20)	ND(1.0)	ND(20)	ND(2.0)	ND(10)	ND(1.0)
Secondary Drinking Water Metals										
Aluminum	16900	ND(30.7)	12400	ND(32.0)	24600	ND(27)	5160	ND(22)	6100	83.4B
Copper	39.3	ND(6.0)	48.1	ND(6.0)	50.6	ND(5.0)	15.7B	ND(4.0)	26.4	ND(4.0)
Iron	51100	ND(22.3)	41200	ND(28.0)	51800	ND(23)	10700	ND(21)	16600	113
Manganese	1030	113	1220	65.1	1070	ND(9.0)	318	87.2	419	37.0
Zinc	129	15.7B	133	17.7B	127	ND(2.0)	45.7	9.8B	58.8	10.6B

Notes:

Only detected primary and secondary drinking water metals listed.

B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

ND ( ) - not detected at concentration indicated in parenthesis.

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TABLE 4.2-2(K)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-I
(UG/L)

ANALYTE		AUGUST 1989		SEPTEMBER 1989		DECEMBER 1989		MARCH 1990		JUNE 1990
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals										
Arsenic	2.3B	ND(2.0)	ND(1.0)	ND(1.0)	6.0B	ND(2.0)	2.2B	ND(1.0)	6.7B	ND(1.0)
Barium	236	215	238	184B	352	193B	237	139B	880	106B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	9.6B	ND(5.5)	ND(8.0)	ND(8.0)	31.1	ND(5.0)	12.3	ND(5.0)	59.6	ND(5.0)
Lead	3.2B	1.7B	ND(1.0)	ND(1.0)	10.7	ND(10)	3.3B	ND(2.0)	31.9	ND(2.0)
Selenium	ND(2.0)	ND(2.0)	ND(10.0)	ND(10.0)	6.4	ND(10)	ND(20)	ND(20)	ND(1.0)	ND(2.0)
Secondary Drinking Water Metals										
Aluminum	1840	ND(30.7)	1120	ND(32.0)	9560	ND(27)	3010	ND(22)	33300	ND(22)
Copper	10.1B	ND(6.0)	ND(6.0)	ND(6.0)	39.4	ND(5.0)	16.5B	ND(4.0)	109	ND(4.0)
Iron	4250	ND(22.3)	2820	ND(28.0)	19400	ND(23)	6350	ND(21)	67500	ND(21)
Manganese	436	250	773	751	1280	608	749	709	2150	1080
Zinc	41.3	17.0B	33.9	18.7B	79.3	ND(2.0)	38.0	9.3B	245	23.9

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-2(L)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
BAIER SITE GROUND WATER SAMPLES
WELL MW-J
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)	
	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals				
Arsenic	4.6B	3.8B	3.9B	2.4B
Barium	1730	148B	167B	153B
Cadmium	ND(10)	ND(5.0)	ND(3.0)	ND(3.0)
Chromium	170	ND(5.0)	15.3	ND(5.0)
Lead	232	ND(1.0)	4.9B	ND(2.0)
Selenium	ND(20)	ND(2.0)	ND(10)	ND(2.0)
Secondary Drinking Water Metals				
Aluminum	52600	ND(25)	1300	47.3B
Copper	154	ND(4.0)	30.9	ND(4.0)
Iron	162000	ND(22)	4010	ND(21)
Manganese	5410	2010	2880	2690
Zinc	606	7.7B	98.7	75.3

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(E)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-D2
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	JUNE 1990
Hardness	348	372	NA
Nitrate/Nitrite	0.11	0.14	NA
Sulfate	92.0	77.0	NA
Alkalinity	391	381	NA
Chloride	36.0	30.7	NA
Total Dissolved Solids (TDS)	666	560	NA

Notes:

NA - not analyzed.

TABLE 4.2-3(F)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-E
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	1313	1320	1330	1022	1130
Nitrate/Nitrite	0.44	0.35	0.34	0.77	0.97
Sulfate	660	582	635	573	504
Alkalinity	567	539	550	562	594
Chloride	39.5	44.1	41.7	41.1	52.1
Total Dissolved Solids (TDS)	1710	1760	1660	1520	1400
Total Suspended Solids (TSS)	NA	NA	NA	432	1570

Notes:

NA - not analyzed.

TABLE 4.2-3(G)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-F
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	781	787	710	663	980
Nitrate/Nitrite	0.11	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.1)
Sulfate	66.0	12.7	ND(5)	ND(5)	ND(5)
Alkalinity	821	790	767	727	829
Chloride	17.5	19.5	10.8	8.4	9.6
Total Dissolved Solids (TDS)	964	999	867	842	986
Total Suspended Solids (TSS)	NA	NA	NA	1090	437

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(H)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-F2
(MG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (initial-D)	JUNE 1990 (verification)	JUNE 1990 (verification-D)
Hardness	817	836	927	925
Nitrate/Nitrite	ND(0.2)	0.77	0.13	ND(0.1)
Sulfate	520	500	490	560
Alkalinity	389	388	388	384
Chloride	9.7	9.2	7.3	12.2
Total Dissolved Solids (TDS)	1280	1260	1290	1300
Total Suspended Solids (TSS)	NA	NA	191	140

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.
D - indicates a duplicate sample.

TABLE 4.2-3(I)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-G
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	NS	788	710	636	956
Nitrate/Nitrite	NS	ND(0.1)	ND(0.1)	0.28	0.41
Sulfate	NS	267	ND(5)	175	242
Alkalinity	NS	552	767	479	581
Chloride	NS	25.7	10.8	16.1	13.6
Total Dissolved Solids (TDS)	NS	1010	867	757	859
Total Suspended Solids (TSS)	NA	NA	NA	63.6	1280

Notes:

NS - Not available due to insufficient ground water recharge prior to sampling.
NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(J)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-H
(MG/L)

ANALYTE	**AUGUST 1989**	**SEPTEMBER 1989**	**DECEMBER 1989**	**MARCH 1990**	**JUNE 1990**
Hardness	389	471	570	406	467
Nitrate/Nitrite	5.3	6.9	6.5	4.8	8.4
Sulfate	97.0	52.1	77.0	55.3	55
Alkalinity	567	435	388	402	380
Chloride	32.4	17.7	12.4	7.3	14.2
Total Dissolved Solids (TDS)	652	584	513	518	522
Total Suspended Solids (TSS)	NA	NA	NA	519	130

Notes:

NA - not analyzed.

TABLE 4.2-3(K)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-I
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	1049	344	846	906	1220
Nitrate/Nitrite	0.70	0.18	0.13	ND(0.1)	0.15
Sulfate	332	377	342	423	464
Alkalinity	527	493	520	539	649
Chloride	20.0	16.5	16.0	13.3	20.2
Total Dissolved Solids (TDS)	1180	1110	1060	1140	1240
Total Suspended Solids (TSS)	NA	NA	NA	104	7300

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(L)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-J
(MG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Hardness	1680	503
Nitrate/Nitrite	ND(0.1)	ND(0.1)
Sulfate	35.5	54.0
Alkalinity	539	540
Chloride	16.7	16.7
Total Dissolved Solids (TDS)	625	664
Total Suspended Solids (TSS)	NA	209

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(M)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-K1
(MG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Hardness	1860	783
Nitrate/Nitrite	0.87	1.8
Sulfate	585	475
Alkalinity	894	603
Chloride	66.5	47.7
Total Dissolved Solids (TDS)	1690	1520
Total Suspended Solids (TSS)	NA	348

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-3(N)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
BAIER SITE GROUND WATER SAMPLES
MW-K2
(MG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Hardness	3720	353
Nitrate/Nitrite	ND(0.1)	ND(0.1)
Sulfate	233	153
Alkalinity	717	401
Chloride	94.7	67.2
Total Dissolved Solids (TDS)	752	680
Total Suspended Solids (TSS)	NA	2040

Notes:

NA - not analyzed.
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.2-4
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
BAIER SITE GROUND WATER SAMPLES
MARCH 1990
(UG/L)

ANALYTE[1]	**MONITORING WELL** **MW-F**	 **MW-FD**
Volatile Organics		
Toluene	3500	3700
Ethylbenzene	9900	10000
Total Xylenes	34000	35000
Acetone	24000	25000
Methylene Chloride	ND(1700)	ND(1700)
2-Butanone	15000	16000
4-Methyl-2-Pentanone	35000	37000
1,1,1-Trichloroethane	ND(1700)	ND(1700)
Chloroform	ND(1700)	ND(1700)
Semi-volatile Organics		
Benzoic Acid	280J	ND(5000)
Napthalene	420J	300J

Notes:

[1] Only compounds of historical interest and/or detected are listed. All samples analyzed for hazardous substance list (HSL) volatile organic compounds in accordance with SOW 7/87. Monitoring well MW-F also analyzed for hazardous substance list (HSL) semi-volatile organic compounds in accordance with SOW 7/87.

[2] ND ( ) - not detected at concentration indicated in parenthesis.

[3] J - indicates an estimated value.

[4] NA - not analyzed for semi-volatile organics.

TABLE 4.3-1
ANALYTICAL DATA SUMMARY
MCCARL SITE SOIL SAMPLES
MAY 1989
(mg/kg)

Analyte	MA-04[1] (0-6)[2]	MA-04 (12-24)	MA-05 (0-6)	MA-06 (12-24)	MA-06D (12-24)
Volatile Organics					
Toluene	NC[3]	ND(0.006)[4]	ND(0.007)	ND(0.006)	ND(0.006)
Ethylbenzene	NC	ND(0.006)	ND(0.007)	ND(0.006)	ND(0.006)
Total Xylenes	NC	ND(0.006)	ND(0.007)	ND(0.006)	ND(0.006)
Methylene Chloride	NC	0.003BJ[5,6]	0.004J	0.006J	0.004BJ
Acetone	NC	ND(0.013)	ND(0.014)	17	0.013B
Metals					
Cadmium	ND(0.98)[4]	ND(1.0)	8.5	1.0B	3.3
Chromium	10.1	18.9	70.0	24.6	40.8
Arsenic	2.3B	4.5	6.2	9.3	23.3
Selenium	ND(0.24)	ND(0.26)	2.4	0.43B	2.2
Lead	14.0	18.2	663	69.6	254
pH	4.95	5.23	5.84	5.71	5.31

Notes:

[1] Refer to Figures 3 and 5 for sample locations.
[2] Sample interval below ground surface (inches).
[3] NC - Not collected from this interval.
[4] ND ( ) - Not detected at concentration indicated in parenthesis.
[5] B (Volatile Organics) - Analyte is found in associated blank as well as sample.
[6] J - Indicates an estimated value.
[7] B (Metals) - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limits (IDL).

TABLE 4.3-1
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE SOIL SAMPLES
MAY 1989
(mg/kg)

Analyte	MA-07[1] (0-6)[2]	MA-07 (12-24)	MA-08 (0-6)	MA-08 (12-24)	TP-09 (6-12)	TP-09 (18-24)
Volatile Organics						
Toluene	NC[3]	ND(0.006)	NC[3]	ND(0.006)	NC	ND(13)
Ethylbenzene	NC	ND(0.006)	NC	ND(0.006)	NC	29
Total Xylenes	NC	ND(0.006)	NC	ND(0.006)	NC	240
Methylene Chloride	NC	0.009B	NC	0.004BJ	NC	ND(13)
Acetone	NC	0.021B	NC	0.003BJ	NC	ND(26)
Metals						
Cadmium	14.3	ND(1.0)	4.2	ND(0.96)	56	3.7
Chromium	100	18.8	19.2	16.4	936	225
Arsenic	8.6	7.3	6.3	10.1	9.7	25.8
Selenium	1.4	ND(0.26)	0.35B[7]	0.31B	7.2B	3.1
Lead	714	14	231	25	14900	215
pH	8.66	4.32	6.35	5.01	6.52	5.44

Notes:

1. Refer to Figures 3 and 5 for sample locations.
2. Sample interval below ground surface (inches).
3. NC - Not collected from this interval.
4. ND ( ) - Not detected at concentration indicated in parenthesis.
5. B (Volatile Organics) - Analyte is found in associated blank as well as sample.
6. J - Indicates an estimated value.
7. B (Metals) - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

TABLE 4.3-2

ANALYTICAL DATA SUMMARY
MCCARL SITE WASTE SAMPLES
MAY 1989
(mg/kg)

Analyte	MA-06[1] (0-6)[2]	MA-06D (0-6)	TP-09 (0-6)
Metals			
Cadmium	107	166	293
Chromium	1100	1430	3630
Arsenic	4.4	2.6B[3]	6.9
Selenium	11.1	36.3	42.0
Lead	7,420	11400	15700
pH	6.23	6.12	7.0

Notes:

[1] Refer to Figures 3 and 5 for sample locations.

[2] Sample interval below ground surface (inches).

[3] B - Indicates value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

TABLE 4.3-3
ANALYTICAL DATA SUMMARY
TCLP RESULTS
MCCARL SITE WASTE SAMPLES
MAY 1989
(mg/l)

Analyte[1]	TP-09[2] (0-6)[3]
Volatile Organics	
Toluene	0.54
Ethylbenzene	0.61
Total Xylenes	12.5
2-Chloroethyl-vinyl ether	4.1
Semi-Volatile Organics	
2,4-Dimethylphenol	0.058
Naphthalene	0.44
2-Methylnaphthalene	0.045
2-Methylphenol	0.024
Metals	
Barium	0.6
Cadmium	0.5
Chromium	0.23
Lead	50

Notes:

[1] Only detected compounds reported.
[2] Refer to Figures 3 and 5 for sample locations.
[3] Composite interval (inches).
[4] ND( ) - Not detected at concentration indicated in parenthesis.

TABLE 4.3-4
MCCARL SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	4	5	6	7	8	9	10	11	12	13	14
COLUMN A	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
B	*	*	*	76.27	64.65	127.8	40.16	106.3	118.5	114.5	*
	*	*	*	155.5	116	135.6	188	183.9	122.9	203.4	*
	*	*	*	216.7	166.9	144.3	124.5	230	245.5	225.3	*
C	*	*	*	55.91	87.19	147.4	158.1	305.6	361.8	157.2	*
	*	*	*	127.6	168.5	129.5	201	157.4	199.9	185.4	*
	*	*	*	209.7	178.9	194.8	225.8	188.8	204.2	206.3	*
D	*	*	156.5	301.1	200.2	489/524	158.6	537.4	922.3	291.2	*
	*	*	159.7	186	166.5	173	179.9	248.3	178.2	209.9	*
	*	*	170.4	193.9	204.4	265.5	208.6	203.7	221.6	225.1	*
E	*	*	402.5	696	206.5	268.8	87.19	116.4	966.7	669.4	*
	*	*	234.6	262.7	173.7	202.9	251	228.7	226.2	190.7	*
	*	*	284.2	251.6	212	207.6	192.8	161.8	313	190.8	*
F	*	*	216.5	414.1	219.8	145.6	234.8	2263	115.5	82.13	*
	*	*	216.7	163.7	192.8	176.2	209	516.9	180.5	155.3	*
	*	*	195.7	197.4	197.3	198.9	224.7	212.7	258.8	139.7	*

TABLE 4.3-4
(Continued)
MCCARL SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	4	5	6	7	8	9	10	11	12	13	14
COLUMN G	*	179.4	205.3	177.1	632.4	147.6	474.7	67.74	92.23	167.9	*
	*	196.1	166.3	190.3	181.8	205.2	226.7	93.67	161	200.2	*
	*	210.8	188.4	208.3	213.7	233.2	196.8	156.1	165.3	259.3	*
H	*	225.4	102.1	270.2	633.7	644.9	545.5	1959	144.6	35.12	*
	*	160.1	169.9	164.8	237.7	220	210.7	108.8	209	201.9	*
	*	212.2	185.2	199.3	230.9	201.3	199.2	153	190.4	137.6	*
I	*	292.1	202.7	810.2	211.8	532/571	601.9	2098	2586	798/807	127.7
	*	160.7	187.7	179.4	196.2	200.4	173.3	501/548	>10000	691/643	230.6
	*	178	212.6	176.8	194.9	182.4	270.6	291.7	>10000	181.1	NS
J	1130/1152	160.6	2354	5855	7999	674	5745	7170	297.7	106.8	*
	219.9	173.6	189.2	719.2	>10000	469/454	9179	>10000	189	231.7	*
	223.9	212.4	196.7	1007	2787	189.4	4028	5764	124.1	NS	*
K	85.98	174.1	300.4	559.9	435.8	292.7	2678	140.8	*	*	*
	137.9	189.3	185.5	196.7	251.5	914.4	3938	185.9	*	*	*
	216.9	184.5	202.5	231.7	237.5	130.9	1245	187.4	*	*	*
L	107	1561/1416	160	123.5	83.93	170.9	ND	69.14	*	*	*
	150.3	224.3	254.2	162.9	160.9	204.4	182.5	155.4	*	*	*
	199.2	194.6	176.3	197.8	122	205.3	187.7	108	*	*	*

TABLE 4.3-4
(Continued)
MCCARL SITE
XRF LEAD ANALYSIS
FIELD SCREENING RESULTS

ROW	4	5	6	7	8	9	10	11	12	13	14
COLUMN M	*	75.35	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*

Notes: * No sample collected for field screening.

Sample collected at 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot intervals, respectively.

TABLE 4.3-5
MCCARL SITE
XRF VERIFICATION ANALYSIS
VERSUS
XRF FIELD ANALYSIS
(mg/kg)

Sample No.	XRF Analysis	Laboratory Analysis
M-C9-1	147.4	43.0
M-D6-1	156.5	69.0
M-D8-1	200.2	113
M-D10-3	208.6	35.0
M-D13-2	209.9	38.0
M-D13-3	225.1	49.0
M-E7-2	262.7	161
M-E10-1	87.19	63.0
M-E10-2	251	26.0
M-E13-3	190.8	24.0
M-F6-2	216.7	41.0
M-F6-3	195.7	47.0
M-F13-2	155.3	42.0
M-F13-3	139.7	27.0
M-G11-1	67.74	28.0
M-G12-3	165.3	20.0
M-I5-3	178	29.0
M-I6-1	202.7	117
M-J5-3	212.4	21.0
M-J13-1	106.8	20.0

TABLE 4.3-5
(Continued)
MCCARL SITE
XRF VERIFICATION ANALYSIS
VERSUS
XRF FIELD ANALYSIS
(mg/kg)

Sample No.	XRF Analysis	Laboratory Analysis
M-K7-3	231.7	101
M-K8-1	435.8	267
M-L9-2	204.4	ND(20)
M-L11-1	69.14	ND(20)

TABLE 4.3-6
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-D13-1.5-2	M-D13-3.5-4	M-D13-5.5-6
Volatile Organics			
Toluene	ND(0.006)	0.040	1.1
Ethylbenzene	ND(0.006)	0.048	2.7
Total Xylenes	ND(0.006)	1.8	20
Acetone	0.016B	0.940	32
2-Butanone	ND(0.013)	0.048J	ND(2.0)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-6
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-H9-1.5-2	M-H9-3.5-4	M-H9-3.5-4D	M-H9-5.5-6
Volatile Organics				
Toluene	ND(0.006)	8.8	15	8.9
Ethylbenzene	ND(0.006)	20	36	24
Total Xylenes	ND(0.006)	120	200	140
Acetone	0.015	ND(7.9)	ND(16)	ND(15)
2-Butanone	ND(0.013)	4.3BJ	9.3BJ	9.6BJ

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-6
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-J7-1.5-2	M-J7-3.5-4	M-J7-5.5-6	M-J7-5.5-6
Volatile Organics				
Toluene	ND(0.006)	ND(0.79)	ND(0.032)	ND(0.8)
Ethylbenzene	ND(0.006)	1.5	0.690	8.7D
Total Xylenes	0.004J	16	2.0E	22D
Acetone	ND(1.6)	ND(1.6)	0.130	ND(1.6)
Methylene Chloride	0.002J	ND(0.79)	ND(0.032)	ND(0.8)
2-Butanone	ND(0.012)	ND(1.6)	0.054J	ND(1.6)
4-Methyl-2-Pentanone	ND(0.012)	ND(1.6)	0.072	ND(1.6)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.
D - compounds identified during a re-analysis of a diluted sample.
E - compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.

TABLE 4.3-7
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	**M-I12-0-2**	**M-I12-2-4**	**M-I12-4-6**
Metals			
Arsenic	8.5	5.9	3.3
Cadmium	45.5	69.6	1.1B
Chromium	157	140	15.5
Lead	3230	1760	15.7
Selenium	9.2	7.7	ND(0.25)
Zinc	4790	3710	45.8
Semi-volatile Organics			
Benzoic Acid	1.3J	0.5J	0.12J
bis(2-Ethylhexyl) Phthalate	0.5J	ND(2.1)	ND(0.4)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-7
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	**M-J7-0-2**	**M-J7-2-4**	**M-J7-4-6**
Metals			
Arsenic	5.8	4.8	5.5
Cadmium	26.0	3.6	ND(0.81)
Chromium	112	34.0	24.9
Lead	1510	210	14.1
Selenium	3.6	0.68B	ND(0.27)
Zinc	2010	619	87.1
Semi-volatile Organics			
Naphthalene	ND(25)	0.41J	0.29J
2-Methylnaphthalene	ND(25)	0.48	0.081J
Pentachlorophenol	ND(120)	0.17J	ND(2.6)
bis(2-Ethylhexyl) Phthalate	ND(25)	0.18J	ND(0.53)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-7
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-J8-0-2	M-J8-2-4	M-J8-4-6
Metals			
Arsenic	4.1	4.8	6.1
Cadmium	20.3	ND(0.74)	ND(0.78)
Chromium	236	17.2	15.9
Lead	2310	14.4	21.7
Selenium	1.7	ND(2.5)	ND(0.26)
Zinc	3230	35.9	56.5
Semi-volatile Organics			
Naphthalene	77J	0.14J	ND(25)
2-Methylnaphthalene	30J	ND(0.82)	ND(25)
bis(2-Ethylhexyl) Phthalate	ND(270)	0.91	ND(25)

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-7
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-J10-0-2	M-J10-2-4	M-J10-4-6
Metals			
Arsenic	1.3B	2.2B	0.47B
Cadmium	1.4	1.0B	ND(0.70)
Chromium	20.2	11.6	15.0
Lead	129	13.7	11.1
Selenium	ND(0.25)	ND(0.24)	ND(0.23)
Zinc	173	25.8	37.3
Semi-volatile Organics			
Benzoic Acid	0.071J	ND(1.9)	ND(1.9)

Notes:
ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-7
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-J11-0-2	M-J11-2-4	M-J11-4-6
Metals			
Arsenic	5.5	2.5B	11.8
Cadmium	57.8	1.7	0.79B
Chromium	189	20.9	17.2
Lead	2600	250	46.3
Selenium	5.0	1.2B	0.42B
Zinc	3530	280	91.9
Semi-volatile Organics			
Benzoic Acid	ND(8.4)	0.30J	0.28J
Di-n-Butylphthalate	0.22J	ND(0.42)	ND(0.40)
bis(2-Ethylhexyl) Phthalate	0.25J	0.46	0.19J

Notes:
ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-7
(Continued)
ANALYTICAL DATA SUMMARY
MCCARL SITE
SOIL SAMPLES
MAY 1990
(mg/kg)

Analyte	M-K10-0-2	M-K10-2-4	M-K10-4-6	M-K10-4-6D
Metals				
Arsenic	6.9	6.8	10.4	4.4
Cadmium	7.6	ND(0.77)	1.6	1.1B
Chromium	24.8	12.1	18.6	17.3
Lead	309	30.9	221	341
Selenium	0.53B	0.61B	2.2	0.39B
Zinc	566	69.9	508	915
Semi-volatile Organics				
Benzoic Acid	0.13J	0.16J	0.25J	0.33J
bis(2-Ethylhexyl) Phthalate	0.17J	0.086J	0.47	0.21J

Notes: ND() - not detected at concentration indicated in parenthesis.
J - indicates an estimated value.
B - indicates analyte found in the associated blank as well as the sample.

TABLE 4.3-8

ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-D9-1	M-D11-1	M-D12-1	M-E7-1	M-E-13-1
Aluminum	7810	9980	8810	7480	8720
Antimony	ND(8.6)[1]	ND(8.8)	ND(9.0)	ND(8.2)	ND(9.0)
Arsenic	12.9	5.9	5.1	5.7	6.4
Barium	511	473	2970	493	1240
Beryllium	0.46 B[2]	0.61 B	0.71 B	0.45 B	0.64 B
Cadmium	5.0	1.9	141	7.5	15.2
Calcium	7540	3440	3430	42500	6640
Chromium	17.9	17.2	48.0	26.0	51.7
Cobalt	12.7	17.8	15.1	10.9	14.4
Copper	485	80.6	109	1410	349
Iron	19900	25100	15800	18900	35800
Lead	281	1310	471	456	474
Magnesium	2700	2090	1780	5740	2010
Manganese	1610	2480	1980	1280	1710
Mercury	0.1	ND(0.1)	ND(0.1)	ND(0.1)	0.1
Nickel	31.1	23.7	48.0	28.8	33.7
Potassium	659 B	1050 B	1120 B	984 B	834 B
Selenium	0.47 B	0.60 B	33.7	7.1	1.9
Silver	ND(1.4)	ND(1.4)	ND(1.4)	ND(1.3)	ND(1.4)
Sodium	ND(225)	ND(232)	ND(237)	ND(216)	ND(237)
Thallium	ND(0.45)	ND(0.46)	ND(0.47)	ND(0.43)	ND(0.47)
Vanadium	31.4	33.6	27.0	26.8	26.3
Zinc	2670	357	1660	773	1190

Notes:

[1] ND() - Not detected at concentration in parenthesis.

[2] B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-8
(Continued)
ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-F11-1	M-G8-1	M-H8-1	M-H9-1	M-H10-1
Aluminum	9400	9580	10500	16000	12100
Antimony	47.6	ND(8.3)	10.1 B	ND(8.5)	ND(8.8)
Arsenic	4.2	5.8	6.4	6.9	3.9
Barium	5840	1840	1330	910	1140
Beryllium	0.64 B	0.51 B	0.44 B	0.69 B	0.54 B
Cadmium	443	7.4	11.7	31.0	24.9
Calcium	2230	2590	3990	3240	3840
Chromium	248	71.9	46.6	58.2	99.9
Cobalt	25.8	20.5	11.0	12.4	15.0
Copper	40.5	41.1	69.3	29.3	62.5
Iron	13600	13300	21400	22800	20600
Lead	1590	2800	566	517	708
Magnesium	1820	1820	2020	3150	2270
Manganese	1280	1030	822	604	976
Mercury	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.1)
Nickel	16.8	15.4	55.4	24.1	24.2
Potassium	1130 B	776 B	891 B	1260	938 B
Selenium	177	7.4	2.3	4.2	2.7
Silver	ND(1.4)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.4)
Sodium	ND(238)	ND(218)	ND(215)	ND(223)	ND(231)
Thallium	ND(0.48)	ND(0.44)	ND(0.43)	ND(0.45)	ND(0.46)
Vanadium	29.2	29.9	32.5	44.5	33.4
Zinc	4360	901	740	636	962

Notes: [1]ND() - Not detected at concentration in parenthesis.
[2]B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-8
(Continued)
ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-H11-1	M-I7-1	M-I9-1	M-I10-1	M-I11-1
Aluminum	12800	9780	15500	13600	9300
Antimony	46.7	ND(8.3)	9.0 B	ND(8.7)	8.8 B
Arsenic	4.5	5.1	16.5	4.6	5.3
Barium	3020	2140	2130	2030	3440
Beryllium	1.0 B	0.50 B	0.74 B	0.73 B	0.45 B
Cadmium	35.8	19.8	11.9	24.6	37.5
Calcium	4730	4510	6460	5790	22600
Chromium	124	93.6	45.7	63.3	111
Cobalt	23.0	13.9	13.4	17.8	15.5
Copper	108	23.3	62.4	26.6	114
Iron	25700	15100	28000	18200	31800
Lead	1280	715	581	542	1350
Magnesium	2370	1980	3340	2620	3270
Manganese	2560	1300	705	1200	1180
Mercury	ND(0.1)	ND(0.1)	0.2	0.1	ND(0.1)
Nickel	42.0	17.8	34.9	27.4	40.1
Potassium	1280 B	890 B	1180	1220	1080 B
Selenium	4.5	4.7	1.7	2.9	3.8
Silver	ND(1.6)	ND(1.3)	ND(1.3)	ND(1.4)	ND(1.3)
Sodium	ND(262)	ND(219)	ND(218)	ND(229)	ND(217)
Thallium	ND(0.52)	ND(0.44)	ND(0.44)	ND(0.46)	ND(0.43)
Vanadium	37.8	36.0	45.8	38.2	26.7
Zinc	2020	1220	1570	991	3170

Notes: [1]ND() - Not detected at concentration in parenthesis.
[2] B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-8
(Continued)
ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-I12-1	M-I13-1	M-J4-1	M-J6-1	M-J7-1
Aluminum	9320	9160	1170	8070	17200
Antimony	18.7	ND(12.2)	8.5 B	ND(8.9)	47.7
Arsenic	6.4	3.2	10.6	4.5	6.5
Barium	5990	870	3620	2390	4520
Beryllium	0.61 B	0.52 B	0.71 B	0.56 B	0.63 B
Cadmium	49.6	10.6	10.9	52.4	33.5
Calcium	13700	6710	17600	5860	4350
Chromium	266	43.2	151	163	407
Cobalt	14.8	8.2 B	8.3 B	16.0	29.3
Copper	108	87.4	22.2	38.4	41.5
Iron	28500	11500	17900	14200	23800
Lead	2290	481	959	1720	3560
Magnesium	2660	1950	3530	1710	3470
Manganese	1260	1210	881	1410	1230
Mercury	ND(0.1)	ND(0.2)	0.2	ND(0.1)	ND(0.1)
Nickel	26.5	23.8	21.1	32.3	26.0
Potassium	943 B	910 B	1050 B	718 B	1400
Selenium	7.6	6.6	1.4	9.1	4.9
Silver	ND(1.5)	ND(1.9)	ND(1.3)	ND(1.4)	ND(1.3)
Sodium	ND(257)	ND(321)	ND(222)	ND(234)	ND(224)
Thallium	ND(0.51)	ND(0.64)	ND(0.44)	ND(0.47)	ND(0.45)
Vanadium	34.4	23.8	36.1	29.5	46.9
Zinc	2790	938	1450	1830	2720

Notes: [1]ND() - Not detected at concentration in parenthesis.
[2]B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-8
(Continued)
ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-J8-1	M-J9-1	M-J10-1	M-J11-1	M-K7-1
Aluminum	8310	8600	6490	6250	6860
Antimony	37.2	12.8 B	22.1	62.5	ND(8.4)
Arsenic	6.9	8.1	5.5	5.8	4.4
Barium	7410	3370	4510	6180	528
Beryllium	0.57 B	1.9	0.52 B	0.54 B	0.50 B
Cadmium	52.6	24.8	30.4	53.7	3.3
Calcium	5230	19500	7800	11200	2400
Chromium	201	83.2	115	163	23.2
Cobalt	31.4	10.2 B	18.4	18.2	10.7 B
Copper	63.9	69.4	61.6	55.2	13.4
Iron	22300	18800	26300	24000	11800
Lead	3060	1370	2510	3180	297
Magnesium	1810	1640	1610	1740	1540
Manganese	1740	1050	1370	1290	1090
Mercury	0.1	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.1)
Nickel	32.6	18.5	22.9	49.5	13.4
Potassium	1040 B	895 B	647 B	634 B	489 B
Selenium	5.4	4.7	6.3	5.8	ND(0.22)
Silver	ND(1.4)	ND(1.4)	ND(1.5)	ND(1.4)	ND(1.3)
Sodium	ND(230)	ND(241)	ND(255)	ND(235)	ND(222)
Thallium	ND(0.46)	ND(0.48)	ND(0.51)	ND(0.47)	ND(0.44)
Vanadium	31.1	32.9	23.7	24.8	25.9
Zinc	6020	2760	3090	3290	401

Notes: [1]ND() - Not detected at concentration in parenthesis.
[2] B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-8
(Continued)
ANALYTICAL DATA SUMMARY
TOTAL METALS

MCCARL SITE RISK ASSESSMENT SAMPLES
MAY 1990
(mg/kg)

Analyte Metals	M-K10-1	M-L5-1
Aluminum	6250	5810
Antimony	10.6 B	ND(9.1)
Arsenic	13.3	6.2
Barium	3020	629
Beryllium	0.95 B	0.42 B
Cadmium	20.2	5.1
Calcium	11300	2760
Chromium	87.1	26.6
Cobalt	13.5	11.8 B
Copper	69.0	10.5
Iron	22500	12200
Lead	1550	861
Magnesium	1560	1370
Manganese	1380	1050
Mercury	ND(0.1)	ND(0.1)
Nickel	28.5	11.9
Potassium	700 B	466 B
Selenium	0.72 B	0.78 B
Silver	ND(1.5)	ND(1.4)
Sodium	ND(256)	ND(239)
Thallium	ND(0.51)	ND(0.48)
Vanadium	24.5	23.4
Zinc	2400	1740

Notes: [1]ND() - Not detected at concentration in parenthesis.
[2]B - Reported value is less than the contract required detect limit (CRDL), but greater than the instrument detection limit (IDL).

TABLE 4.3-9
ANALYTICAL DATA SUMMARY
MCCARL SITE
DITCH SEDIMENT SAMPLES
MAY 1990
(mg/kg)

Analyte	M-SED-1	M-SED-2	Background Ranges McCarl 1989[5]	National Background Ranges[6]
Volatile Organics				
Toluene	ND(0.006)[1]	ND(0.006)	NE[2]	NE
Total Xylene	ND(0.006)	ND(0.006)	NE	NE
Ethylbenzene	ND(0.006)	ND(0.006)	NE	NE
Methylene Chloride	0.002J[3]	ND(0.006)	NE	NE
Acetone	0.007J	0.007B[4]J	NE	NE
Semi-volatile Organics				
Benzoic Acid	0.16J	0.056J	NE	NE
4-Nitrophenol	ND(2.0)	0.13J		
Metals				
Arsenic	5.5	9.2	2.3-4.5	1-50
Cadmium	2.9	ND(0.76)	ND(0.98)-ND(1.0)	0.01-0.7
Chromium	19.4	25.6	10.1-18.9	1-1000
Lead	166	14.9	14.0-18.2	2-200
Selenium	2.8	ND(0.25)	ND(0.24)-ND(0.26)	0.1-2.0
Zinc	429	48.1	NE	10-300

Notes:
1. ND() - not detected at concentration indicated in parenthesis.
2. NE - not established.
3. J - indicates an estimated value.
4. B - indicates analyte found in the associated blank as well as the sample.
5. Background sample collected during May 1989 field investigation.
6. USEPA 1983, Hazardous Waste Land Treatment.

TABLE 4.4-2(A)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-1
(UG/L)

ANALYTE	AUGUST 1989		DECEMBER 1989		MARCH 1990		JUNE 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	ND(1.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)
Barium	53.8B	121B	167B	97.9B	102B	93.0B	92.6B	116B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	7.6B	ND(5.5)	ND(8.0)	ND(8.0)	ND(5.0)	ND(5.0)	5.6B	ND(5.0)
Lead	10.6	ND(1.0)	57.1	1.1B	4.1B	ND(2.0)	ND(2.0)	ND(2.0)
Selenium	ND(1.0)	ND(2.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(2.0)	2.0B	2.8B
Secondary Drinking Water Metals								
Aluminum	310	ND(30.7)	1710	42.0B	468	ND(22)	548	ND(22)
Copper	ND(6.0)	ND(6.0)	11.1B	ND(6.0)	6.5B	ND(4.0)	8.2B	ND(4.0)
Iron	664	ND(22.3)	3460	ND(28)	1020	ND(21)	1160	ND(21)
Manganese	90.9	158	260	121	154	124	103	90.0
Zinc	31.6	56.2	81.4	26.7	20.6	10.5B	26.3	14.8B

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(B)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-2
(UG/L)

ANALYTE	AUGUST 1989		DECEMBER 1989		MARCH 1990		JUNE 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	ND(2.0)	ND(2.0)	2.6B	ND(2.0)	1.6B	ND(1.0)	2.0B	ND(1.0)
Barium	429	360	520	341	331	161B	375	297
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	22.8	ND(5.5)	35.7	ND(8.0)	6.9B	ND(5.0)	24.0	ND(5.0)
Lead	12.4	ND(1.0)	44.3	ND(1.0)	7.3	ND(2.0)	12.9	ND(2.0)
Selenium	45.0	56.1	78.3	59.0	48.0B	140	45.4	84.7
Secondary Drinking Water Metals								
Aluminum	8020	ND(30.7)	15600	66.8B	2330	ND(22)	6650	ND(22)
Copper	25.1	ND(6.0)	47.4	ND(6.0)	11.2B	ND(4.0)	53.5	ND(4.0)
Iron	17700	ND(22.3)	35900	34.6B	5560	ND(21)	17000	ND(21)
Manganese	393	206	417	ND(11)	118	25.8	277	15.7
Zinc	108	ND(48.9)	162	ND(3.0)	41.7	10.3B	80.0	26.9

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(C)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-3
(UG/L)

ANALYTE	AUGUST 1989		DECEMBER 1989		MARCH 1990		JUNE 1990	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	ND(2.0)	2.7B	ND(2.0)	ND(2.0)	ND(1.0)	ND(1.0)	ND(1.0)	ND(1.0)
Barium	186	209	166B	156B	172B	161B	153	189B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	90B	5.6B	ND(8.0)	ND(8.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)
Lead	2.2B	ND(1.0)	12.4	ND(1.0)	9.6	ND(2.0)	2.8B	ND(2.0)
Selenium	94.0	83.0	111	127	117	140	139	179
Secondary Drinking Water Metals								
Aluminum	220	ND(30.7)	659	ND(32)	146B	ND(22)	24.9B	ND(22)
Copper	6.88	ND(6.0)	8.7B	ND(6.0)	9.0B	4.1B	29.8	ND(4.0)
Iron	448	ND(22.3)	1570	ND(28)	439	ND(21)	68.8B	ND(21)
Manganese	22.0	16.3	36.9	ND(11)	ND(10)	ND(10)	14.2B	11.1B
Zinc	71.0	32.9	26.0,	ND(3.0)	31.0	17.3B	57.2	55.6

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(D)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-3C
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)	
Primary Drinking Water Metals	Total	Dissolved	Total	Dissolved
Arsenic	11.4	2.9B	2.1B	2.2B
Barium	586	47.3B	119B	151B
Cadmium	ND(5.0)	ND(5.0)	ND(3.0)	ND(3.0)
Chromium	125	ND(5.0)	29.3	ND(5.0)
Lead	45.4	1.0	ND(2.0)	ND(2.0)
Selenium	ND(2.0)	ND(2.0)	ND(1.0)	ND(1.0)
Secondary Drinking Water Metals				
Aluminum	25800	ND(25)	649	22.7B
Copper	109	ND(4.0)	69.1	ND(4.0)
Iron	88700	26.0B	2270	45.6B
Manganese	2540	763	1050	1190
Zinc	295	ND(1.0)	45.8	76.0

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(E)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4A
(UG/L)

ANALYTE										
Primary Drinking Water Metals	**AUGUST 1989**		**SEPTEMBER 1989**		**DECEMBER 1989**		**MARCH 1990**		**JUNE 1990**	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	20.3	ND(2.0)	4.3B	ND(2.0)	2.1B	ND(2.0)	2.1B	ND(1.0)	ND(1.0)	ND(1.0)
Barium	1050	249	419	236	400	130B	254	114B	92.0B	105B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	102	ND(5.5)	36.1	ND(8.0)	37.5	ND(8.0)	23.7	ND(5.0)	10.9	ND(5.0)
Lead	35.4	ND(1.0)	8.6	ND(1.0)	18.9	ND(10)	7.0	ND(2.0)	ND(2.0)	ND(2.0)
Selenium	ND(10)	ND(1.0)	ND(10.0)	ND(1.0)	ND(1.0)	ND(10)	ND(20)	ND(20)	ND(1.0)	ND(1.0)
Secondary Drinking Water Metals										
	47200	ND(30.7)	9570	ND(32.0)	10400	ND(32)	4280	ND(22)	285	ND(22)
	148	ND(6.0)	35.8	ND(6.0)	28.8	ND(6.0)	14.2B	ND(4.0)	13.7B	ND(4.0)
Aluminum	116000	ND(22.3)	24100	ND(28.0)	21800	ND(28)	8990	ND(21)	616	ND(21)
Copper	6230	22.3	1410	13.8B	1210	ND(11)	487	58.1	63.6	131
Iron	886	6.1B	152	26.4	116	ND(3.0)	48.3	4.1B	33.3	56.7
Manganese										
Zinc										

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(F)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4C
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)		JUNE 1990 (verification-D)	
Primary Drinking Water Metals	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Arsenic	5.8B	ND(1.0)	1.9B	ND(1.0)	2.3B	2.2B
Barium	198B	84.4B	128B	110B	126B	101B
Cadmium	ND(5.0)	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	19.1	ND(5.0)	10.6	ND(5.0)	15.2	ND(5.0)
Lead	13.7	ND(1.0)	5.3	ND(2.0)	3.0B	ND(2.0)
Selenium	ND(2.0)	ND(2.0)	4.4B	4.3B	4.6B	3.0B
Secondary Drinking Water Metals						
Aluminum	9090	ND(25)	2220	ND(22)	3660	ND(22)
Copper	25.1	ND(4.0)	12.6B	ND(4.0)	13.9B	ND(4.0)
Iron	25200	ND(22)	6520	ND(21)	8120	ND(21)
Manganese	1210	724	491	481	509	331
Zinc	77.2	ND(1.0)	49.0	11.2B	35.0	29.3

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.
Verification - D - indicates a duplicate sample.

TABLE 4.4-2(G)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-5
(UG/L)

ANALYTE										
Primary Drinking Water Metals	**JUNE 1990**		**AUGUST 1989**		**SEPTEMBER 1989**		**DECEMBER 1989**		**MARCH 1990**	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	4.4B	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(1.0)	ND(1.0)	1.0B	ND(1.0)
Barium	223	252	291	245	348	220	199B	157B	195	145
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	19.3	ND(5.5)	13.9	ND(8.0)	42.8	ND(8.0)	17.6	ND(5.0)	19.4	ND(5.0)
Lead	29.2	ND(1.0)	3.2B	ND(1.0)	11.3	ND(10)	2.6B	ND(2.0)	6.2	ND(2.0)
Selenium	76.4	82.3	34.3	38.8	48.5	33.0	30.1	27.0B	34.5	40.5
Secondary Drinking Water Metals										
Aluminum	5630	ND(30.7)	2630	32.0	12500	ND(32)	3700	ND(22)	3770	ND(22)
Copper	13.1B	ND(6.0)	13.4B	ND(6.0)	25.7	ND(6.0)	9.1B	ND(4.0)	18.1B	ND(4.0)
Iron	13600	ND(22.3)	5630	28.0	21500	ND(28)	6690	ND(21)	8030	ND(21)
Manganese	623	22.2	591	341	962	144	264	74.1	386	54.5
Zinc	60.5	6.1B	37.4	10.9B	84.2	ND(3.0)	25.3	2.5B	41.7	18.4B

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(H)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6
(UG/L)

ANALYTE									
Primary Drinking Water Metals JUNE 1990		**AUGUST 1989**		**SEPTEMBER 1989**		**DECEMBER 1989**		**MARCH 1990**	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic	1.7B	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	4.0B	ND(2.0)	1.3B	1.9B
Barium	142B	171B	248	199B	416	153B	433	153B	182B	136B
Cadmium	ND(3.6)	ND(3.6)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)
Chromium	36.2	ND(5.5)	19.0	ND(8.0)	80.6	ND(8.0)	125	ND(8.0)	32.1	ND(5.0)
Lead	9.4	ND(1.0)	4.8B	ND(1.0)	20.7	ND(10)	18.1	ND(10)	7.8	ND(2.0)
Selenium	98.0	244	125	150	133	184	85.0	184	113	162
Secondary Drinking Water Metals										
Aluminum	5010	ND(30.7)	4720	ND(32.0)	28400	ND(32)	32600	ND(32)	5000	ND(22)
Copper	9.7B	ND(6.0)	17.8B	ND(6.0)	48.4	ND(6.0)	63.2	ND(6.0)	23.5B	ND(4.0)
Iron	13000	ND(22.3)	11800	ND(28.0)	54200	ND(28)	71900	ND(28)	12700	ND(21)
Manganese	382	74.1	611	68.4	1470	23.1	1450	23.1	341	37.0
Zinc	53.6	12.8B	77.0	13.1B	320	ND(3.0)	178	ND(3.0)	63.8	38.5

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(I)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6C
(UG/L)

ANALYTE	JUNE 1990 (initial)		JUNE 1990 (verification)		AUGUST 1990 (reverification)	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
Primary Drinking Water Metals						
Arsenic	53.6	ND(1.0)	3.5B	ND(1.0)	ND(5)	ND(10)
Barium	2700	50.3B	205	96.2B	230	210
Cadmium	104	ND(5.0)	ND(3.0)	ND(3.0)	ND(5)	ND(5)
Chromium	211	ND(5.0)	22.0	ND(5.0)	130	ND(10)
Lead	234	ND(1.0)	9.2	ND(2.0)	ND(10)	ND(10)
Selenium	ND(20)	ND(2.0)	ND(10)	1.4B	ND(5)	ND(5)
Secondary Drinking Water Metals						
Aluminum	46200	181B	7050	ND(22)	4200	540
Copper	275	ND(4.0)	45.9	ND(4.0)	28	ND(20)
Iron	179000	56.9B	17700	ND(21)	10900	1700
Manganese	5770	920	1590	672	2000	1400
Zinc	754	15.2B	72.6	8.5B	54	60

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) - not detected at concentration indicated in parenthesis.

TABLE 4.4-2(J)
ANALYTICAL DATA SUMMARY
TOTAL AND DISSOLVED METALS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-7
(UG/L)

ANALYTE	August 1990	
Primary Drinking Water Metals	Total	Dissolved
Arsenic	3.3B	ND(1.0)
Barium	71.1B	32.1B
Cadmium	ND(5.0)	ND(5.0)
Chromium	8.7B	ND(5.0)
Lead	ND(10)	ND(10)
Selenium	ND(2.0)	48.0B
Secondary Drinking Water Metals		
Aluminum	2360	ND(25)
Copper	15.0B	6.1B
Iron	4770	ND(22)
Manganese	448	343
Zinc	45.1	14.6B

Notes:

Only detected primary and secondary drinking water metals listed.
B - reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).
ND ( ) not detected at concentration indicated in parenthesis.

TABLE 4.4-3(A)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-1
(MG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	188	428	371	391
Nitrate/Nitrite	7.9	7.8	6.8	6.5
Sulfate	55.0	54.0	45.0	58.0
Alkalinity	347	368	354	373
Chloride	12.4	15.6	10.5	ND(3)
Total Dissolved Solids (TDS)	481	511	477	517
Total Suspended Solids (TSS)	NA	NA	37.2	60.0

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.4-3(B)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-2
(MG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	560.8	593	472	562
Nitrate/Nitrite	0.97	1.1	1.2	1.2
Sulfate	35.0	43.6	33.4	35.3
Alkalinity	484	522	521	537
Chloride	9.7	13.3	8.4	9.9
Total Dissolved Solids (TDS)	597	586	596	607
Total Suspended Solids (TSS)	NA	NA	336	740

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.4-3(D)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-3C
(MG/L)

ANALYTE	**JUNE 1990 (initial)**	**JUNE 1990 (verification)**
Hardness	875	338
Nitrate/Nitrite	ND(0.1)	ND(0.1)
Sulfate	83.0	43.6
Alkalinity	830	432
Chloride	15.8	20.0
Total Dissolved Solids (TDS)	522	536
Total Suspended Solids (TSS)	NA	67.5

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed.

TABLE 4.4-3(E)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4A
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	876.0	905	941	817	850
Nitrate/Nitrite	0.91	0.63	0.31	0.15	0.47
Sulfate	357	372	365	437	346
Alkalinity	559	586	588	562	577
Chloride	36.7	39.3	40.8	37.4	46.3
Total Dissolved Solids (TDS)	1220	1220	1220	1280	1340
Total Suspended Solids (TSS)	NA	NA	NA	577	120

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.4-3(F)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4C
(MG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)	JUNE 1990 (verification-D)
Hardness	591	475	453
Nitrate/Nitrite	ND(0.1)	ND(0.1)	0.17
Sulfate	378	390	392
Alkalinity	442	354	373
Chloride	91.8	94.5	86.8
Total Dissolved Solids (TDS)	975	1010	1000
Total Suspended Solids (TSS)	NA	630	880

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed.
Verification - D - indicates a duplicate sample.

'TABLE 4.4-3(G)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-5
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	472	787	929	262	852
Nitrate/Nitrite	1.6	0.62	0.72	0.76	1.1
Sulfate	226	173	173	185	192
Alkalinity	723	762	775	754	761
Chloride	56.9	65.6	62.1	63.1	65.6
Total Dissolved Solids (TDS)	1100	1140	1110	1090	1110
Total Suspended Solids (TSS)	NA	NA	NA	297	902

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.4-3(H)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6
(MG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Hardness	359	602	809	531	601
Nitrate/Nitrite	1.6	1.6	1.7	1.5	1.2
Sulfate	77.0	84.0	92.0	73.2	77.0
Alkalinity	593	555	588	631	581
Chloride	15.2	16.8	21.1	13.9	19.1
Total Dissolved Solids (TDS)	702	703	680	720	752
Total Suspended Solids (TSS)	NA	NA	NA	1940	596

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.4-3(I)
ANALYTICAL DATA SUMMARY
GENERAL WATER QUALITY PARAMETERS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6C
(MG/L)

ANALYTE	**JUNE 1990 (initial)**	**JUNE 1990 (verification)**
Hardness	1240	312
Nitrate/Nitrite	1.8	ND(0.1)
Sulfate	128	138
Alkalinity	382	402
Chloride	28.4	48.0
Total Dissolved Solids (TDS)	643	623
Total Suspended Solids (TSS)	NA	1080

Notes:

ND ( ) - not detected at concentration indicated in parenthesis.
NA - not analyzed

TABLE 4.5-1

ORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(ug/kg)

Volatile Organics[3]	Location[2] No. 1 Du Pont	No. 1 EPA	No. 2 DuPont	No. 2 EPA	No. 3 DuPont	No. 3 EPA	No. 4 DuPont	No. 4 EPA	No. 5 DuPont	No. 5 EPA
Toluene	ND(6)[4]	ND(6.1)	2J	ND(5.8)	ND(6)	ND(5.8)	4J	ND(6)	ND(6)	ND(6)
Xylene, Total	ND(6)	ND(6.1)	ND(6)	ND(5.8)	ND(6)	ND(5.8)	ND(6)	ND(6)	ND(6)	ND(6)
Ethylbenzene	ND(6)	ND(6.1)	ND(6)	ND(5.8)	ND(6)	ND(5.8)	ND(6)	ND(6)	ND(6)	ND(6)
Methylene Chloride	1J[5]	ND(7)	ND(6)	ND(5.8)	2J	ND(7)	1J	ND(6)	2J	ND(7)
Acetone	4J	ND(12)	5J	ND(12)	ND(12)	ND(12)	6J	ND(12)	9J	ND(12)

Notes:

[1] Samples collected by USEPA during the week of May 21, 1990.

[2] See attached figure. Samples collected at a depth of 3.5 feet below ground surface.

[3] Only compounds of historical interest and/or detected are listed. All samples analyzed for hazardous substance list volatile organics in accordance with the current CLP statement of work.

[4] ND ( ) - indicates not detected at detection limit given in parenthesis.

[5] J - indicates an estimated value.

TABLE 4.5-1
(Continued)
ORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(ug/kg)
(Continued)

	Location[2]									
Volatile Organics[3]	**Ditch 1**		**Ditch 2**		**Ditch 3**		**Ditch 4**		**Ditch 5**	
	DuPont	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont** **EPA**	
Toluene	NA	NA	ND(7)	ND(6.5)	ND(7)	ND(6.4)	ND(6) ND(6)		3J	ND(5.8)
Xylene	NA	NA	ND(7)	ND(6.5)	ND(7)	ND(6.4)	ND(6) ND(6)		ND(6)	ND(5.8)
Ethylbenzene	NA	NA	ND(7)	ND(6.5)	ND(7)	ND(6.4)	ND(6) ND(6)		ND(6)	ND(5.8)
Methylene Chloride	NA	NA	2B[5]J[6]	ND(7)	ND(7)	ND(7)	ND(6) ND(6)		2J	ND(5.8)
Acetone	NA	NA	9BJ	ND(13)	9J	ND(13)	7J	ND(12)	7J	ND(12)

Notes:

[1] Samples collected by USEPA during the week of May 21, 1990.

[2] See attached figure. Samples collected at a depth of 3.5 feet below ground surface.

[3] Only compounds of historical interest and/or detected are listed. All samples analyzed for hazardous substances list volatile organics in accordance with the current CLP statement of work.

[4] ND ( ) - indicates not detected at detection limit given in parenthesis.

[5] B - indicates analyte found in the associated blank as well as the sample.

[6] J - indicates an estimated value.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Location 1 (0-1)[3]		Location 1 (1-2)		Location 1 (2-3)		Location 2 (0-1)		Location 2 (1-2)		Location 2 (2-3)	
	DuPont	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont** **EPA**		**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	4.1	5.9	4.5 6.3		6.1	7.6	5.3	9.0	8.1	20	4.6 7.4	
Cadmium	ND(0.76)[4] ND(1.3)		ND(0.74)	ND(1.2)	0.93B	ND(1.2)	ND(0.75)	ND(1.3)	ND(0.74)	ND(1.2)	ND(0.75)	ND(1.3)
Chromium	11.8	14	18.1	16	18.9	22	15.4	17	15.0	19	16.8	15
Lead	17.9	20J[6]	12.0	16J	11.6	10J	12.1	22J	21.6	23J	16.0	11J
Selenium	0.46B[5] ND(1.3)		ND(0.25)	ND(1.2)	ND(0.24) ND(1.2)		ND(0.25)	ND(1.3)	0.42B	1.4	ND(0.25)	ND(1.3)
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.12)	ND(0.1) ND(0.12)		ND(0.1) ND(0.13)		ND(0.1) ND(0.12)		ND(0.1)	ND(0.13)
Aluminum	9140	11000	13500	12000	12000	13000	11900	13000	13600	17000	15000	14000
Iron	13400	15000	19200	20000	24200	24000	15800	16000	18600	35000	19900	19000
Zinc	37.0	28	38.7	30	64.5	30	36.0	33	20.6	28	26.4	24

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals	Location 3 (0-1)[3]		Location 3 (1-2)		Location 3 (2-3)		Location 4 (0-1)		Location 4 (1-2)		Location 4 (2-3)	
	DuPont	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	8.9	6.3	2.2B	7.7	3.7	9.3	4.1	5.9	3.6	5.8J	2.2B	ND(2.4)
Cadmium	ND(0.75)[4] ND(1.3)		ND(0.73)	ND(1.2)	ND(0.71) ND(1.2)		ND(0.76) ND(1.3)		ND(0.76)	ND(1.3)	ND(0.75)	ND(1.2)
Chromium	21.0 19		22.9	20	13.7	14	20.3	16	16.5 20		11.1	11
Lead	38.3 25J[6]		10.9	I[7]	8.4	I	18.0	16J	13.2 I		9.9	I
Selenium	0.78B[5] ND(1.3)		ND(0.24)	ND(1.2)	ND(0.24) ND(1.2)		0.54B ND(1.3)		ND(0.25)	ND(1.3)	ND(0.25)	ND(1.2)
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.12)	ND(0.1) ND(0.12)		ND(0.1) ND(0.13)		ND(0.1) ND(0.13)		ND(0.1)	ND(0.12)
Aluminum	15800	15000	16700	16000	9000	9400	17300	13000	14600	18000	12800	14000
Iron	20500	18000	21700	25000	18700	23000	19700	16000	19400	25000	7640	7500
Zinc	41.2	40	33.1	32	33.1	38	31.2	32	28.6	29	23.3	18

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Location 5 (0-1)[3]		Location 5 (1-2)		Location 5 (2-3)		Ditch 1 Location 1		Ditch 1 Location 2	
	DuPont	EPA	DuPont	EPA	DuPont	EPA	DuPont	EPA	DuPont EPA	
Arsenic	3.2	7.5	2.8	6.8	1.28[5]	ND(2.4)	6.1	14	6.4	11
Cadmium	ND(0.75)[4]	ND(1.3)	ND(0.76) ND(1.3)		ND(0.72)	ND(1.2)	ND(0.78)	ND(1.4)	ND(0.82)	ND(1.3)
Chromium	17.6	18	20.4	21	21.0	23	14.7	13	11.2	10
Lead	11.6	14J[6]	18.4	19J	7.2	4.7J	14.6	13J	15.1	12J
Selenium	ND(0.25)	ND(1.3)	ND(0.25) ND(1.3)		ND(0.24)	ND(1.2)	ND(0.26)	ND(1.4)	ND(0.27)	ND(1.3)
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.13)	ND(0.1)	ND(0.12)	ND(0.1)	ND(0.14)	ND(0.1)	ND(0.13)
Aluminum	14500	15000	17400	19000	17900	20000	11000	8500	6250	7000
Iron	21000	17000	30400	26000	22500	21000	18800	17000	15400	15000
Zinc	28.9	35	32.0	29	29.9	31	45.9	43	43.8	44

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Ditch 2 (0-1)[3]		Ditch 2 (1-2)		Ditch 2 (2-3)		Ditch 2 (3.5-5)	
	DuPont	EPA	DuPont	EPA	DuPont	EPA	DuPont	EPA
Arsenic	8.0	11	8.2	7.6	5.5	7.3	9.4	8.0
Cadmium	ND(0.81)[4]	ND(1.4)	ND(0.79)	ND(1.3)	ND(0.77)	ND(1.3)	ND(0.79)	ND(1.4)
Chromium	17.9	17	12.7	19	18.5	28	20.3	23
Lead	22.3	14J[6]	17.3	25	15.0	13	21.9	15
Selenium	0.35B[5]	ND(1.4)	ND(0.26)	ND(1.3)	ND(0.26)	ND(1.3)	0.48B	ND(1.4)
Mercury	ND(0.1) ND(0.14)		ND(0.1)	ND(0.13)	ND(0.1)	ND(0.13)	ND(0.1) ND(0.14)	
Aluminum	13200	12000	8720	14000	14300 24000		15600	18000
Iron	19200	19000	15600	19000	19900 25000		20500	22000
Zinc	60.9	55	48.4	56J	38.8	43J	63.3	65J

Note: Footnotes defined on last page.

TABLE 4.4-1(A)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-1
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(2)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)	ND(5)
Methylene Chloride	6B	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	12	ND(5)	51	ND(5)
Semi-Volatile Organics				
Benzoic Acid	ND(51)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	35B	3J	NA	NA
Naphthalene	ND(10)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	ND(10)	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(B)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-2
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)	ND(5)
Methylene Chloride	7B	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	3J	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics				
Benzoic Acid	ND(52)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	6BJ	6J	NA	NA
Naphthalene	ND(10)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	ND(10)	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(C)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-3
(UG/L)

ANALYTE	AUGUST 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics				
Toluene	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)	ND(5)
Methylene Chloride	6B	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	9	ND(5)	ND(5)	2J
Semi-Volatile Organics				
Benzoic Acid	ND(52)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	8BJ	3J	NA	NA
Naphthalene	ND(10)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	ND(10)	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(D)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-3C
(UG/L)

ANALYTE	JUNE 1990 (initial)	JUNE 1990 (verification)
Volatile Organics		
Toluene	ND(5)	2J
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	ND(5)	ND(5)
Acetone	3J	ND(10)
2-Butanone	3J	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	2J	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(53)	ND(260)
bis(2-Ethylhexyl)Phthalate	4J	ND(53)
Naphthalene	ND(11)	ND(53)
Di-n-Octyl-Phthalate	ND(11)	ND(53)
Butylbenzylphthalate	ND(11)	ND(53)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(E)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4A
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Methylene Chloride	7B	ND(5)	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	2J
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	51	ND(5)	ND(5)
Semi-Volatile Organics					
Benzoic Acid	ND(52)	ND(53)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	13B	47B	6J	NA	NA
Naphthalene	ND(10)	ND(11)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	8BJ	ND(11)	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	ND(11)	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(F)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-4C
(UG/L)

ANALYTE	**JUNE 1990 (initial)**	**JUNE 1990 (verification)**	**JUNE 1990 (verification-D)**
Volatile Organics			
Toluene	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics			
Benzoic Acid	ND(52)	ND(52)	ND(52)
bis(2-Ethylhexyl)Phthalate	ND(10)	5BJ	4BJ
Naphthalene	ND(10)	ND(10)	ND(10)
Di-n-Octyl-Phthalate	ND(10)	ND(10)	ND(10)
Butylbenzylphthalate	ND(10)	ND(10)	ND(10)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.
Verification - D - indicates a duplicate sample.

TABLE 4.4-1(G)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-5
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	3J	3J	2J
Methylene Chloride	6B	ND(5)	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	11	ND(5)	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics					
Benzoic Acid	2J	ND(52)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	13B	52B	ND(10)	NA	NA
Naphthalene	ND(10)	ND(10)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	ND(10)	3BJ	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	6J	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(H)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6
(UG/L)

ANALYTE	AUGUST 1989	SEPTEMBER 1989	DECEMBER 1989	MARCH 1990	JUNE 1990
Volatile Organics					
Toluene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)	3J	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)	2BJ	ND(5)	ND(5)
Benzene	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
2-Butanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Carbon Disulfide	ND(5)	51	ND(5)	ND(5)	ND(5)
Semi-Volatile Organics					
Benzoic Acid	ND(52)	ND(77)	ND(50)	NA	NA
bis(2-Ethylhexyl)Phthalate	59B	79B	10	NA	NA
Naphthalene	ND(10)	ND(15)	ND(10)	NA	NA
Di-n-Octyl-Phthalate	ND(10)	ND(15)	ND(10)	NA	NA
Butylbenzylphthalate	ND(10)	ND(15)	ND(10)	NA	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(I)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-6C
(UG/L)

ANALYTE	**JUNE 1990 (initial)**	**JUNE 1990 (verification)**
Volatile Organics		
Toluene	ND(5)	ND(5)
Ethylbenzene	ND(5)	ND(5)
Total Xylenes	ND(5)	ND(5)
1,2-Dichloropropane	ND(5)	ND(5)
Methylene Chloride	ND(5)	ND(5)
Benzene	ND(5)	ND(5)
Acetone	3BJ	2J
2-Butanone	ND(10)	ND(10)
4-Methyl-2-Pentanone	ND(10)	ND(10)
Carbon Disulfide	ND(5)	ND(5)
Semi-Volatile Organics		
Benzoic Acid	ND(52)	ND(120)
bis(2-Ethylhexyl)Phthalate	ND(10)	7BJ
Naphthalene	ND(10)	ND(25)
Di-n-Octyl-Phthalate	ND(10)	ND(25)
Butylbenzylphthalate	ND(10)	ND(25)

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(J)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-7
(UG/L)

ANALYTE	**AUGUST 1990 (initial)**
Volatile Organics	
Toluene	ND(5)
Ethylbenzene	ND(5)
Total Xylenes	ND(5)
1,2-Dichloropropane	ND(5)
Methylene Chloride	ND(5)
Benzene	ND(5)
Acetone	3BJ
2-Butanone	ND(10)
4-Methyl-2-Pentanone	ND(10)
Carbon Disulfide	ND(5)
Semi-Volatile Organics	
Napthalene	NA
bis(2-Ethylhexyle) Phthalate	NA
Benzoic Acid	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in acordance with SOW 7/87.
ND ( ) - not detected at concentration indicated in parenthesis.
B - indicates analyte found in the associated blank as well as in the sample.
J - indicates an estimated value.
NA - indicates not analyzed.

TABLE 4.4-1(K)
ANALYTICAL DATA SUMMARY
VOLATILE/SEMI-VOLATILE ORGANICS
MCCARL SITE GROUND WATER SAMPLES
WELL MC-FB
(UG/L)

ANALYTE	JUNE 1990
Volatile Organics	
Toluene	ND(5)
Ethylbenzene	ND(5)
Total Xylenes	ND(5)
1,2-Dichloropropane	ND(5)
Methylene Chloride	ND(5)
Benzene	ND(5)
Acetone	ND(10)
2-Butanone	ND(10)
4-Methyl-2-Pentanone	ND(10)
Carbon Disulfide	ND(5)
Semi-Volatile Organics	
Benzoic Acid	NA
bis-(2-Ethylhexyl)Phthalate	NA
Naphthalene	NA
Di-n-Octyl-Phthalate	NA
Butylbenzylphthalate	NA

Notes:

Only detected compounds are listed. All samples analyzed for hazardous substance list (HSL) volatile organic and semi-volatile organic compounds in accordance with SOW 7/87.

ND ( ) - not detected at concentration indicated in parenthesis.

B - indicates analyte found in the associated blank as well as in the sample.

J - indicates an estimated value.

NA - indicates not analyzed.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Ditch 3 (0-1)[3]		Ditch 3 (1-2)		Ditch 3 (2-3)		Ditch 3 (3.5-5)	
	DuPont	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	8.7	12	8.4 8.6		7.1	8.4	6.7	11
Cadmium	ND(0.76)[4]	ND(1.3)	ND(0.76)	ND(1.2)	ND(0.73)	ND(1.3)	ND(0.79)	ND(1.3)
Chromium	27.6	25	29.6	19	20.6	20	23.7	25
Lead	15.7	16	13.5	17	19.3	14	18.0	16
Selenium	0.38B[5]	ND(1.3)	ND(0.25)	ND(1.2)	ND(0.24)	ND(1.3)	ND(0.26)	ND(1.3)
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.12)	ND(0.1)	ND(0.13)	ND(0.1) ND(0.13)	
Aluminum	21600	20000	23100	14000	15900 15000		18000	19000
Iron	26500	27000	28400	22000	18800 24000		21900	27000
Zinc	82.2	77J[6]	87.3	64J	58.4	69J	72.3	79J

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Ditch 4 (0-1)[3]		Ditch 4 (1-2)		Ditch 4 (2-3)		Ditch 4 (3.5-5)	
	DuPont	EPA	DuPont	EPA	DuPont	EPA	DuPont	EPA
Arsenic	4.9	7.4	1.9B	ND(2.6)	1.5B[5] ND(2.4)		1.6B	ND(2.4)
Cadmium	ND(0.82)[4]	ND(1.3)	ND(0.76)	ND(1.3)	ND(0.71)	ND(1.2)	ND(0.72)	ND(1.2)
Chromium	19.2	17	21.9	21	15.5	16	18.7	17
Lead	38.7	15	11.6	9.3	7.2	6.8	10.3	8.2
Selenium	ND(0.27) 1.5J[6]		ND(0.25)	ND(1.3)	ND(0.24)	ND(1.2)	ND(0.24)	ND(1.2)
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.13)	ND(0.1)	ND(0.12)	ND(0.1) ND(0.12)	
Aluminum	14100	12000	18100	17000	13100 12000		12400	12000
Iron	19500	16000	11200	10000	6930	6500	28700	19000
Zinc	63.3	48J	53.1	37J	34.7	34J	103	55J

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES[1]
MAY 1990
(mg/kg)
(Continued)

Metals[2]	Ditch 5 (0-1)[3]		Ditch 5 (1-2)		Ditch 5 (2-3)		Ditch 5 (3.5-5)	
	DuPont	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	5.5	5.8	10.1	6.9	6.4	ND(2.6)	5.6	3.2
Cadmium	ND(0.76)[4]	ND(1.3)	ND(0.77)	ND(1.3)	ND(0.72)	ND(1.2)	ND(0.70)	ND(1.2)
Chromium	22.5	16	27.5	21	21.7	22	18.2	13
Lead	18.4	16	9.8	11	15.5	6.5	8.5	9.8
Selenium	0.468[5]	ND(1.3)	ND(0.26)	ND(1.3)	ND(0.24)	ND(1.2)	ND(0.23)	1.3J
Mercury	ND(0.1) ND(0.13)		ND(0.1)	ND(0.13)	ND(0.1)	ND(0.12)	ND(0.1) ND(0.12)	
Aluminum	15600	11000	23900	17000	13000 15000		11500	8500
Iron	22700	15000	34900	18000	16600 21000		27800	18000
Zinc	49.6	49J[6]	43.7	41J	47.3	43J	53.0	39J

Note: Footnotes defined on last page.

TABLE 4.5-1
(Continued)
INORGANIC
ANALYTICAL DATA SUMMARY
FEDLER PROPERTY SPLIT SAMPLES
MAY 1990
(mg/kg)
Continued)

NOTES:

[1] Samples collected by USEPA during the week of May 21, 1990.

[2] Arsenic, Cadmium, Chromium, Lead and Selenium were the primary metals of interest during May 1989 and July 1989 field investigations. Others provided for general interest.

[3] (0-1) - numbers in parenthesis indicate depth interval below ground surface where samples were collected.

[4] *ND ( ) - indicates not detected at detection limit given in parenthesis.*

[5] B - indicates reported value is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL).

[6] J - (EPA data) indicates the associated numerical value is an estimated quantity.

[7] I - (EPA data) indicates the data are invalid (compound may or may not be present). Resampling and/or reanalysis is necessary for verification.

TABLE 4.6-1 (A)
SPLIT SAMPLE ANALYTICAL DATA COMPARISON - SOILS
VOLATILE ORGANICS
(ug/kg)

	B-SED-1		B-SED-5		M-J-10 (5.5-6.0)	
Analyte[1]	Du Pont	EPA	Du Pont	EPA	Du Pont[2]	EPA
Toluene	ND(7)[2]	ND(6.9)	ND(6)	ND(6.6)	NA[3]	ND(6)
Total Xylene	ND(7)	ND(6.9)	ND(6)	ND(6.6)	NA	ND(6)
Ethylbenzene	ND(7)	ND(6.9)	ND(6)	ND(6.6)	NA	ND(6)
Acetone	14B[4]	ND(22)	9BJ[5]	ND(14)	NA	ND(12)
Methylene Chloride	ND(7)	ND(8)	2J	ND(6.6)	NA	ND(6)

Notes:

[1] Only detected compounds listed. All samples analyzed for volatile organics in accordance with the CLP statement of work. Compounds not listed were below their respective detection limits.

[2] ND ( ) - Not detected at concentration indicated in parenthesis.

[3] NA - No sample required from this grid for volatile organic analysis by Du Pont according to the provisions of the approved RI/FS work plan.

[4] B - Indicates compound detected in the associated blank as well.

[5] J - Indicates an estimated value.

TABLE 4.6-1 (B)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA COMPARISON - SOILS
VOLATILE ORGANICS
(ug/kg)

Analyte[1]	M-I-12 (5.5-6.0) Du Pont	M-I-12 (5.5-6.0) EPA	B-D-3 (3.5-4.0) Du Pont	B-D-3 (3.5-4.0) EPA	B-D-3 (3.5-4.0) EPA(D)[2]	B-L-3 (5.5-6.0) Du Pont	B-L-3 (5.5-6.0) EPA
Toluene	NA[3]	ND(6.5)	ND(570)	ND(31)	ND(31)	NA	ND(6.4)
Total Xylene	NA	ND(6.5)	6400	640	ND(31)	NA	ND(6.4)
Ethylbenzene	NA	ND(6.5)	ND(570)	ND(31)	ND(31)	NA	ND(6.4)
Acetone	NA	ND(13)	ND(1100)	ND(62)	ND(62)	NA	ND(13)
Methylene Chloride	NA	ND(6.5)	ND(570)	ND(31)	ND(31)	NA	ND(6.4)

Notes:
[1] Only detected compounds listed. All samples analyzed for volatile organics in accordance with the CLP statement of work. Compounds not listed were below their respective detection limits.
[2] EPA(D) - represents EPA duplicate sample.
[3] NA - No sample required from this grid for volatile organic analysis by Du Pont according to the provisions of the approved RI/FS work plan.

TABLE 4.6-2 (A)

SPLIT SAMPLE ANALYTICAL DATA COMPARISON - SOILS METALS (mg/kg)

	B-SED-1		B-SED-5		M-J-10 (0-2)	
Analyte[1]	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**
Arsenic	6.1	7.4	6.7	5.9	1.3B	4.0
Cadmium	1.2B	ND(1.4)[2]	13.4	8.7	1.4	ND(1.3)
Chromium	13.5	13	95.0	36	20.2	15
Lead	25.4	29	1190	310J	129	16
Selenium	ND(0.27)	ND(1.4)	5.5	1.4	ND(0.25)	ND(1.3)
Aluminum	9530	9000	14,900	10,000	15,500	17,000
Copper	14.6	7.4	45.3	16	12.4	10
Iron	13,900	14,000	22,700	23,000	16,700	25,000
Manganese	2310	2400J	900	940J[3]	155	110
Zinc	87.0	90J	1310	680J	173	26J

Notes:

1. Arsenic, cadmium, chromium, lead and selenium are the primary metals of concern. Other metals provided for comparison purposes only.
2. ND ( ) - Not detected at concentration indicated in parenthesis.
3. J - Indicates an estimated value.

TABLE 4.6-2 (B)
(Continued)
SPLIT SAMPLE ANALYTICAL DATA COMPARISON - SOILS
(mg/kg)

	B-Q-11 (0-1)		B-T-11 (0-1)		B-H-11 (0-1)	
ANALYTE	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	4.6	6.4	5.2	6	4.3	5.1
Cadmium	ND(1.2)	NR	ND(1.2)	NR	ND(1.3)	NR
Chromium	13.7	12	12.1	12	13.7	11
Lead	46.6	43	40.1	20	28.7	19
Selenium	2.0	ND(1.4)	0.94B	ND(1.2)	1.4	ND(1.2)
Aluminum	7840	8500	7630	8300	9850	7200
Copper	36.8	ND(6.8)	8.7	ND(6.2)	9.5	ND(6.2)
Iron	14100	12000	13700	13000	14500	11000
Manganese	2910	2100	3110	2100	1720	2300
Zinc	61.7	70	49.7	54	46.7	47

Notes:

[1] Arsenic, cadmium, chromium, lead, and selenium are the primary metals of concern. Other metals provided for comparison purposes only.

[2] EPA(D) - represents EPA duplicate sample.

[3] NA - No sample required from this grid for metals analysis by DuPont according to the provisions of the approved RI/FS work plan.

[4] ND( ) - Not detected at concentration indicated in parenthesis.

[5] J - Indicates an estimated value.

[6] NR - Not reported by Jacobs Engineering.

TABLE 4.6-2 (C)
(Continued)
SPLIT SAMPLE ANALYTICAL DATA COMPARISON - SOILS
(mg/kg)

	B-O-11 (2-3)		B-P-11 (2-3)		B-J-12 (0-1)	
ANALYTE	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	8.6	14	10.8	12	4.7	6
Cadmium	ND(1.3)	NR	ND(1.3)	NR	ND(1.2)	NR
Chromium	21.9	20	21.9	21	12.9	14
Lead	20.4	23J	29.4	24J	25.0	18
Selenium	2.9	ND(1.2)	2.5	ND(1.2)	0.77B	ND(1.3)
Aluminum	17100	16000	16600	17000	8600	10000
Copper	23.9	16	26.1	16	10.1	ND(6.3)
Iron	26800	27000	27800	28000	13900	14000
Manganese	317	460	661	490	1670	2000
Zinc	72.9	70	73.4	73	44.5	47

Notes:

[1] Arsenic, cadmium, chromium, lead, and selenium are the primary metals of concern. Other metals provided for comparison purposes only.

[2] EPA(D) - represents EPA duplicate sample.

[3] NA - No sample required from this grid for metals analysis by DuPont according to the provisions of the approved RI/FS work plan.

[4] ND( ) - Not detected at concentration indicated in parenthesis.

[5] J - Indicates an estimated value.

[6] NR - Not reported by Jacobs Engineering.

TABLE 4.6-2 (D)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA COMPARISON - SOILS
(mg/kg)

	B-L-12 (1-2)		B-N-12 (0-1)		B-O-12 (1-2)	
ANALYTE	**DuPont**	**EPA**	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	8.7	9.9	6.2	7.4	10.2	13
NRCadmium	ND(1.3)	NR	ND(1.2)	NR	ND(1.3)	NR
Chromium	21.7	22	14.8	17	23.1	27
Lead	14.7	23	29.9	31	13.7	24
Selenium	2.7	ND(1.3)	1.4	ND(1.2)	3.3	ND(1.3)
Aluminum	16800	19000	10600	13000	18500	24000
Copper	20.8	ND(16)	10.9	ND(6.1)	24.0	20
Iron	25800	24000	17100	16000	27700	30000
Manganese	375	190	2140	2300	222	180
Zinc	69.9	72	47.7	49	68.1	73

Notes:

[1] Arsenic, cadmium, chromium, lead, and selenium are the primary metals of concern. Other metals provided for comparison purposes only.

[2] EPA(D) - represents EPA duplicate sample.

[3] NA - No sample required from this grid for metals analysis by DuPont according to the provisions of the approved RI/FS work plan.

[4] ND( ) - Not detected at concentration indicated in parenthesis.

[5] J - Indicates an estimated value.

[6] NR - Not reported by Jacobs Engineering.

TABLE 4.6-2 (E)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA COMPARISON - SOILS
(mg/kg)

	B-Q-12 (0-1)		B-Q-12 (2-3)	
ANALYTE	**DuPont**	**EPA**	**DuPont**	**EPA**
Arsenic	6.3	7.4	8.2	13
Cadmium	ND(1.2)	NR	ND(1.3)	NR
Chromium	15.6	13	21.6	21
Lead	26.9	24J	25.1	16J
Selenium	0.71B	ND(1.2)	10.7	ND(1.3)
Aluminum	10500	9300	16300	17000
Copper	12.2	ND(6.1)	24.2	16
Iron	17400	15000	25900	27000
Manganese	1710	1400J	334	520J
Zinc	48.2	42	67.7	72

Notes:

[1] Arsenic, cadmium, chromium, lead, and selenium are the primary metals of concern. Other metals provided for comparison purposes only.

[2] EPA(D) - represents EPA duplicate sample.

[3] NA - No sample required from this grid for metals analysis by DuPont according to the provisions of the approved RI/FS work plan.

[4] ND( ) - Not detected at concentration indicated in parenthesis.

[5] J - Indicates an estimated value.

[6] NR - Not reported by Jacobs Engineering.

TABLE 4.6-2 (F)
(Continued)
SPLIT SAMPLE ANALYTICAL DATA COMPARISON - SOILS
METALS
(mg/kg)

	M-I-12 (0-2)		B-D-3 (0-2)		
Analyte[1]	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**EPA(D)**[2]
Arsenic	8.5	30	NA[3]	10	7.5
Cadmium	45.5	ND(1.3)[4]	NA	ND(1.3)	ND(1.3)
Chromium	157	90	NA	27	26
Lead	3230	1000	NA	37J	33
Selenium	9.2	17	NA	ND(1.3)	ND(1.3)
Aluminum	6120	3300	NA	22,000	20,000
Copper	84.8	93	NA	16	17
Iron	65,800	130,000	NA	27,000	26,000
Manganese	20,200	360	NA	170	250
Zinc	4790	350J[5]	NA	140J	140J

Notes:

[1] Arsenic, cadmium, chromium, lead, and selenium are the primary metals of concern. Other metals provided for comparison purposes only.
[2] EPA(D) - represents EPA duplicate sample.
[3] NA - No sample required from this grid for metals analysis by DuPont according to the provisions of the approved RI/FS work plan.
[4] ND( ) - Not detected at concentration indicated in parenthesis.
[5] J - Indicates an estimated value.

TABLE 4.6-3
SPLIT SAMPLE
ANALYTICAL DATA COMPARISON
METALS - SOILS
(mg/kg)

	B-D-3-3			B-G-10-2			B-H-8-1		
	XRF[1]	**DU PONT**	**EPA**[3]	**XRF**	**DUPONT**	**EPA**	**XRF**	**DUPONT**	**EPA**
LEAD	316	NS[2]	150	175	NS	19	715	NS	600J

	B-R-7-1			B-R-5-2		
	XRF	**DU PONT**	**EPA**	**XRF**	**DUPONT**	**EPA**
LEAD	>10000	16,700	350J	942	NS	23000J

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[1] XRF - Lead analysis by x-ray fluorescence.
[2] NS - not sampled for analysis by Du Pont per the provisions of the approved RI/FS work plan.
[3] EPA samples analyzed for CLP metals.

TABLE 4.6-4
SPLIT SAMPLE ANALYTICAL
DATA COMPARISON - SOILS
VOLATILE ORGANICS
(ug/kg)

BAIER SITE

	B-C-8			B-E-2			B-K-2		
Analyte	**Soil Gas**[1]	**Du Pont**[2]	**EPA**[3]	**Soil Gas**	**Du Pont**	**EPA**	**Soil Gas**	**Du Pont**	**EPA**
Toluene	ND(10)	ND(50)	ND(6.3)	ND(10)	ND(50)	ND(6)	ND(10)	ND(50)	ND(6.3)
Total Xylene	ND(10)	ND(100)	ND(6.3)	ND(10)	ND(100)	ND(6)	ND(10)	ND(100)	ND(6.3)
Ethylbenzene	ND(10)	ND(50)	ND(6.3)	ND(10)	N(50)	ND(6)	ND(10)	ND(50)	ND(6.3)

MCCARL SITE

	M-F-7			M-L-11			M-C-12		
	Soil Gas[1]	Du Pont[2]	EPA[3]	Soil Gas	Du Pont	EPA	Soil Gas	Du Pont	EPA
Toluene	ND(10)	ND(50)	ND(6.3)	ND(10)	ND(50)	ND(6.0)	ND(10)	ND(50)	ND(6.6)
Total Xylene	ND(10)	ND(100)	ND(6.3)	ND(10)	ND(100)	ND(6.0)	ND(10)	ND(100)	ND(6.6)
Ethylbenzene	ND(10)	ND(50)	ND(6.3)	ND(10)	ND(50)	ND(6.0)	ND(10)	ND(50)	ND(6.6)

Notes:

[1] Soil gas samples analyzed for toluene, total xylene, and ethylbenzene only using an approved headspace technique and a portable GC in the field.

[2] Du Pont soil gas verification samples analyzed by Method 8020 (BTEX) only.

[3] EPA split samples analyzed for CLP statement of work volatile organics. All other volatile organics were non-detectable at their respective detection limit.

TABLE 4.6-5 (A)
SPLIT SAMPLE ANALYTICAL
DATA SUMMARY - GROUND WATER
METALS
(ug/L)

JUNE 1990

	MC-4C				MC-3C			
	Total		Dissolved		Total		Dissolved	
Analyte	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**
Arsenic	1.9B	ND	ND(10)	ND	2.1B	ND	2.2B	ND
Barium	128B	130	110B	78	119B	140	151B	130
Cadmium	ND(3.0)	NR	ND(3.0)	NR	ND(3.0)	NR	ND(3.0)	NR
Chromium	10.6	ND	ND(5.0)	ND	29.3	62	ND(5.0)	ND
Lead	5.3	ND	ND(2.0)	ND	ND(2.0)	ND	ND(2.0)	ND
Selenium	4.4B	ND	4.3B	ND	ND(1.0)	ND	ND(1.0)	ND
Aluminum	2220	2900	ND(22)	ND	649	2000	22.7B	ND
Copper	12.6B	ND	ND(4.0)	ND	69.1	ND	ND(4.0)	ND
Iron	6520	6000	ND(2.1)	ND	2270	5400	45.6B	ND
Manganese	491	470	481	350	1050	1200	1190	1100
Zinc	49	28	11.2B	ND	45.8	67	76	25

Notes:

[1] B - Reported value is less than the contract required detection limit (CRDI) but greater than the instrument detection limit (IDL).

[2] ND() - Not detected at concentration given in parentheses. (Note: No detection limits were reported by Jacobs Engineering for the EPA data.)

[3] Samples collected by WCC and split by Jacobs Engineering on behalf of USEPA.

[4] NR - Not reported by Jacobs Engineering.

TABLE 4.6-5 (B)
(Continued)
SPLIT SAMPLE ANALYTICAL DATA SUMMARY - GROUND WATER
METALS
(ug/L)

JUNE 1990

	MC-6C				MW-F2			
	Total		Dissolved		Total		Dissolved	
Analyte	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**
Arsenic	3.5B	ND	ND(1.0)	ND	60B	ND	ND(1.0)	ND
Barium	205	240	96.2B	120	150B	90	100B	80
Cadmium	ND(3.0)	NR	ND(3.0)	NR	ND(3.0)	NR	ND(3.0)	NR
Chromium	220	30	ND(5.0)	ND	19.0	ND	ND(5.0)	ND
Lead	9.2	ND	ND(2.0)	ND	ND(20)	ND	ND(2.0)	ND
Selenium	ND(10)	ND	1.4B	ND	ND(1.0)	ND	ND(2.0)	ND
Aluminum	7050	13000	ND(22)	ND	3890	1200	ND(22)	ND
Copper	45.9	38	ND(4.0)	ND	14.5B	ND	ND(4.0)	ND
Iron	17700	23000	ND(21)	1600J	12100	2600	ND(21)	ND
Manganese	1590	1700	672	610J	846	580	602	560
Zinc	78.6	74	8.5B	24J	71.3	31	34.2	22

Notes:

[1] B - Reported value is less than the contract required detection limit (CRDI) but greater than the instrument detection limit (IDL).

[2] ND() - Not detected at concentration given in parentheses. (Note: No detection limits were reported by Jacobs Engineering for the EPA data.)

[3] Samples collected by WCC and split by Jacobs Engineering on behalf of USEPA.

[4] NR - Not reported by Jacobs Engineering.

TABLE 4.6-5 (C)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA SUMMARY - GROUND WATER
METALS
(ug/L)

JUNE 1990
MW-K2

Analyte	Total Du Pont	EPA	Dissolved Du Pont	EPA
Arsenic	5.3B	ND	1.1B	ND
Barium	135B	130	87.7B	81
Cadmium	ND(3.0)	NR	ND(3.0)	NR
Chromium	21.2	29	ND(5.0)	ND
Lead	6.2	ND	ND(2.0)	ND
Selenium	1.6B	ND	ND(2.0)	ND
Aluminum	3410	4000	50.8B	ND
Copper	29.9	11	ND(4.0)	ND
Iron	15000	10000	207	ND
Manganese	906	610	579	500
Zinc	57.1	42	24.3	ND

Notes:

[1] B - Reported value is less than the contract required detection limit (CRDI) but greater than the instrument detection limit (IDL).

[2] ND() - Not detected at concentration given in parentheses. (Note: No detection limits were reported by Jacobs Engineering for the EPA data.)

[3] Samples collected by WCC and split by Jacobs Engineering on behalf of USEPA.

[4] NR - Not reported by Jacobs Engineering.

TABLE 4.6-5 (D)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA SUMMARY - GROUND WATER
METALS
(ug/L)

JULY 1990

	MW-D1				MW-D2			
	Total		Dissolved		Total		Dissolved	
Analyte	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**
Arsenic	1.7B	ND	ND(1.0)	ND	5.2B	ND	ND(1.0)	ND
Barium	167B	230	158B	148	286	300	146B	120
Cadmium	ND(5.0)	NR	ND(5.0)	NR	ND(5.0)	NR	ND(5.0)	NR
Chromium	10.8	17	5.2B	ND	37.4	39	ND(5.0)	ND
Lead	2.4B	ND	ND(1.0)	ND	18.6	ND	ND(1.0)	ND
Selenium	148	140	178	128	ND(20)	ND	3.4B	ND
Aluminum	2220	6800	ND(25)	ND	11700	16000	ND(25)	ND
Copper	14.3B	22	6.1B	ND	45.2	40	ND(4.0)	ND
Iron	6600	14000	ND(22)	ND	32100	36000	ND(22)	ND
Manganese	352	480	135	145	1210	1200	661	570
Zinc	64.6	59	24	21	210	200	83.6	25

Notes:

[1] B - Reported value is less than the contract required detection limit (CRDI) but greater than the instrument detection limit (IDL).

[2] ND() - Not detected at concentration given in parentheses. (Note: No detection limits were reported by Jacobs Engineering for the EPA data.)

[3] Samples collected by WCC and split by Jacobs Engineering on behalf of USEPA.

[4] NR - Not reported by Jacobs Engineering.

TABLE 4.6-5 (E)
(Continued)
SPLIT SAMPLE ANALYTICAL
DATA SUMMARY - GROUND WATER
METALS
(ug/L)

JULY 1990

	MW-L1				MW-L2			
	Total		Dissolved		Total		Dissolved	
Analyte	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**	**Du Pont**	**EPA**
Arsenic	6.1B	ND	6.9B	ND	63.7	89	ND(2.0)	ND
Barium	479	440	69.9B	220	1180	1000	220	56
Cadmium	ND(5.0)	NR	ND(5.0)	NR	ND(5.0)	NR	ND(5.0)	NR
Chromium	60.4	64	ND(5.0)	49	276	230	44.8	ND
Lead	12.5	ND	ND(1.0)	ND	147	120	ND(1.0)	ND
Selenium	11.8	ND	ND(2.0)	ND	ND(2.0)	ND	13.3	ND
Aluminum	8200	11000	30.5B	ND	84300	74000	ND(25)	ND
Copper	45.6	33	ND(4.0)	ND	234	200	ND(4.0)	ND
Iron	25400	24000	23.1B	ND	216000	180000	ND(22)	ND
Manganese	1080	890	ND(8.0)	190	55200	2600	205	2.8
Zinc	80	65	4.4B	ND	588	510	7.8B	ND

Notes:

[1] B - Reported value is less than the contract required detection limit (CRDI) but greater than the instrument detection limit (IDL).

[2] ND() - Not detected at concentration given in parentheses. (Note: No detection limits were reported by Jacobs Engineering for the EPA data.)

[3] Samples collected by WCC and split by Jacobs Engineering on behalf of USEPA.

[4] NR - Not reported by Jacobs Engineering.

TABLE 5-1

ENVIRONMENTAL FACTORS AFFECTING POTENTIAL CHEMICAL RELEASES

Process	Key Environmental Property
Physical Transport	
Meteorological transport	Wind Velocity
Bio-Uptake	Biomass
Sorption	Organic content of soil or sediments; mass loading of aquatic systems
Volatilization	Air turbulence; evaporation rate; reaeration coefficients; soil organic content
Run-Off	Precipitation rate
Leaching	Adsorption coefficient
Fallout	Particulate concentration, wind velocity
Chemical Processes	
Photolysis	Solar irradiance; transmissivity of water or air
Oxidation/Reduction	Concentrations of oxidants and retarders; pH; oxygen concentration; soil metal concentration; complexation state
Hydrolysis	Soil moisture content
Biological Processes	
Biotransformation	Micro-organism population and acclamation level

TABLE 5-2

MECHANISMS FOR TRANSFORMATION AND TRANSPORT WITHIN AND BETWEEN ENVIRONMENTAL COMPARTMENTS

Water - Transport from water to atmosphere, sediments or organisms

- Volatilization
- Absorption onto sediments; desorption
- Absorption into cells (protists, plants, animals)

- Transformations

- Biodegradation
- Photochemical degradation
- Chemical degradation (e.g. hydrolysis, free-radical oxidation, etc.)

Soil - Transport to water, sediments, atmosphere, or cells

- Dissolution in rain water
- Adsorption on particles carried by run-off
- Volatilization from leaf or soil surfaces
- Uptake by protista, plants, and animals

- Transformations

- Biodegradation
- Photodegradation on plant and soil surfaces

Atmosphere - Transport from atmosphere to land or water

- Adsorption to particulate matter followed by gravitational settlings or rain washout
- Washout through dissolution in rain water
- Dry deposition (direct absorption in water bodies)

TABLE 5-2
(Continued)
MECHANISMS FOR TRANSFORMATION AND TRANSPORT WITHIN AND BETWEEN ENVIRONMENTAL COMPARTMENTS

- Transport within atmosphere
  - Turbulent mixing and diffusion within troposphere
  - Diffusion to stratosphere
- Atmospheric Transformation
  - Photochemical degradation by direct absorption of light, or by accepting energy from an excited donor molecule (sensitizer), or by reacting with another chemical that has reached an excited state
  - Oxidation by ozone
  - Reaction with free radicals
  - Reactions with other chemical contaminants

TABLE 5-3

PHYSICOCHEMICAL AND BIOLOGICAL PROCESSES INFLUENCING MOBILITY AND ENVIRONMENTAL FATE OF CONTAMINANTS

Sorption	Adsorption to particulate matter (i.e., soil colloids) is an important mechanism by which chemicals interact with soils. Adsorption is the electrostatic attraction (adhesion) of chemical ions or molecules to the surface of soil solids. This process is reversible and the adsorbed material may be released through the opposite reaction known as desorption. In soils, adsorbent materials include clay minerals and organic matter.
Ion-Cation Exchange	This process is a specific sorption mechanism for inorganics (i.e., heavy metals) in soil. Ion exchange is an exchange of a chemical ion with some other ion that initially occupies a binding site on a soil particle.
Diffusion	Diffusion in a solution is a physical process where ionic or molecular constituents move from regions of higher concentration to lower concentrations. This "spreading out" of molecular constituents tends to equalize concentrations in all parts of the solution or medium and thus, the movement of pollutant ions or molecules occurs from a region of high concentration to a region of low concentration.
Volatilization	Volatilization or vaporization is a form of diffusion in which pollutant transfer occurs from soil to air or water to air or plant surfaces to air. Volatilization is an important pathway for many organic chemicals, but is less important for inorganic chemicals because many ionic substances are considered non-volatile. The volatility of a chemical is a function of its vapor pressure.

TABLE 5-3
(Continued)
PHYSICOCHEMICAL AND BIOLOGICAL PROCESSES INFLUENCING MOBILITY AND ENVIRONMENTAL FATE OF CONTAMINANTS

	As a general rule, the volatility of organic chemicals from water increases with decreasing water solubility. Thus, chemical compounds with high vapor pressures and low water solubilities would be expected to be highly volatile from aqueous solution.
Ionization	Ionization is a chemical process where the molecules of a chemical compound separate or dissociate into particles (ions) of opposite electrical charge.
Hydrolysis	Hydrolysis is a chemical reaction in which a compound reacts with water to form one or more new compounds.
Oxidation/Reduction	This process is a chemical reaction in which one or more electrons are transferred from one molecule to another. (Reduction is the acceptance of electrons from another molecule oxidation in the transfer of electrons to another molecule.) This transformation process is important for many inorganic compounds as well as some organics. Oxidation is more important than reduction under aerobic conditions (i.e., adequate oxygen tension) in the environment.
Complexation	This is a process (also referred to as chelation) where metal ions combine with organic or other non-metallic molecules (called ligands) such that the metal does not undergo further reaction.
Photochemical Reactions	These reactions are an important degradation mechanism for organic chemicals in air, water, and soil. This type of reaction requires exposure to light and absorption of sufficient energy to break existing chemical bonds.

TABLE 5-3
(Continued)
PHYSICOCHEMICAL AND BIOLOGICAL PROCESSES INFLUENCING MOBILITY AND ENVIRONMENTAL FATE OF CONTAMINANTS

Bioaccumulation	This behavior is also referred to as bio-uptake and is a process where organisms, such as plants and animals, accumulate and concentrate chemicals from soil or water. This transport process is different from many of the others described above because it results in chemicals becoming concentrated rather than dispersed.
Biotransformation	This process refers to a chemical change in a substance brought about by a living organism (e.g. micro-organisms). The new compound resulting from biotransformation may have fate and transport characteristics different than those of the original compound.

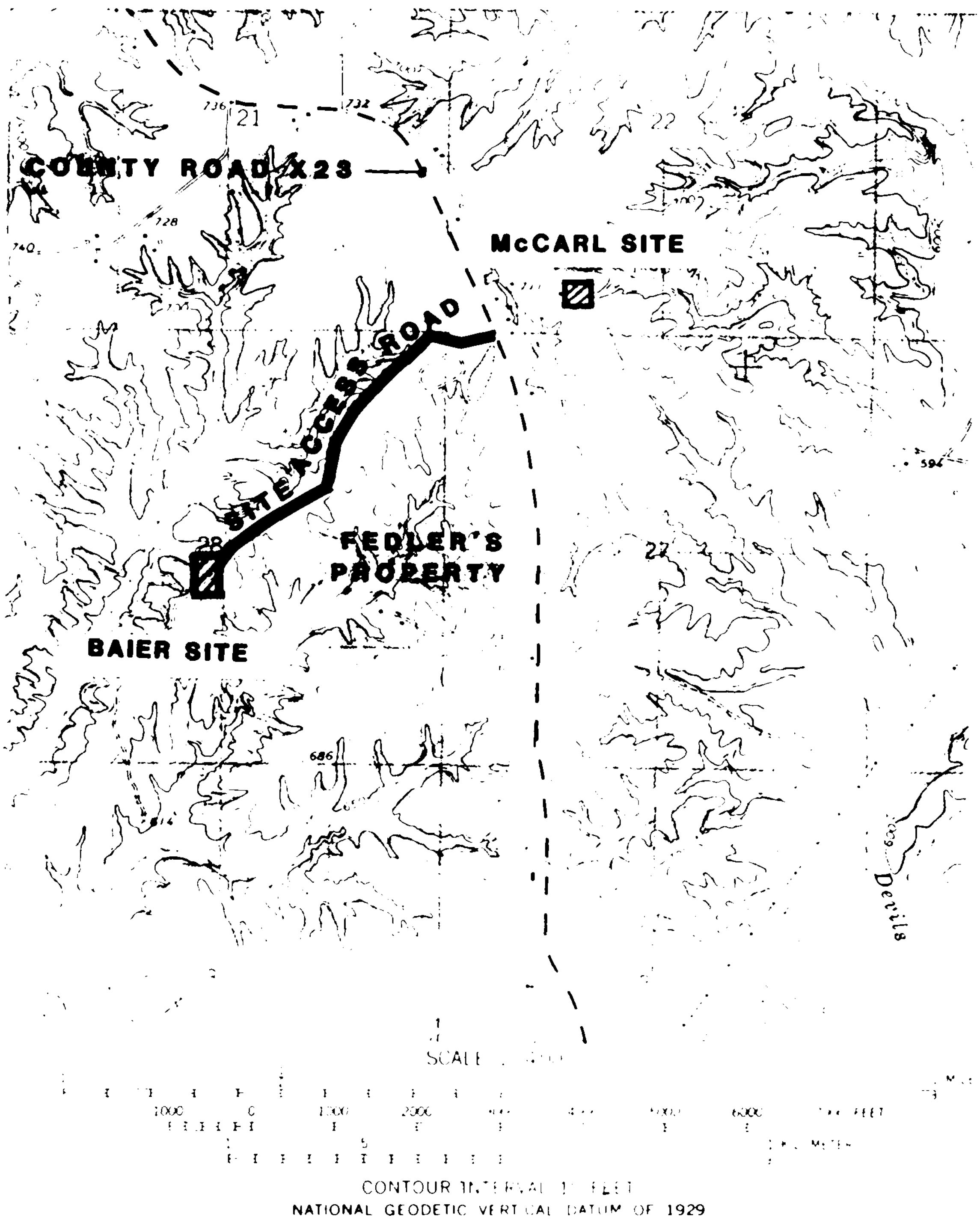
TABLE 5-4
CONCENTRATIONS AND BACKGROUND RANGES OF METALS DETECTED IN SITE SOILS

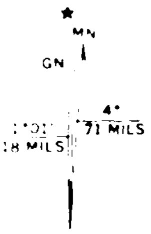
Metals[1]	Arithmetic Mean[2]	National Background Range[2]	National Background Mean[2]
Aluminum	9,439	10,000 - 300,000	71,000
Antimony	14.7	0.2 - 150	6
Arsenic	6.7	1 - 50	5
Barium	2,689	100 - 3,000	430
Beryllium	0.7	0.1 - 40	6
Cadmium	43.2	0.01 - 0.7	0.06
Calcium	8,590	7,000 - 500,000	13,700
Chromium	105.6	1 - 1,000	100
Cobalt	15.9	1 - 40	8
Copper	135	2 - 100	30
Iron	20,733	7,000 - 550,000	38,000
Lead	1,314	2 - 200	10
Magnesium	2,354	600 - 6,000	5,000
Manganese	1,321	20 - 3,000	600
Mercury	0.07	0.01 - 0.3	0.03
Nickel	28.5	5 - 500	40
Potassium	933	400 - 30,000	8,300
Selenium	11.4	0.1 - 2	0.3
Silver	0.7	0.01 - 5	0.05
Sodium	118	750 - 7,500	6,300
Thallium	0.24	0.1 - 0.5	0.2
Vanadium	31.7	20 - 500	100
Zinc	1950	10 - 300	50

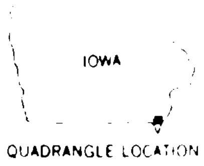
Notes: [1] Metals listed in this table are for McCarl site only.
[2] Concentrations have units of mg/kg and are arithmetic means.

TABLE 6-1
SUMMARY OF CUMULATIVE POTENTIAL CANCER RISKS AND NON-CARCINOGENIC HAZARD INDICES

Exposure Scenario	Reasonable Maximum Exposure (RME)		Representative Exposure	
	Potential Cancer Risk	Non-Carcinogenic Hazard Index	Potential Cancer Risk	Non-Carcinogenic Hazard Index
Baier				
Hiker (Child)	2.9×10^{-7}	0.062	9.5×10^{-8}	0.020
Juvenile Hunter	4.3×10^{-7}	0.10	1.5×10^{-7}	0.034
Hiker (Edibles)	2.7×10^{-7}	0.016	8.8×10^{-8}	0.0078
Hiker (Year Round)	2.3×10^{-7}	0.053	7.4×10^{-8}	0.017
Hunter	3.1×10^{-8}	0.0074	1.0×10^{-8}	0.0024
Farmer	1.2×10^{-6}	0.11	4.0×10^{-7}	0.035
McCarl				
Hiker (Child)	1.8×10^{-7}	0.029	9.6×10^{-8}	0.0092
Juvenile Hunter	2.7×10^{-7}	0.035	1.5×10^{-7}	0.011
Hiker (Edibles)	1.7×10^{-7}	0.011	8.8×10^{-8}	0.0035
Hiker (Year Round)	1.5×10^{-7}	0.018	7.5×10^{-8}	0.0055
Hunter	1.9×10^{-8}	0.0025	1.0×10^{-8}	0.00076
Farmer	7.8×10^{-7}	0.051	4.1×10^{-7}	0.016







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