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September 1991

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Superfund Record of Decision:

Berlin & Farro, MI

50272-101

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Berlin & Farro, MI
First Remedial Action - Final

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16. Abstract (Limit: 200 words)

The 40-acre Berlin & Farro site is a former liquid incineration and landfill facility in Gaines Township, Genesee County, Michigan. Land near the site consists of woodland and agricultural areas. In addition, the site overlies two aquifers, which provide well water to the approximately 80 permanent homes located within a 1/2 mile radius of the site. From 1971 to 1975, Berlin and Farro Liquid Incineration, Inc., used the site to accept and store industrial wastes prior to incineration, and disposed of crushed drums in a 1.1-acre onsite landfill. During this period, the owners failed to comply with air emission standards, onsite storage volume limits, and permit standards that prohibited onsite disposal of wastes other than solid wastes. The facility also operated two unauthorized waste storage lagoons and two unlined storage lagoons; illegally buried five tanks of wastewater; buried liquid wastes; operated underground storage tanks; poured liquid wastes into subsurface agricultural drains; and dumped thousands of gallons of barrelled wastes into two onsite pits. In 1975, Berlin and Farro's permits were revoked; however, illegal dumping of industrial waste into the lagoons apparently continued after the site was closed. Several separate clean-up actions were undertaken by the PRPs, the State,

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Berlin & Farro, MI
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Contaminated Media: soil, sediment, gw
Key Contaminants: VOCs (benzene, PCE, TCE, toluene, xylenes), metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 72
	20. Security Class (This Page) None	22. Price

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Abstract (Continued)

and EPA during the early to mid-1980's. These activities included, but were not limited to, removing lagoon sludge, the incinerator facility, five underground tanks, an agricultural drain and paint sludge trench, surface debris, drums, waste piles and soil, and 1,000,000 gallons of contaminated water; backfilling the lagoons and old drum landfill; and constructing settling ponds. This Record of Decision (ROD) addresses the final remedy for contaminated soil, sediment, and ground water at the Berlin and Farro site. The primary contaminants of concern affecting the soil, sediment, and ground water are VOCs including benzene, PCE, TCE, toluene, and xylenes; and metals including arsenic, chromium, and lead.

The selected remedial action for this site includes excavating, partially treating using solidification, and consolidating (in an onsite RCRA containment cell) contaminated soil and sediment from the central site area and sediment from an offsite drain (treatment of the materials will remove free liquids and render characteristic waste and non-characteristic RCRA waste); collection and treating leachate from the call; backfilling, covering with soil and revegetating the excavated onsite areas; regrading the excavated areas of the drain; pumping and treatment of ground water from the shallow portion of the aquifer using a system of collection trenches, followed by treatment using air stripping and onsite discharge to the drain; treating off-gas emissions from the ground water treatment system; monitoring ground water; and implementing institutional controls including deed restrictions. The estimated present worth cost for this remedial action is $8,119,300, which includes an annual O&M cost of $233,100 for 30 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific soil and sediment clean-up goals are based on State health-based standards and include benzene 0.02 mg/kg, lead 20.8 mg/kg, toluene 16 mg/kg, and xylenes 6 mg/kg. Chemical-specific ground water clean-up goals are based on health standards, and include benzene 1 ug/l.

DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Berlin and Farro Site
Swartz Creek, Michigan

Statement of Basis and Purpose

This decision document represents the selected remedial action for the Berlin and Farro site, Swartz Creek, Michigan, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based upon the contents of the administrative record for the Berlin and Farro site.

The State of Michigan concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of Remedy

This final remedy addresses remediation of ground water, soil and sediment contamination by eliminating or reducing the low level threat posed by contaminated soil and sediment through containment on-site and the threat from contaminated ground water through treatment.

The major elements of the selected remedy include:

* Excavation, partial treatment, and containment of approximately 48,000 cubic yards of contaminated soil and sediment from on site locations and sediment from Slocum Drain in an on-site RCRA Subtitle C/Act 64 cell, with treatment of any leachate collected from the cell;

* Back-filling, covering with topsoil and revegetating the excavated on-site areas and regrading the excavated areas of Slocum Drain;

* Extraction of contaminated ground water and treatment of the ground water by air stripping on site and treatment of the off gases;

* Site deed restrictions to prevent installation of drinking water wells or other intrusive activity at the site; and

* Ground water monitoring to assess the state of the remediation.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. As this remedy will result in containment of waste on-site and initially result in hazardous substances remaining on-site above health-based levels during the remediation of ground water, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

FOR Valdas V. Adamkus
Regional Administrator
U.S. EPA - Region V

9/30/91
Date

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
BERLIN AND FARRO SITE
SWARTZ CREEK, MICHIGAN

I. SITE NAME, LOCATION AND DESCRIPTION

The Berlin and Farro facility is a fenced 40-acre site situated in a primarily rural area approximately 3½ miles south of the town of Swartz Creek in Gaines Township, Genesee County, Michigan (Figure 1). The street address of the site is 8322 South Morrish Road, Swartz Creek, Michigan. Primary land use in the area consists of agricultural row crops and small deciduous woodlands. The property is zoned for residential and agricultural use. Residences are located within about 500 feet of the northeast and southeast boundaries of the site. Approximately 80 permanent residences are located within a ½ mile radius of the site. There are no known endangered species or critical habitats within close proximity of the site.

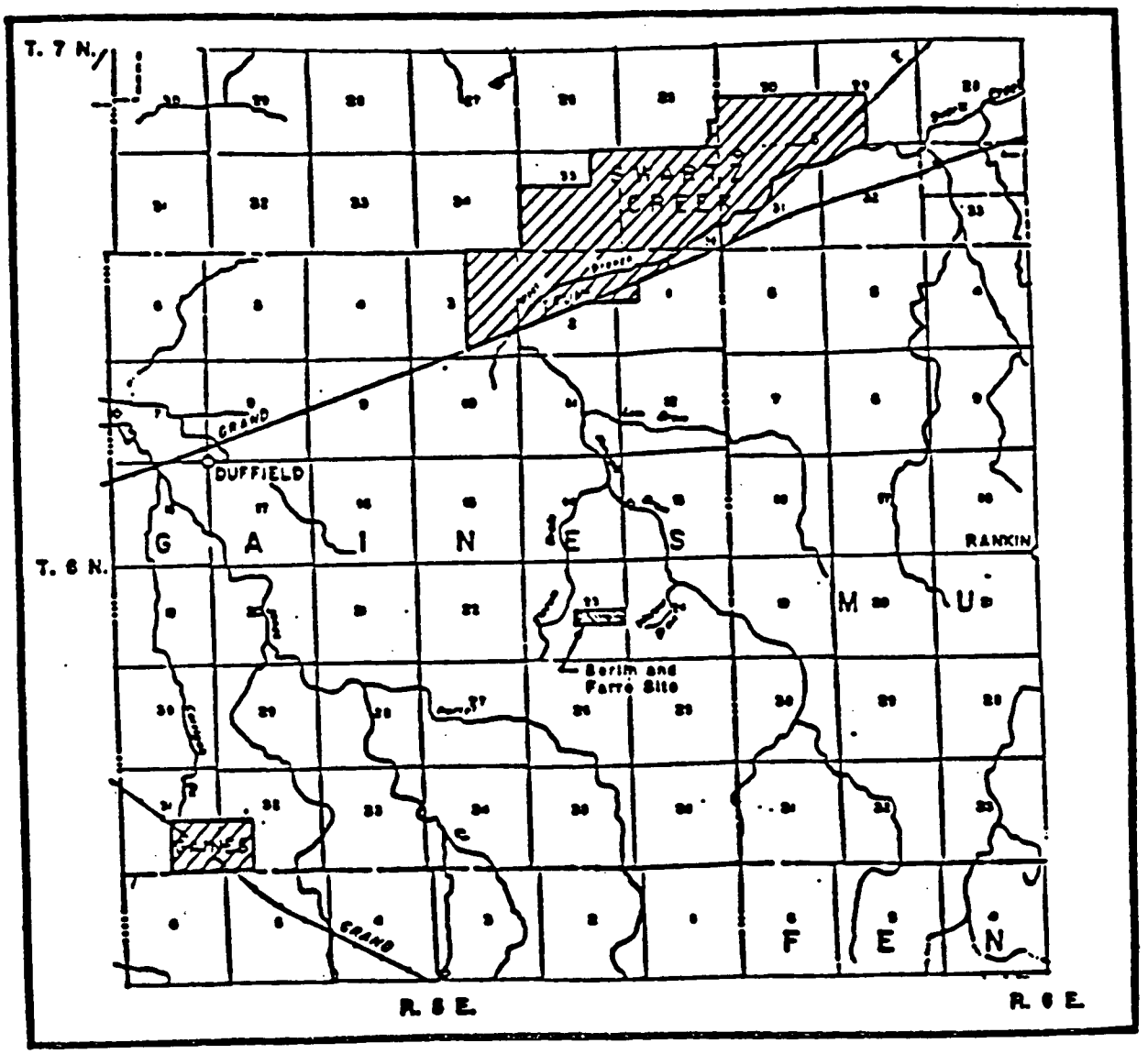
The site ground surface is flat to gently rolling with 0 to 6 percent slopes. Ground surface varies from elevation 812 to 822 feet, mean sea level. Surface water runoff generally flows westward toward Slocum Drain with lesser amounts of runoff flowing eastward toward Vincent Drain and then Kimball Drain. Slocum and Kimball Drains are excavated ditches used to convey runoff to help drain surrounding farmland. Agricultural drain tiles (buried clay pipe) are also used in the area to drain surface water infiltration from farm fields. The tiles discharge into the drains.

The site also contains several bodies of water which have resulted from surface cleanup activities (Figure 2). The South Lagoon and the Tank Excavation Area ponds retain water year round. Two settling ponds constructed to reduce off-site runoff, retain water for much of the year. In addition, there are three marshy areas created by prior cleanup activities at the site which retain standing water during parts of the year, especially during rainy seasons. These marshy areas are not classified as wetlands.

The site geology is characterized by glacial till overlying bedrock. The glacial till is approximately 120 to 150 feet thick and is comprised primarily of clay with intermittent water-bearing sand lenses up to 10 feet thick.

The glacial till overlies the Saginaw formation, a typically fractured sandstone, which is the uppermost bedrock. Two units are recognized in the glacial till; an upper unit to a depth of about 50 to 70 feet and a lower unit to a depth of about 130 feet. Both units have sufficient permeability to be considered aquifers. The upper till unit has been divided into two zones defined as the shallow zone and the intermediate zone. The shallow zone extends to a depth of about 30 feet. The intermediate zone extends from 30 feet to 50-70 feet. This subdivision is based on interpretation of

FIGURE 1

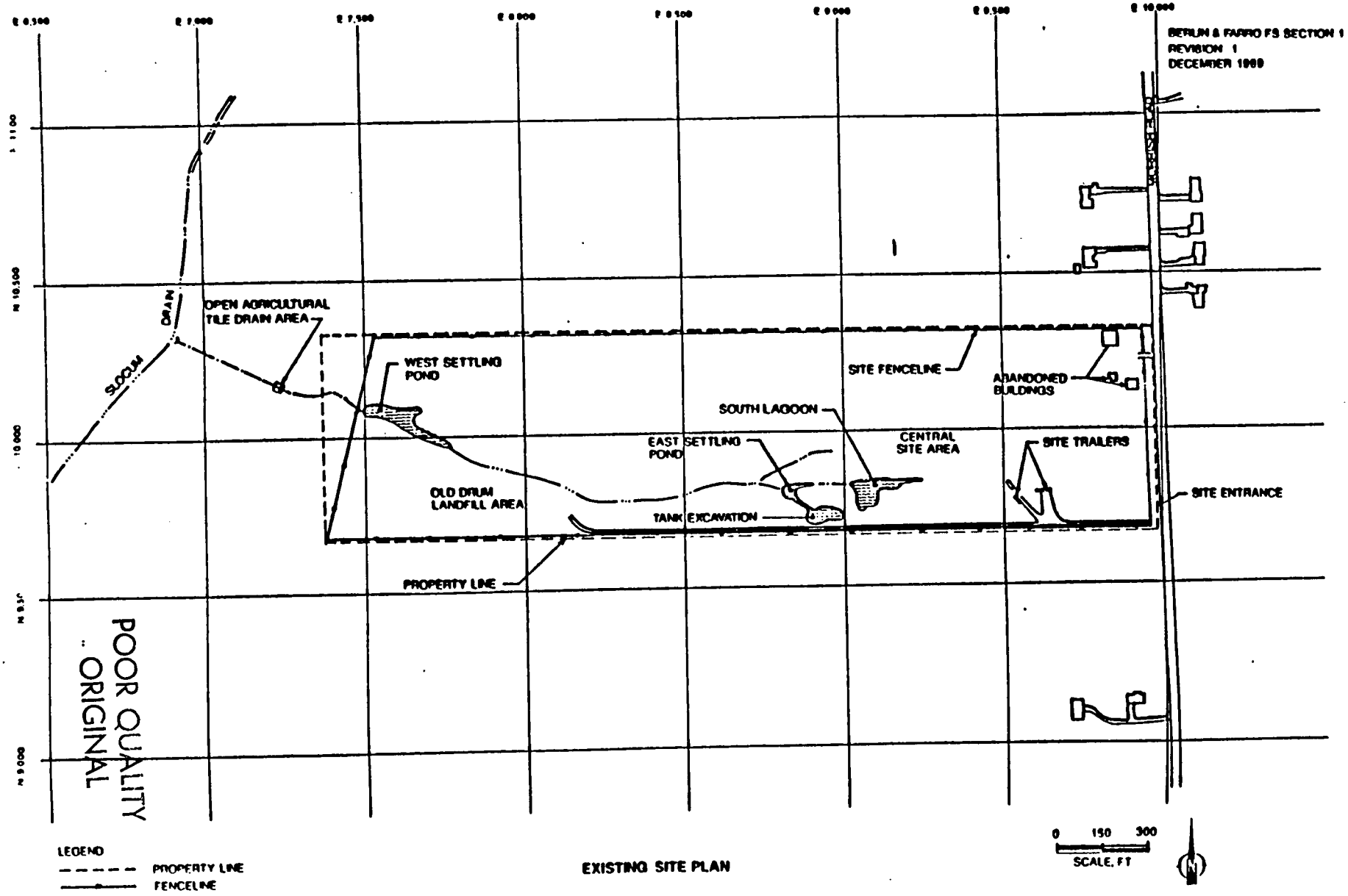


FROM: MICHIGAN DEPARTMENT OF NATURAL RESOURCES GENESEE COUNTY MAP, AUGUST 8, 1978

SCALE, MILE

NORTH

VICINITY MAP
BERLIN AND FARRO



EXISTING SITE PLAN

FIGURE 2

differences in water level variation in the geology with depth. Wells in the glacial till water-bearing sand lenses typically have yields of 5 to 20 gallons per minute. Test wells at the site generally have yields lower than 5 gallons per minute. The upper portion of the bedrock at the site is primarily sandstone. Wells in the bedrock aquifer have yields of 1½ to 20 gallons per minute.

Residents near the site obtain ground water from wells in glacial till aquifers and from the underlying bedrock. There are 115 residential wells within one mile of the site. Approximately 1/3 of the residential wells draw water from the glacial till aquifers. At least one well in the area draws water from the shallow portion of the aquifer. The remaining residential wells draw water from the bedrock.

Groundwater migrates both laterally and vertically in the upper glacial till. The direction is generally radial away from a mounded area in the north central part of the site and otherwise in a westerly direction. The ground water migrates laterally in the upper till at a rate of approximately 7 ft/yr. A vertical ground water migration rate of 0.8 feet per year is considered representative of the upper glacial till. Vertical migration is impeded by low permeability clay zones between the shallow and intermediate zones. The intermediate ground water migrates primarily to the northwest and west. A lateral migration rate of 2 ft/yr is considered representative of this zone.

Lateral ground water migration in the lower glacial till is considered to be negligible due to the over consolidated nature of the clay till and the low frequency of permeable zones.

The bedrock aquifer is part of the regional ground water flow system. Lateral ground water migration is to the northwest toward regional surface water drainage systems such as the west branch of Swartz Creek and the Flint River. A lateral migration rate of approximately 20 ft/yr is representative of the bedrock aquifer.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Berlin and Farro Liquid Incineration, Inc. began operations at the site in April, 1971. The facility was permitted to accept industrial waste for incineration, to store waste prior to incineration, and to operate an on-site 1.1 acre landfill for disposal of crushed used drums. Numerous violations of permit requirements were cited during the period of operation, until September 1975 when Berlin and Farro lost its operating permit for the incinerator. Permit violations included failure to comply with air emission standards and on-site storage volume limits, and failure to meet permit standards prohibiting on-site disposal of wastes other than solid wastes. The facility also operated two unauthorized waste storage lagoons and two unlined storage lagoons, illegally buried five tanks of waste water, buried liquid wastes,

operated underground storage tanks, poured liquid wastes into subsurface agricultural drains and dumped thousands of gallons of barrelled wastes into two pits. These permit violations and unpermitted activities led to the revocation of Berlin and Farro's incinerator and landfill permits on September 16, 1975.

From 1975 until 1978, while the permit revocations were under appeal, Berlin and Farro was permitted by the State of Michigan ("State") to transport industrial wastes for other generators, but not to transport wastes to its own site. Michigan Department of Natural Resources ("MDNR") investigations indicated that illegal dumping of industrial wastes into the lagoons apparently continued after 1975. In 1978, Berlin and Farro's appeal of its permit revocation failed.

Limited cleanup activities were conducted by Berlin and Farro under a plan submitted to MDNR from 1978 until 1980, when Berlin and Farro filed for Chapter 11 Bankruptcy.

In 1978 and 1981, ownership of the property was transferred to the State for nonpayment of property taxes. Ten acres of the site remain under the jurisdiction of the Genesee County Circuit Court as a result of a lawsuit filed by the State. The site was placed on the National Priorities List on September 8, 1983 and ranked number 13 on that list (48 Fed. Reg. 40658).

The United States Environmental Protection Agency ("U.S. EPA") identified over 125 generators through review of site records. U.S. EPA, the State, and certain settling Potentially Responsible Parties ("PRPs") undertook surface cleanup actions intermittently from December 1981 through October 1984. Primary remediation activities through 1984 included:

* fencing of the site,
* removal of north and south lagoon sludges,
* backfill of north lagoon and part of the south lagoon,
* removal of the incinerator facility,
* construction of the east and west settling ponds,
* removal of 5 underground tanks,
* removal of drums and buried drums from the old drum landfill and two small nearby drum burial areas,
* backfilling of the old drum landfill,
* excavation and removal of the N-S agricultural drain and paint sludge trench,

- removal of surface debris, drums, waste piles and soils,
- removal and disposal of over 1 million gallons of contaminated water recovered during remedial operations,
- performance of a hydrogeologic study, and
- performance of a Focused Feasibility Study of soil contamination.

In April 1981, the facility was declared a toxic substances emergency site by the State Toxic Substance Control Commission. The Michigan State Legislature subsequently appropriated funds to continue cleanup at the site. By December 1981 the State had removed 15,300 cubic yards of lagoon sludge contaminated primarily with hexachlorocyclopentadiene (C-56) waste to off-site disposal facilities.

Because MDNR's funding for the project was exhausted, in June and July 1982, U.S. EPA performed an emergency response action at the site. At that time, U.S. EPA installed a fence around the property, and excavated and removed approximately 30 drums that were not secured in the landfill.

In October 1982, MDNR removed five tanks containing approximately 10,000 gallons of liquid waste, and removed 580 cubic yards of contaminated soil and began a hydrogeologic study under a Superfund cooperative agreement. Beginning in April, 1983, the State resumed its activities at the site under order of the Genesee County Circuit Court. The State treated storm water runoff from the site and continued excavation and off-site disposal of drums from the landfill, and of contaminated soils, lagoon liquids and sludges, and debris. Approximately 18,000 cubic yards of contaminated soils were shipped off site and approximately 4,000 drums were excavated and characterized. The drums contained, among other hazardous substances, C-series chlorinated organic compounds, polychlorinated biphenyls (PCBs), benzene and ethylbenzene.

In August 1983, MDNR again exhausted its funding for the site while it was still in the middle of its cleanup activities. At that point, MDNR had excavated, but not yet disposed of, roughly 4,000 drums containing hazardous liquids, solids and sludges from the landfill. Because many of the drums were bulging or leaking, and contained highly flammable toxic substances, U.S. EPA performed another emergency response action to stabilize the materials and complete safe disposal of these wastes. This removal action took place between August 29 and October 28, 1983.

On March 22, 1984, a group of PRPs agreed to perform a voluntary partial cleanup, under an agreed work plan, which was based in large part on the U.S. EPA's August 31, 1983 Focused Feasibility Study. This agreement was formalized in a consent decree, signed

by 87 PRPs, which was entered on March 14, 1985, after the partial surface cleanup had been completed. Under the work plan, the PRPs removed solid waste, liquid waste and contaminated soil from the drum landfill; removed waste and contaminated soil from the paint sludge trench; removed waste and contaminated soils from the agricultural drains; removed some of the piles of soil contaminated with C-series waste; and removed waste and contaminated soil from several identified hot spots. Under the agreement the PRPs also reimbursed U.S. EPA and the State of Michigan for a portion of past costs incurred up to that time.

The PRP-financed cleanup removed more than one million gallons of liquid waste and 75,000 tons of drums and contaminated surface soils and soil piles from several areas. The cleanup activities ended in October 1984.

Pursuant to a Consent Decree signed in January 1986 and entered June 5, 1986, a group of 77 PRPs agreed to perform the Remedial Investigation/Feasibility Study (RI/FS) for the Berlin and Farro site. The RI/FS was intended to quantify through field sampling and analysis the residual contamination at the site and to identify appropriate remedial alternatives.

Most of the wastes originally disposed of at the site were removed during the above response actions. Constituents remain in site media but no previously unknown waste disposal areas have been identified on-site during the RI. The RI conducted for the site was initiated in March 1986 and continued intermittently through January 1989. A post-screening investigation (PSI) was initiated in October 1988 to obtain additional data for the FS detailed analysis. The PSI was essentially complete as of April 1989.

PRPs who performed response work at the site, and additional PRPs identified by U.S. EPA, were sent a general notice letter on July 20, 1990. That letter indicated, among other things, that a period of negotiations concerning the remedy to be performed at the site was initiated, as required by the 1986 RI/FS consent decree. That period was extended, pursuant to court order, into January 1991.

III. COMMUNITY RELATIONS HISTORY

A Proposed Plan for this remedial alternative was released July 11, 1991. This documents and all supporting documents are available to the public in the administrative record maintained in the U. S. EPA Docket Room in Region 5 the information repositories at the Swartz Creek Public Library in Lansing, Michigan and the Gaines Township Hall. The notice of availability for the Proposed Plan was published in the Flint Journal on July 8, 1991. A sixty day public comment period was held from July 11, 1991 through September 9, 1991. In addition, a public meeting was held on August 8, 1991. At this meeting, representatives of the U.S. EPA and MDNR answered questions about problems at the site and the remedial alternatives

under consideration and accepted formal comments from the Public regarding the proposed alternative and other alternatives analyzed in the FS. A response to these comments and to written comments received during the comment period is included in the Responsiveness Summary, which is part of this Record of Decision. This decision document presents the selected remedial action for the Berlin and Farro site, in Swartz Creek, Michigan.

The RI/FS Report and a Proposed Plan for the Berlin and Farro site were previously released to the public on July 20, 1990. A fact sheet summarizing this Proposed Plan and remedial alternatives was released to the public on August 2, 1990. These documents were made available to the public in both the administrative record and the information repository maintained in the EPA Docket Room in Region 5, at the Perkins Public Library in Swartz Creek, Michigan, and at the Gaines Township Hall. The notice of availability for the RI/FS Report and the Proposed Plan was published in the Flint Journal on July 20, 1990. A sixty day public comment period was held from July 20, 1990 through September 19, 1990. On September 7, 1990 U.S. EPA sent a letter to all persons on the site mailing list informing them about a change in its preference among the various alternatives under consideration, subject to review of public comments.

In addition, public meetings were held on August 9 and September 12, 1990. At these meetings, representatives from EPA and the MDNR discussed the Proposed Plan and answered questions about conditions at the site and about the remedial alternatives under consideration. A response to the comments received during this comment period are included in the Responsiveness Summary, which is part of the Record of Decision.

At the start of the 1990 public comment period, U.S. EPA proposed a remedial alternative which addressed both groundwater and soil contamination at the Berlin and Farro Liquid Incineration site ("Berlin and Farro"), Swartz Creek, Michigan. The alternative, as specified in the proposed plan, called for on-site incineration of contaminated soils and for the extraction of contaminated groundwater with treatment via air stripping. On-site incineration was projected to last for approximately 1 year and extraction and treatment of the groundwater was projected to last for at least 30 years. In addition, the Berlin and Farro proposed plan required groundwater monitoring and long-term maintenance of the air stripper.

Initial written comments received by the U.S. EPA and those voiced at the August 9, 1990 public meeting in Swartz Creek left no doubt that most concerned members of the public were strongly opposed to on-site incineration.

The strong opposition to the proposed plan expressed early in the comment period, especially those comments offered at the public

meeting, led the U. S. EPA and the MDNR to alter the preferred soil cleanup plan. This opposition was based on the short term risk presented by the estimated 380 days of operation of the on-site incinerator. In addition, information was provided indicating that much of the volume of soil proposed to be remediated was to be treated based only on metals contamination. Incineration is not generally considered an effective treatment for metals, and in fact, may produce treatment residuals that could require significant additional treatment. The new plan called for the removal of excavated soils to a licensed off-site facility for treatment and disposal. This plan retained the use of an air stripper for treatment of contaminated groundwater.

A second public meeting was held on September 12, 1990. At this meeting representatives from U.S. EPA and MDNR discussed the changes that the Agencies were considering based on public comment. During this 1990 public comment period U. S. EPA continued negotiations with potentially responsible parties ("PRPs") regarding cleanup options at Berlin and Farro as required under the terms of the RI/FS Consent Decree ("Decree"). U. S. EPA made it clear that at the end of the public comment period, following response to all comments, the terms of the Decree would be met and it intended to sign a ROD as early as the last week of September 1990. PRPs filed for and were granted an order which enjoined the U. S. EPA from issuing a ROD as planned. The Court ruled on September 27, 1990 that terms of the Decree would not be fulfilled, and a ROD could not be issued, until an additional sixty day period of negotiations had been held.

U.S. EPA and MDNR determined, based on information developed and clarified during these extended negotiations that a remedial action to address soil contamination other than the previously proposed options is most appropriate for Berlin and Farro.

This Record of Decision (ROD) presents the selected remedial action for the Berlin and Farro site, in Swartz Creek, Michigan based on the Agencies response to public concerns expressed during the comment period. The selected remedial action will be chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this site is based on the administrative record.

IV. SCOPE AND ROLE OF REMEDIAL ACTIVITIES

This ROD addresses the final remedy for treatment of sediment, soil, surface water, and ground water contamination at the Berlin and Farro site. The principal remaining threats at the site are considered to be the contaminated soil, sediments and contaminated ground water.

The selected remedial alternative will address all remaining principal threats at the site. Remaining concerns to be addressed by the remedy include contamination in on-site surface water and shallow ground water (through collection and treatment) and six general areas where significant soil and sediment contamination exists (through excavation and disposal). The four areas containing contaminated soils of concern are: the central site area, the former metal hydroxide ponds, the south transportation area, and the old drum landfill area. The two areas containing contaminated sediments of concern are: the on-site drainage ditch and ponds, and Slocum Drain (see Figures 3 and 4).

The final remedy for the site is intended to address the entire site with respect to the threats to human health and the environment indicated in the site risk assessment. The findings of the risk assessment are included in the RI/FS Report and are summarized in a later section of this ROD.

V. SUMMARY OF SITE CHARACTERISTICS

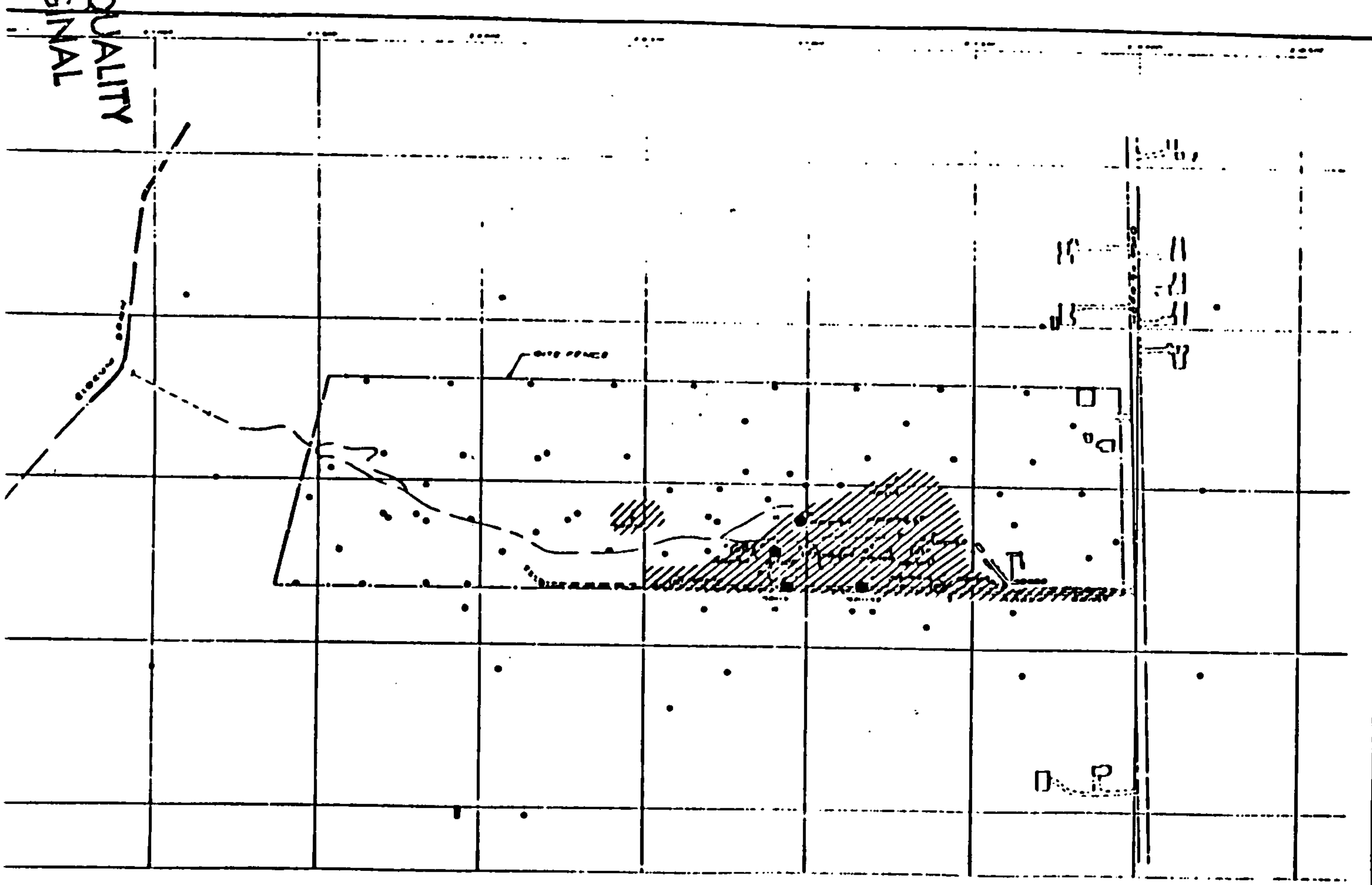
Residual levels of contaminants were detected in on-site soils.

Locations of soil with residual constituents are linked to prior site disposal areas and activities. Site related constituents in soil primarily include hexachlorobenzene (C66), volatile organic compounds (VOCs), other semi-volatile organic compounds and to a limited extent, metals. C-66 and other C-series compounds are generally in the upper 5 feet of soil. The lateral extent of the C-series compound contamination is shown in figure 3. VOCs generally occur in the upper 10 feet of soil near the old site operation areas. Soils along the south transportation route showed the greatest number of metals above background levels. Soil analyses are summarized in Table 1-2.

Additional investigation was conducted to assess the characteristics and extent of soil contamination in the former metal hydroxide settling ponds. Several test pits were excavated and soil samples were collected and analyzed. These data were used to determine the total lateral extent of soil contamination.

Site-related constituents are present in sediments in drainageways and ponded water areas. Sediment constituents are similar to soil constituents. The extent of C-58 and C-66 in sediments is shown in figure 4. VOCs and metals are also present in the sediments but are less widespread than in the soils. Sediment analyses are presented in Table 1-3.

Site related organic constituents are present in shallow zone ground water in isolated sandy zones in locations near old facilities and within the upper 18 feet of the soil profile. No monitoring wells screened below 20 feet indicated the presence of



NOTES

1. REFER TO FIGURE 1-5 FOR SOIL BORING NUMBERS.
2. REFER TO RI TABLES FOR SELECTED DEPTH AND C-SERIES CONCENTRATIONS AT SOIL BORING DEPTH.
3. REFER TO RI TABLES FOR THE TYPE OF ANALYSES PERFORMED ON THE SOIL SAMPLES SHOWN ON THIS FIGURE.

REVISIONS

REV. 0	COMMENT		SZ	JFS

LEGEND

ESTIMATED EXTENT (BASED ON PRESENCE OF COMPOUNDS IN CLP ANALYSES)

FEASIBILITY STUDY

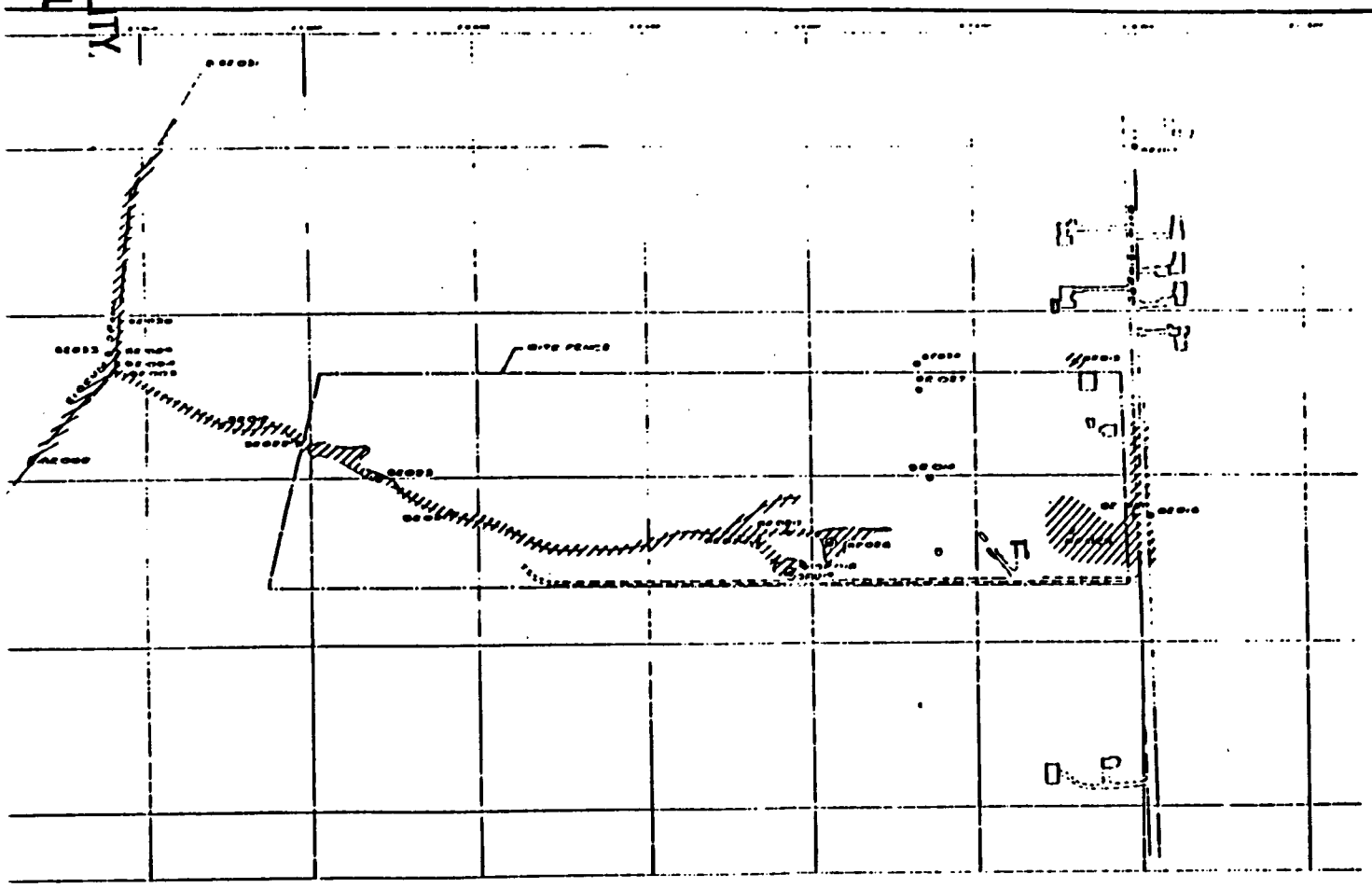
BERLIN AND FARRO RI / FS

ESTIMATED EXTENT OF C-SERIES INDICATOR COMPOUNDS IN SOILS

05C3147

Woodward-Clyde Consultants

FIGURE 3



REV. 0	COMMENT		SZ	JHS

FEASIBILITY STUDY

BERLIN AND FARRO RI / FS

ESTIMATED EXTENT OF C-SERIES INDICATOR COMPOUNDS IN SEDIMENTS

DECEMBER 89 | 455-3147 | 1-11

Woodward-Clyde Consultants

FIGURE 4

TABLE 1-2

SUMMARY OF SOIL ANALYSES

Constituents	Central Site Area		Old Drum Landfill Area		Main Site Area		Background	
	# Hits/ # Analyses[a]	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)
Volatile Organics								
Acetone	14/20	27-13,100	1/1	1,200	0/4	-	1/5	27
Benzene	12/20	5-670	1/1	33	0/4	-	0/5	-
2-Butanone	5/20	69-780	1/1	2,300	0/4	-	0/5	-
Carbon Disulfide	3/20	13-43	0/1	-	0/4	-	0/5	-
Carbon Tetrachloride	1/20	4	0/1	-	0/4	-	0/5	-
Chlorobenzene	8/20	23-1,600	1/1	23	0/4	-	0/5	-
Chloroethane	1/20	53	0/1	-	0/4	-	0/5	-
Chloroform	5/20	23-163	0/1	-	0/4	-	0/5	-
Trans 1,2-Dichloroethene	6/20	10-1,200	1/1	63	0/4	-	0/5	-
1,1-Dichloroethane	6/20	23-80	0/1	-	0/4	-	0/5	-
Ethylbenzene	14/20	33-23,000	1/1	70	0/4	-	0/5	-
2-Hexanone	2/20	73-9	1/1	20	0/4	-	0/5	-
4-Methyl-2-Pentanone	9/20	18-3,840	1/1	2,600	0/4	-	0/5	-
Methylene Chloride	7/20	14-800	1/1	4708	0/4	-	0/5	-
Styrene	1/20	11	0/1	-	0/4	-	0/5	-
Tetrachloroethene (PCE)	6/20	12-11,000	1/1	11	0/4	-	0/5	-
1,1,1-Trichloroethane(TCA)	6/20	6-2,600	0/1	-	0/4	-	0/5	-
1,1,2-Trichloroethane	3/20	6-1603	1/1	29	0/4	-	0/5	-
Trichloroethene (TCE)	8/20	23-5,700	1/1	33	0/4	-	0/5	-
Toluene	15/20	23-21,000	1/1	590	0/4	-	0/5	-
Vinyl Chloride	2/20	33-20	0/1	-	0/4	-	0/5	-
Total Xylenes	16/20	33-200,000	1/1	430	0/4	-	0/5	-
Semi-Volatile Organics								
Anthracene	2/17	443-703	NT	-	0/3	-	0/5	-
Benzo(a)Anthracene	1/17	923	NT	-	0/3	-	0/5	-
Benzo(k)Fluoranthene	1/17	168	NT	-	0/3	-	0/5	-

TABLE 1-2

SUMMARY OF SOIL ANALYSES

Constituents	Central Site Area # Hits/ # Analyses*	Central Site Area Range in Hit Concentration (ug/kg)	Old Drum Landfill Area # Hits/ # Analyses	Old Drum Landfill Area Range in Hit Concentration (ug/kg)	Main Site Area # Hits/ # Analyses	Main Site Area Range in Hit Concentration (ug/kg)	Background # Hits/ # Analyses	Background Range in Hit Concentration (ug/kg)
Semi-Volatile Organics (cont'd)								
Benzoic Acid	2/17	1623-1,900	NT	-	0/3	-	0/5	-
Butybenzylphthalate	2/17	2303-5,100B	NT	-	1/3	853	0/5	-
Chrysene	1/17	197J	NT	-	0/3	-	0/5	-
Dibenzofuran	1/17	110J	NT	-	0/3	-	0/5	-
1,2-Dichlorobenzene	1/17	101J	NT	-	0/3	-	0/5	-
1,3-Dichlorobenzene	1/17	1,500	NT	-	0/3	-	0/5	-
Di-n-Butylphthalate	4/17	277JB-1,400	NT	-	2/3	400-430	0/5	-
Di-n-Octylphthalate	2/17	330-1,500	NT	-	0/3	-	0/5	-
Bis(2-Ethylhexyl) Phthalate	7/17	83J-1,700	NT	-	3/3	1103-1100	2/5	43-440
Fluoranthene	1/17	196J	NT	-	0/3	-	0/5	-
Fluorene	1/17	170J	NT	-	0/3	-	0/5	-
Hexachlorobenzene(C66)	7/17	10-6,900	NT	-	0/3	-	0/5	-
Hexachlorobutadiene(C06)	1/17	107J	NT	-	0/3	-	0/5	-
Hexachlorocyclopentadiene(C56)	1/17	2,000	NT	-	0/3	-	0/5	-
2-Methylnapthalene	2/17	52J-1,200	NT	-	0/3	-	0/5	-
Napthalene	2/17	67J-3,700	NT	-	0/3	-	0/5	-
Octachlorocyclopentene(C58)	1/17	13,600	NT	-	0/3	-	1/5	15
Phenanthrene	2/17	104J-370	NT	-	0/3	-	0/5	-
Pyrene	1/17	390J	NT	-	0/3	-	0/5	-

TABLE I-2

SUMMARY OF SOIL ANALYSES

Constituents	Central Site Area # Hits/ # Analyses*	Central Site Area Range in Hit Concentration (mg/kg)	Old Drum Landfill Area # Hits/ # Analyses	Old Drum Landfill Area Range in Hit Concentration (mg/kg)	Main Site Area # Hits/ # Analyses	Main Site Area Range in Hit Concentration (mg/kg)	Background # Hits/ # Analyses	Background Range in Hit Concentration (mg/kg)
Metals/Inorganics								
Aluminum	17/17	1,700-25,200	NT	-	3/3	3,200-9,270	5/5	8,170-125,000
Arsenic	16/17	0.0-68 20.1	NT	-	3/3	5.1-8.7	5/5	3.2-7.5
Barium	17/17	49-174	NT	-	3/3	39-130	5/5	82-138
Cadmium	1/17	1.1	NT	-	0/3	-	0/5	-
Chromium	16/17	6-55	NT	-	3/3	10-27	5/5	10-17
Cobalt	16/17	2-14	NT	-	3/3	3.1-7.4	5/5	6.4-15
Copper	17/17	4.9-58	NT	-	3/3	11-14	5/5	7.2-10
Iron	17/17	7,800-29,600	NT	-	3/3	12,300-20,300	5/5	15,700-22,800
Lead	10/17	3.5-118 20.1	NT	-	3/3	3.7-14	5/5	9.6-17
Manganese	17/17	139-608	NT	-	3/3	304-620	5/5	216-559
Mercury	0/17	-	NT	-	0/3	-	5/5	0.028-0.060
Nickel	17/17	8.8-42	NT	-	3/3	9.8-31	5/5	7.3-14
Selenium	0/17	-	NT	-	0/3	-	5/5	0.230-0.510
Silver	8/17	1.1-2.2	NT	-	1/3	1.8	0/5	-
Thallium	0/17	-	NT	-	0/3	-	0/5	-
Vanadium	17/17	10-110	NT	-	3/3	22-55	5/5	24-34
Zinc	17/17	20-220	NT	-	3/3	17-55	5/5	94-118
Cyanide	7/17	0.22-3.7	NT	-	0/3	-	0/5	-

NOTES: See Appendix L of the RI and the Supplemental RI for complete data listing

* Only results from WCC Hazardous Substance List testing included; target screens not included.

NT Not tested.

\- Not detected.

J Indicates an estimated value. Used either when estimating a concentration for tentatively identified compounds where a 1:1 ratio is assumed, or when the mass spectral data indicates the presence of a compound where the result is less than the detection limit but greater than zero.

B The analyte is found in the blank as well as the sample and thus indicates possible blank contamination.

Central Site Area includes: SB030, SB032, SB033, SB039, SB072**, SB078**, SB094 (4 ft), SB094 (20 ft)**, SB095, SB096, SB098 (2 ft)**, SB098 (3 ft), SB099 (1 ft)**, SB099 (20 ft), SB099 (42 ft)**, SB100, SB101 (3 ft)**, SB101 (7 ft), SB102 (2 ft), SB102 (6 ft), SB103 (3 ft), SB103 (4 ft), SB104 (3 ft), SB104 (12 ft) for VOA.

**SVOA, pesticides and metals not completed.

Main Site Area includes: SB024, SB025, SB082 (29 ft)**, SB082 (34 ft) for VOA.

Old Drum Landfill Area includes: SB077**

Background includes: WTP002, WTP003, WTP004, WTP005, WTP005D for all analyses.

TABLE 1-3

SUMMARY OF SEDIMENT ANALYSES

Constituents	Slocum Drain		On-Site Ponds & Ditches		On-Site & Near Site Marshy Area		Other Off-Site Pond & Ditches		Vincent & Kimball Drains		Background	
	# Hits/ # Analyses[a]	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)	# Hits/ # Analyses	Range in Hit Concentration (ug/kg)
Volatile Organics												
Acetone	1/13	137	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Benzene	1/13	33	1/8	33	0/5	-	0/5	-	0/7	-	0/2	-
2-Butanone	2/13	103	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Carbon Disulfide	1/13	27	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Chlorobenzene	0/13	-	1/8	190	0/5	-	0/5	-	0/7	-	0/2	-
Chloroform	0/13	-	0/8	-	0/5	-	1/5	383	0/7	-	0/2	-
Chloromethane	0/13	-	0/8	-	1/5	133	0/5	-	0/7	-	0/2	-
Trans-1,2-Dichloroethene	0/13	-	1/8	5	0/5	-	0/5	-	0/7	-	0/2	-
1,1-Dichloroethane	0/13	-	2/8	6-7	0/5	-	0/5	-	0/7	-	0/2	-
1,2-Dichloroethane	0/13	-	1/8	7	0/5	-	0/5	-	0/7	-	0/2	-
Ethylbenzene	0/13	-	1/8	29	0/5	-	0/5	-	0/7	-	0/2	-
Methylene Chloride	0/13	-	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Tetrachloroethene (PCE)	2/13	23-33	1/8	11	1/5	23	0/5	-	0/7	-	0/2	-
Toluene	0/13	-	1/8	28	1/5	60	0/5	-	0/7	-	0/2	-
Trichloroethane (TCA)	0/13	-	1/8	28	0/5	-	0/5	-	0/7	-	0/2	-
Vinyl Chloride	0/13	-	1/8	23	0/5	-	0/5	-	0/7	-	0/2	-
Total Xylenes	0/13	-	1/8	309	0/5	-	0/5	-	0/7	-	0/2	-
Semi-Volatile Organics												
Benzo(a)Pyrene	0/13	-	1/8	1,320J	0/5	-	0/5	-	0/7	-	0/2	-
Benzo(a)Anthracene	0/13	-	1/8	935J	0/5	-	0/5	-	0/7	-	0/2	-
Benzo(k)Fluoranthene	0/13	-	1/8	1,650J	0/5	-	0/5	-	0/7	-	1/2	470J
Benzoic Acid	1/13	560J	3/8	1,000J-1,800J	0/5	-	0/5	-	0/7	-	0/2	-
Butybenzylphthalate	1/13	120J	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Chrys	1/13	1,040	1/8	2,530J	0/5	-	0/5	-	0/7	-	0/2	-
1,2-Dic...robenzene	0/13	-	1/8	980J	0/5	-	0/5	-	0/7	-	0/2	-

TABLE 1-3

SUMMARY OF SEDIMENT ANALYSES

Constituents	Slocum Drain # Hits/ # Analyses[a]	Slocum Drain Range in Hit Concentration (ug/kg)	On-Site Ponds & Ditches # Hits/ # Analyses	On-Site Ponds & Ditches Range in Hit Concentration (ug/kg)	On-Site & Near Site Marshy Area # Hits/ # Analyses	On-Site & Near Site Marshy Area Range in Hit Concentration (ug/kg)	Other Off-Site Ponds & Ditches # Hits/ # Analyses	Other Off-Site Ponds & Ditches Range in Hit Concentration (ug/kg)	Vincent & Kimball Drains # Hits/ # Analyses	Vincent & Kimball Drains Range in Hit Concentration (ug/kg)	Background # Hits/ # Analyses	Background Range in Hit Concentration (ug/kg)
Semi-Volatile Organics (cont'd)												
1,3-Dichlorobenzene	0/13	-	1/8	7,900	0/5	-	0/5	-	0/7	-	0/2	-
1,4-Dichlorobenzene	0/13	-	1/8	1,780J	0/5	-	0/5	-	0/7	-	0/2	-
Diethylphthalate	1/13	6,300	0/8	-	0/5	-	0/5	-	2/7	290J-1,600	0/2	-
Di-n-Butylphthalate	6/13	120-1,600	0/8	-	0/5	-	2/5	83J-110J	1/7	1,200	0/2	-
Di-n-Octylphthalate	0/13	-	0/8	-	0/5	-	0/5	-	1/7	200J	0/2	-
Bis(2-ethylhexyl)phthalate	9/13	110-2,300	0/8	-	0/5	-	3/5	390-18,000B	2/7	95J-370	0/2	-
Fluoranthene	0/13	-	1/8	5,750	0/5	-	0/5	-	1/7	81J	1/2	610J
Phenanthrene	0/13	-	1/8	1,620J	0/5	-	0/5	-	0/7	-	0/2	-
Pyrene	0/13	-	1/8	5,030	0/5	-	0/5	-	0/7	-	1/2	471J
Pentachlorophenol	1/13	1,600	0/8	-	0/5	-	0/5	-	0/7	-	0/2	-
Octachlorocyclopentene(C58)	4/13	60-2,500	1/8	43,000	0/5	-	0/5	-	0/7	-	0/2	-
Hexachlorobenzene(C66)	10/13	40J-11,020	8/8	91J-82,000	1/5	57J	3/5	21J-86J	1/7	21	0/2	-
Pesticides												
4-4'-DDE	0/13	-	0/8	-	0/5	-	1/5	42	0/7	-	0/2	-
4-4'-DDT	0/13	-	0/8	-	0/5	-	1/5	78	0/7	-	0/2	-

TABLE 1-3

SUMMARY OF SEDIMENT ANALYSES

Constituents	Slocum Drain		On-Site Ponds & Ditches		On-Site & Near Site Marshy Area		Other Off-Site Ponds Ditches		Vincent & Kimball Drains		Background	
	# Hits/ # Analyses[a]	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)
Metals/Inorganics												
Aluminum	13/13	3,010-27,100	8/8	11,100-27,000	5/5	6,140-19,200	5/5	5,090-17,200	7/7	2,220-11,500	2/2	2,950-10,700
Antimony	1/13	1.3	0/8	-	2/5	1.5-1.7	0/5	-	1/7	1.63	0/2	-
Arsenic	11/13	2.9-29	8/8	0.6-9.0	4/5	1.5-5.6	5/5	4.5-13	7/7	1.6-19	2/2	1.8-6.6
Barium	12/13	79-380	8/8	73-170	5/5	97-130	5/5	86-100	7/7	30-150	2/2	20-130
Beryllium	0/13	-	1/8	1.0	0/5	-	0/5	-	0/7	-	0/2	-
Cadmium	3/13	0.703-30	2/8	1.8-3.6	2/5	0.203-0.283	0/5	-	1/7	0.313	0/2	-
Chromium	13/13	7.1-300R	8/8	20-73	5/5	11-33	5/5	11-35	7/7	5.7-17	2/2	5.2-27
Cobalt	13/13	4-23	8/8	5.2-14	5/5	2.2-8.7	4/5	2.9-9.9	3/7	2.5-3.8	1/2	4.9
Copper	13/13	6.7-486	8/8	13-140	5/5	8.6-21	4/5	4.7-25	7/7	3.7-19	2/2	4.2-16
Iron	13/13	1,600-361,000	8/8	18,200-38,200	5/5	9,060-28,000	5/5	8,310-28,100	7/7	5,960-12,500	2/2	6,800-16,100
Lead	12/13	5.0-66	8/8	6.9-61	5/5	8.6-11	5/5	9-20	5/7	3.7-10	1/2	10.9
Manganese	13/13	120-2,320	8/8	100-460	5/5	83-370	5/5	63-370	7/7	59-377	2/2	153-221
Mercury	3/13	0.05-0.073	0/8	-	2/5	0.027-0.03	0/5	-	1/7	0.043	0/2	-
Nickel	13/13	5.9-266	8/8	18-63	5/5	12-40	5/5	7.0-28	7/7	3.7-19	2/2	3.2-17
Selenium	3/13	1.5-2.3	0/8	-	2/5	0.22-0.25	0/5	-	1/7	0.48	0/2	-
Silver	1/13	1,620	0/8	-	2/5	1,530-1,640	0/5	-	1/7	1,150	0/2	-
Thallium	1/13	3.3	0/8	-	2/5	3.9-4.0	0/5	-	1/7	3.83	0/2	-

TABLE 1-3

SUMMARY OF SEDIMENT ANALYSES

Constituents	Slocum Drain		On-Site Ponds & Ditches		On-Site & Near Site Marshy Area		Other Off-Site Ponds Ditches		Vincent & Kimball Drains		Background	
	# Hits/ # Analyses*	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)	# Hits/ # Analyses	Range in Hit Concentration (mg/kg)
Metals/Inorganics (cont'd)												
Tin	1/13	2.7	0/8	-	2/5	3.0-3.3	0/5	-	1/7	2.03	0/2	-
Vanadium	12/13	9.2-80	8/8	38-96	5/5	19-63	5/5	10-49	7/7	15-31	2/2	18-37
Zinc	13/13	33-1,300	8/8	68-240	5/5	45-100	5/5	55-200	7/7	25-93	2/2	50-71
Cyanide	3/13	0.22-13	3/8	1.1-5.6	2/5	0.22-0.3	0/5	-	2/7	0.05-1.1	0/2	-

Notes:

See Appendix L of the RI and the Supplemental RI for Complete Data Listing

* = Only results from Hazardous Substance List testing included; target screens not included.

R = Indicates spike sample recovery is not within control limits.

NT = Not Tested.

- = Not Detected.

B = Analyte is found in blank as well as the sample. Indicates possible blank contamination.

J = Indicates an estimated value. Used either when estimating a concentration for tentatively identified compounds where a 1:1 ratio is assumed, or when the mass spectral data indicates the presence of a compound where the result is less than the detection limit but greater than zero.

Slocum Drain Area Includes: SED002, 003, 003D, 004, 005, 012, 022, 029, 030, 030D, 031, 031D, and 033.

On-Site Ponds and Ditches Includes: SED018, 019, 020, 021, 023, 024, 024D, and 026.

On-Site and Near Site Marshy Area Includes: SED014, 025, 027, 034, and 034D.

Off-Site Ponds and Ditches Includes: SED013, 013D, 015, 016, and 017.

Vincent and Kimball Drains Include: SED006, 007, 008, 009, 010, 011, and 032.

Background Area Includes: SED001 and 028.

TABLE 1-4

SUMMARY OF GROUND WATER ANALYSES

Constituents	Old Drum Landfill (Glacial Zones) # Hits/ # Analyses*	Old Drum Landfill (Glacial Zones) Range in Hit Concentration (ug/l)	North Central Site Area (Glacial Zones) # Hits/ # Analyses	North Central Site Area (Glacial Zones) Range in Hit Concentration (ug/l)	Other Site and Near Site Area (Glacial & Bedrock Zones) # Hits/ # Analyses	Other Site and Near Site Area (Glacial & Bedrock Zones) Range in Hit Concentration (ug/l)	Background Glacial # Hits/ # Analyses	Background Glacial Range in Hit Concentration (ug/l)	Background Bedrock # Hits/ # Analyses	Background Bedrock Range in Hit Concentration (ug/l)
Volatile Organics										
Acetone	5/32	33-210	0/7	-	0/89	-	0/6	-	0/0	-
Benzene	8/32	23-16	3/7	120-140	0/89	-	0/6	-	0/0	-
2-Butanone	1/32	16	0/7	-	0/89	-	0/6	-	0/0	-
Chloroethane	0/32	-	2/7	91-140	1/89	13	0/6	-	0/0	-
Chloroform	0/32	-	0/7	-	4/89	8-32	0/6	-	0/0	-
Trans-1,2-Dichloroethene (tDCE)	12/32	5-1700	0/7	-	0/89	-	0/6	-	0/0	-
1,1-Dichloroethene (DCE)	3/32	17-120	0/7	-	0/89	-	0/6	-	0/0	-
1,1-Dichloroethane	9/32	13-35	0/7	-	0/89	-	0/6	-	0/0	-
1,2-Dichloroethane	8/32	23-123	0/7	-	0/89	-	0/6	-	0/0	-
Ethylbenzene	3/32	59-77	0/7	-	0/89	-	0/6	-	0/0	-
2-Hexanone	0/32	-	2/7	23	0/89	-	0/6	-	0/0	-
Methylene Chloride	6/32	13-103	0/7	-	0/89	-	0/6	-	0/0	-
Tetrachloroethene (PCE)	0/32	-	0/7	-	0/89	-	0/6	-	0/0	-
Toluene	3/32	920-1,200	0/7	-	0/89	-	0/6	-	0/0	-
Vinyl Chloride	7/32	23-1,400	0/7	-	0/89	-	0/6	-	0/0	-
Total Xylenes	0/32	-								
Semi-Volatiles										
Di-n-Butylphthalate	6/28	13-93	0/6	-	0/89	-	0/5	-	0/2	-
Bis(2-Ethylhexyl)phthalate	0/28	-	0/6	-	0/89	-	0/5	-	2/2	1-10
Phenol	0/28	-	0/6	-	0/89	-	1/1	186	0/2	-

TABLE I-4

SUMMARY OF GROUND WATER ANALYSES

Constituents	Old Drum Landfill (Glacial Zones) # Hits/ # Analyses*	Old Drum Landfill (Glacial Zones) Range in Hit Concentration (mg/l)	North Central Site Area (Glacial Zones) # Hits/ # Analyses	North Central Site Area (Glacial Zones) Range in Hit Concentration (mg/l)	Other Site and Near Site Area (Glacial & Bedrock Zones) # Hits/ # Analyses	Other Site and Near Site Area (Glacial & Bedrock Zones) Range in Hit Concentration (mg/l)	Background Glacial # Hits/ # Analyses	Background Glacial Range in Hit Concentration (mg/l)	Background Bedrock # Hits/ # Analyses	Background Bedrock Range in Hit Concentration (mg/l)
Metals/Inorganics										
Aluminum	5/25	0.117-1.09R	2/6	0.910-0.902	19/87	0.173-9.36	2/6	0.27-3.2	0/3	-
Arsenic	16/25	0.001-0.03	2/6	0.010-0.015	75/87	0.003-0.051	3/6	0.010-0.031	3/3	0.026-0.077
Barium	17/25	0.1-0.692	3/6	0.181-1.1	65/87	0.100-0.505	5/6	0.311-1.13	3/3	0.185-0.380
Cadmium	3/25	0.00022-0.003	1/6	0.002	2/87	0.0020-0.0030	0/6	-	0/3	-
Chromium	3/25	0.010-0.050	0/6	-	12/87	0.011-0.630	0/6	-	1/3	0.012
Cobalt	0/25	-	0/6	-	9/87	0.021-0.033	0/6	-	0/3	-
Copper	1/25	0.066	1/6	0.023	0/87	-	0/6	-	0/3	-
Iron	17/25	0.060-4.3	9/6	0.050-3.06	73/87	0.050-9.08	3/6	0.030-2.05	3/3	0.120-0.160
Lead	1/25	0.001	0/3	-	1/78	0.003	1/6	0.039	1/3	0.005
Manganese	25/25	0.011-0.550	6/6	0.037-1.1	84/87	0.010-1.1	3/6	0.015-0.051	3/3	0.039-0.068
Nickel	6/25	0.022-0.068	6/6	0.018-0.097	27/87	0.018-0.690	1/6	0.039	1/3	0.027
Silver	2/25	0.013-0.015	2/6	0.013-0.010	9/87	0.011-0.082	2/6	0.012-0.010	0/3	-
Zinc	7/25	0.020-0.110	2/6	0.025-0.083	20/87	0.012-0.245	1/6	0.026	1/3	0.230

NOTES:

See Appendix L of the RI and the Supplemental RI for complete data listing.

*Only results from hazardous substance List Testing included; target screen not included.

- = Not Detected

J = Indicates an estimated value. Used either when estimating a concentration for tentatively identified compounds where a 1:1 ratio is assumed, or when the mass spectral data indicates the presence of a compound where the result is less than the detection limit but greater than zero.

Old Drum Landfill Area Includes: MW012, 021, 025, 029, 030, 035, 035D, 36, 36D, 05, 07, 08, 09, 30, 31

North Central Site Area Includes: MW008, 040, 032

Other Site and Near Site Areas Includes: MW003, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19 20, 22, 23, 24, 26, 27, 28, 30, 31, 32,33, 37, 38, 39, 40, 43, 46

Background Glacial Includes: MW002, 041, 042

Background Bedrock Includes: MW001

TABLE I-3

SUMMARY OF SURFACE WATER ANALYSES

Constituents	Slocum Drain		On-Site Ponds & Ditches		On-Site & Near Site Marshy Area		Off-Site Ponds & Ditches		Vincent & Kimball Drains		Background	
	# Hits/ # Analyses	Range in Hit Concentration (ug/l)	# Hits/ # Analyses	Range in Hit Concentration (ug/l)	# Hits/ # Analyses	Range in Hit Concentration (ug/l)	# Hits/ # Analyses	Range in Hit Concentration (ug/l)	# Hits/ # Analyses	Range in Hit Concentration (ug/l)	# Hits/ # Analyses	Range in Hit Concentration (ug/l)
Volatile Compounds												
Trans-1,2-Dichloroethene	4/10	13-30	0/8	-	0/4	-	0/6	-	0/7	-	0/2	-
Semi-Volatile Organics												
Bis(2-ethylhexyl)phthalate	1/10	33	2/8	13	1/4	16	1/6	13	2/7	63-17	1/2	73
Octachlorocyclopentene(C58)	2/10	0.13-0.183	8/8	0.03-0.93	0/4	-	0/6	-	0/7	-	0/2	-
Hexachlorobenzene(C66)	6/10	0.06-0.03	7/8	0.16-1.6	0/4	-	0/6	-	0/7	-	0/2	-
Hexachloroethane	1/10	33	0/8	-	0/4	-	2/6	5-5	3/7	23-63	0/2	-

TABLE 1-9

SUMMARY OF SURFACE WATER ANALYSES

Constituents	Slocum Drain # Hits/ # Analyses	Slocum Drain Range in Hit Concentration (mg/l)	On-Site Ponds & Ditches # Hits/ # Analyses	On-Site Ponds & Ditches Range in Hit Concentration (mg/l)	On-Site & Near Site Marshy Area # Hits/ # Analyses	On-Site & Near Site Marshy Area Range in Hit Concentration (mg/l)	Off-Site Ponds & Ditches # Hits/ # Analyses	Off-Site Ponds & Ditches Range in Hit Concentration (mg/l)	Vincent & Kimball Drains # Hits/ # Analyses	Vincent & Kimball Drains Range in Hit Concentration (mg/l)	Background # Hits/ # Analyses	Background Range in Hit Concentration (mg/l)
Metals/Inorganics												
Aluminum	11/10	0.099-4.3	6/8	0.111-2.02	2/4	0.13	6/6	0.138-0.606	6/7	0.275-2.9	1/2	0.77
Antimony	2/10	0.023	0/8	-	2/4	0.023	1/6	0.023	1/7	0.023	0/2	-
Arsenic	6/10	0.002-0.0062	0/8	-	2/4	0.002J	3/6	0.002-0.02	7/7	0.002J-0.019	1/2	0.0086
Barium	9/10	0.13-0.116	7/8	0.1-0.292	2/4	0.13	6/6	0.183-0.566	2/7	0.13-0.21	1/2	0.183
Cadmium	2/10	0.001J	0/8	-	2/4	0.001J	2/6	0.001J-0.0096	1/7	0.001J	0/2	-
Chromium	3/10	0.01-0.019	8/8	0.1-0.027	2/4	0.013-0.014	3/6	0.012R-0.033	0/7	-	0/2	-
Cobalt	2/10	0.02J	0/8	-	2/4	0.02J	2/6	0.02J-0.03	1/7	0.02J	0/2	-
Copper	1/10	0.02J	2/8	0.012-0.016	2/4	0.02J	3/6	0.02J-0.06	1/7	0.02J	0/2	-
Iron	12/10	0.163-3.24	8/8	0.302-6.96	4/4	0.302-2.52	6/6	0.681-2.22	7/7	0.26-0.8	2/2	0.334-1.21
Lead	2/10	0.002-0.002J	0/8	-	2/4	0.002-0.00J	3/6	0.002-0.009	3/7	0.002-0.02J	0/2	-
Manganese	12/10	0.036-2.53	8/8	0.018-0.761	4/4	0.018-0.042	6/6	0.03-0.696	7/7	0.02J-0.171	2/2	0.037-0.363
Mercury	1/10	0.0002J	0/8	-	1/4	0.00032	0/6	-	1/7	0.00021	1/2	0.0079
Nickel	9/10	0.02J-0.04	8/8	0.02J-0.196	4/4	0.02J-0.02J	2/6	0.02J-0.03J	1/7	0.02J	1/2	0.042

TABLE I-3

SUMMARY OF SURFACE WATER ANALYSES

Constituents	Slocum Drain		On-Site Ponds & Ditches		On-Site & Near Site Marshy Area		Off-Site Ponds & Ditches		Vincent & Kimball Drains		Background	
	# Hits/ # Analyses	Range in Hit Concentration (mg/l)	# Hits/ # Analyses	Range in Hit Concentration (mg/l)	# Hits/ # Analyses	Range in Hit Concentration (mg/l)	# Hits/ # Analyses	Range in Hit Concentration (mg/l)	# Hits/ # Analyses	Range in Hit Concentration (mg/l)	# Hits/ # Analyses	Range in Hit Concentration (mg/l)
Metals/Inorganics												
Selenium	2/10	0.002J	0/8	-	2/4	0.002J	1/6	0.002J	1/7	0.002J	0/2	-
Silver	1/10	0.03I	0/8	-	0/4	-	0/6	-	0/7	-	0/2	-
Zinc	1/10	339	1/8	0.050	2/4	0.277-0.284	4/6	0.063-0.20	1/7	0.280	0/2	-
Cyanide	6/10	0.021-0.040	0/8	-	2/4	0.012-0.013	3/6	0.016-0.060	7/7	0.021-0.039	1/2	0.019

Notes:

See Appendix L of the RI and Supplemental RI for Complete Data Listing

- = Not Detected.

J = Indicates an estimated value. Used either when estimating a concentration for tentatively identified compounds where a 1:1 ratio is assumed, or when the mass spectral data indicates the presence of a compound where the result is less than the detection limit but greater than zero.

Slocum Drain Area includes: SED002, 003, 003D, 004, 005, 012, 022, 029, 030, 030D, 031, 031D, and 033.

On-Site Ponds and Ditches includes: SED018, 019, 020, 021, 023, 024, 024D, and 026.

On-Site and Near-Site Marshy Area includes: SED014, 025, 027, 034, and 034D.

Off-Site Ponds and Ditches includes: SED013, 013D, 015, 016, and 017.

Vincent and Kimball Drains Area includes: SED006, 007, 008, 009, 010, 011 and 032.

Background Area includes: SED001, and 028.

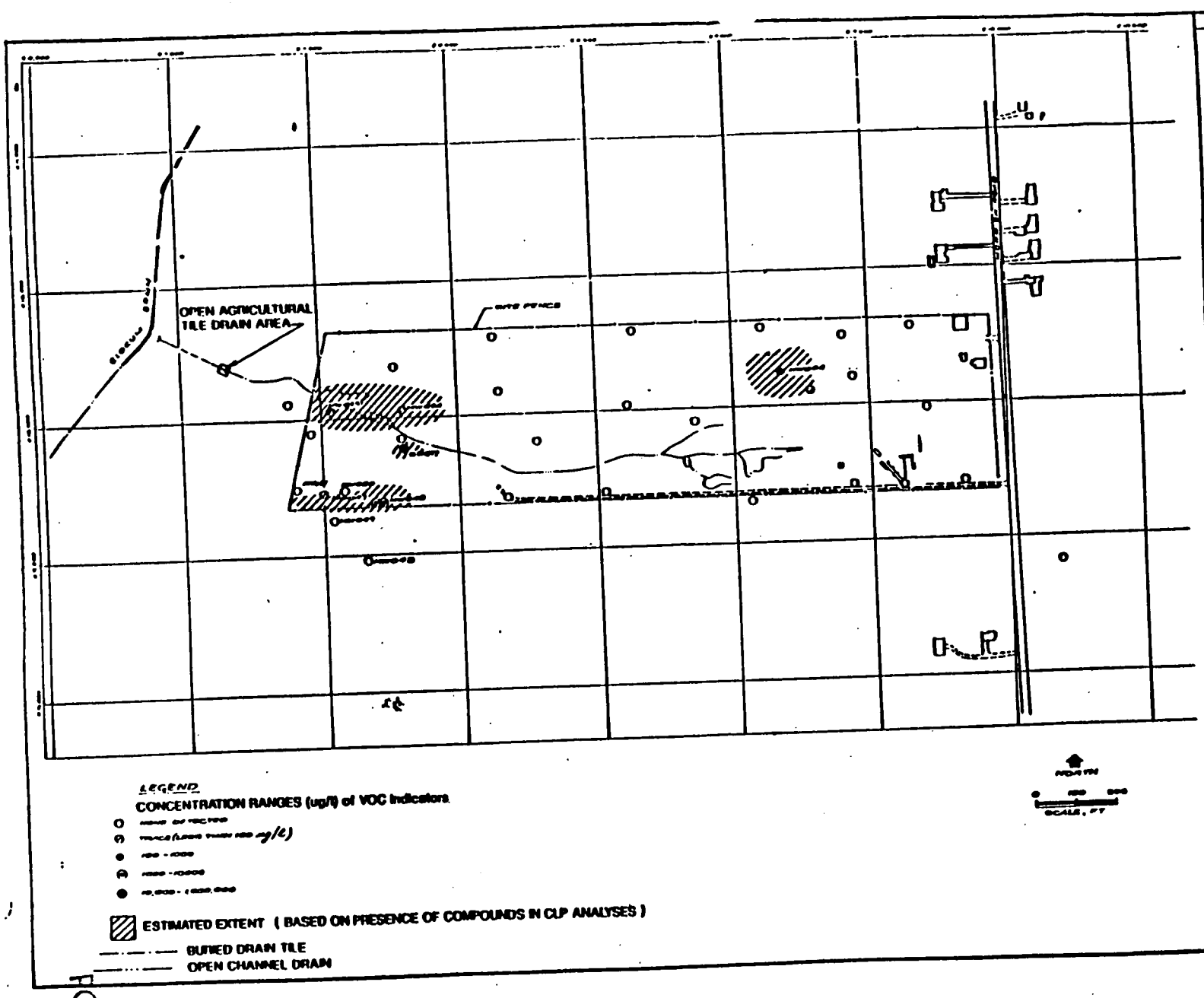
TABLE 1-6

SUMMARY OF RESIDENTIAL WELL ANALYSES

Constituents	# Hits/ # Analyses	Range in Hit Concentration (mg/l)
Metals/Inorganics*		
Aluminum	40/40	0.027-1.34
Arsenic	35/40	0.006-0.221
Barium	40/40	0.022-0.328
Cadmium	2/40	0.002-0.004
Chromium	19/40	0.002-0.006
Copper	32/40	0.006-0.290
Iron	39/40	0.044-6.69
Lead	27/40	0.002-0.023
Manganese	40/40	0.007-0.456
Nickel	12/40	0.010-0.077
Tin	7/40	0.012-0.028
Zinc	40/40	0.010-0.737

NOTES:

* Only metals/inorganics detected in well water presented.



FEASIBILITY STUDY

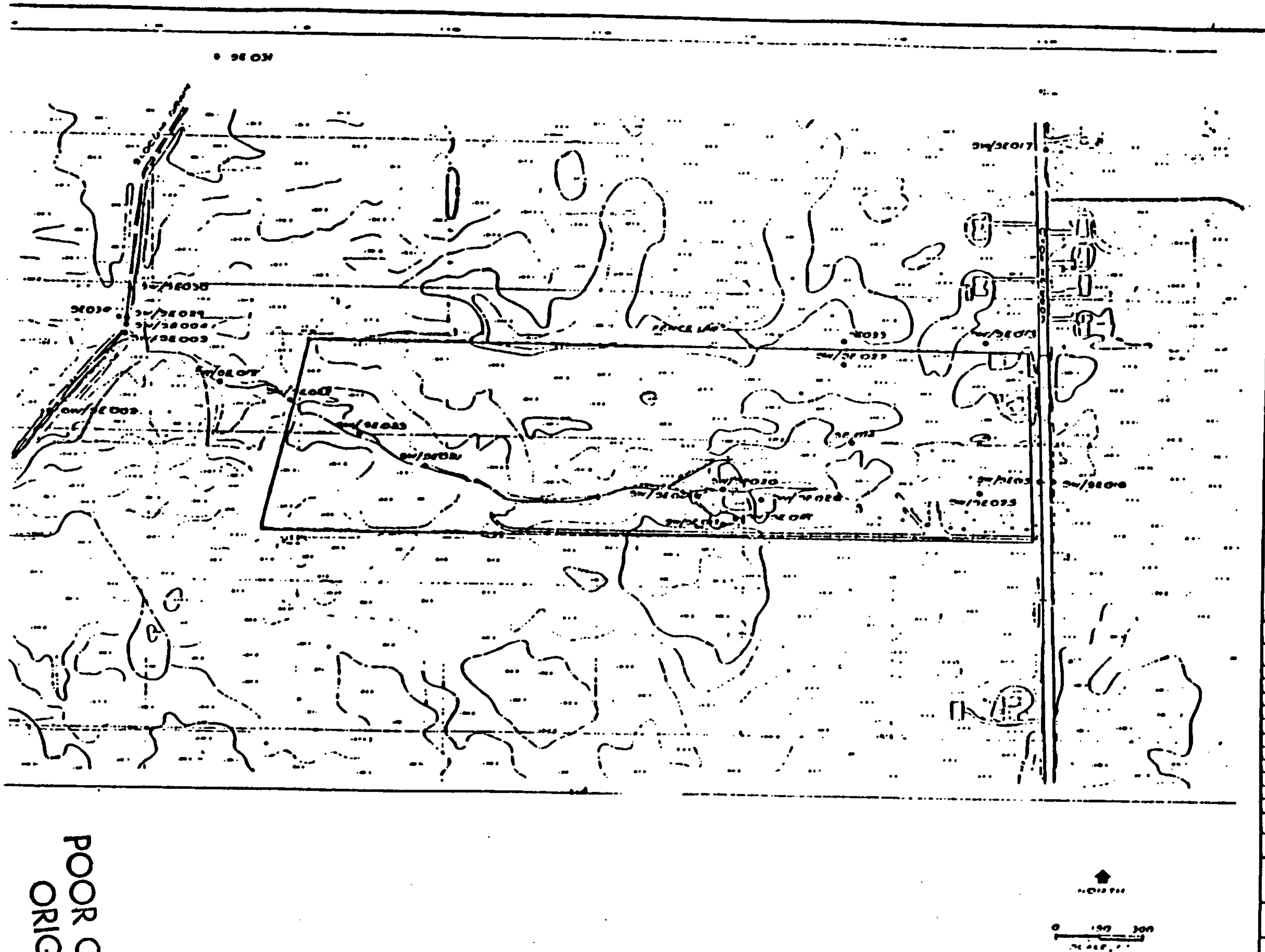
BERLIN AND FARRO R/FS

ESTIMATED EXTENT OF VOLATILE ORGANIC INDICATOR COMPOUNDS IN GROUND WATER

DECEMBER 89 | 93C3147 | 1-12

Woodward-Clyde Consultants

FIGURE 5



FEASIBILITY STUDY

BERLIN AND FARRO RI/FS

ON-SITE AND VICINITY
SURFACE WATER/SEDIMENT
SAMPLE LOCATIONS

Woodward-Clyde Consultants

FIGURE 6

POOR QUALITY
ORIGINAL

FIGURE 7
BERLIN AND FARRO FS SECTION 1
REVISION 1
DECEMBER 1989

OFF-SITE SURFACE WATER/SEDIMENT SAMPLE LOCATIONS

site-related constituents. Chemicals detected in shallow ground water are primarily VOCs. C-series compounds were not shown to be present in the ground water above the detection limit. VOCs, being relatively more mobile than the C-series compounds, were found in shallow ground water within 18 feet of the surface. The extent of VOC indicator chemicals in ground water is shown in Figure 5. Seven metals were detected in the shallow zone ground water above the background concentrations. Five other metals not detected in background wells were also detected in shallow zone ground water. Shallow ground water analyses are summarized in Table 1-4.

Constituents were detected in surface water in several drainageways and ponds. The constituents were primarily C-58, C-66 and semi-volatile organic compounds. Locations of surface water samples are presented in Figure 6. Surface water analyses are presented in Table 1-5.

Off-site soil testing was limited since Berlin and Farro operational activities were confined to the site. Those off-site samples tested for target screen (organic) compounds did not indicate contamination and analyses for the Hazardous Substance List (HSL) were not done off-site. Sediments containing site related constituents migrated off-site and were detected in Slocum Drain and Vincent Drain. Off-site sediment constituents were similar to those detected in on-site soils and sediments except at the manhole northeast of the site fence line where 4,4-DDE and 4,4 DDT were detected. These compounds commonly detected in soils in agricultural areas were not associated with known disposal activities at the site.

Ground water from the 38 off-site residential wells tested did not indicate site-related constituents. Site-related organics were detected in on-site monitoring wells near the southwest boundary but off-site investigations in this area did not identify off-site presence of organic contaminants. Comparison of ground water samples obtained from off-site residential wells with the up gradient residential background wells indicated that nine metals were detected above the maximum background levels. Three other metals were detected in residential wells but were not in the background wells. A summary of inorganic constituents found in the residential wells is presented in Table 1-6.

Surface water containing site-related constituents was limited to near-site areas; C-66 and C-58 were the most consistently detected compounds, at concentration of less than 1 ug/l. Off-site surface water sample locations are shown in Figure 7.

Until remediation occurs, ground water contamination may migrate off-site, contaminated sediments in drainageways may increase in concentration due to runoff from contaminated areas of the site,

and contamination may be absorbed in surface water flowing above these sediments. This contaminated ground and surface water may create pathways for exposure to contamination through ingestion and dermal contact. Contaminated soil and sediment may create pathways for exposure through dermal contact, ingestion and inhalation.

VI. SUMMARY OF SITE RISKS

During the RI an analysis was conducted to estimate the health or environmental problems that could result if the contaminated soil and sediments and the contaminated ground water were left untreated. This analysis, commonly referred to as a baseline risk assessment, is documented in sections 5 through 9 of the RI Report.

During the course of an RI/FS the U.S. EPA requires that a risk assessment be prepared according to U.S. EPA policy and guidelines. At Berlin and Farro, PRP contractors prepared a risk assessment under the 1986 Consent Decree for the Remedial Investigation and Feasibility Study. This risk assessment provides U.S. EPA with a basis for selection of a remedy which would be protective of public health, welfare, and the environment. The risk assessment, prepared by the PRP contractor, utilized available information and is consistent with the U.S. EPA policy and guidance available at the time.

The U.S. EPA, under the guidance, commonly uses a "residential scenario" (i.e., unrestricted use of the site) when quantifying risks. Although the site is not currently used for residential purposes, the property is zoned for residential use and there are no assurances that land usage may not change in the future. It is not inconsistent with the NCP for soil at a site that is not currently residential but may potentially have future residential uses to be cleaned up to levels appropriate to residential use.

Changes in Risk Assessment Guidance have occurred subsequent to preparation of the risk assessment for the Berlin and Farro site. The new guidance, Risk assessment Guidance for Superfund, was issued in September 1989 and specifically states:

> "Following the date of its publication, this manual is intended to be used as guidance for all human health risk assessments conducted as part of the Superfund remedial investigations and feasibility studies. Issuance of this manual does not invalidate human health risk assessments completed before (or in progress at) the publication date and based on previously released Agency guidance.

The use of average and worst case exposure scenarios and soil ingestion rates developed for the Berlin and Farro risk assessment are consistent with this guidance. The use of such scenarios is recommended in the Superfund Public Health Evaluation Manual (SPHEM), "A second, and generally preferred, approach is to

calculate both best estimates and conservative upper bound estimates for all exposure point chemical concentrations." A range of possible soil ingestion rates is recommended, "... soil ingestion rates can vary from 0.1 - 5 grams per day, with higher values representative of pica behavior."

In assessing possible exposure pathways, the focus was on the health effects associated with direct exposure to the contaminants as a result of the soil coming in contact with the skin or from direct ingestion of the soil by a child playing in the area, and by ingestion of and dermal exposure to contaminated ground water and surface water. Exposure through inhalation of volatile compounds and dust from contaminated soil was also considered. These exposure scenarios are reasonable, especially in light of the selected alternative which would permit the site to be returned to full use.

Indicator chemicals were selected from the large number of contaminants which were detected on site in order to facilitate the risk assessment. The analysis focused on a number of indicator chemicals which were determined to be of greatest concern because of their toxicity, level of concentration, and wide spread occurrence. Toxicities of these compounds are discussed in the FS. In ground water the indicator chemicals are methylene chloride, 1,2-dichloroethane (1,2 DCA), vinyl chloride, 1,1-dichloroethene (DCE), trans-1,2-dichloroethene (t-DCE), benzene, and trichloroethene. The soil and sediment indicator compounds were C-66 and C-58. The volatile organic compounds are generally mobile in soil due to high vapor pressures and high water solubility. They have limited capacity to adsorb to soil particles. The C-series compounds have limited mobility due to their strong tendency to adsorb to soil and sediments. It is likely that migration from the source will occur primarily through soil erosion or anthropogenic transfer.

The RI risk assessment used standard conservative assumptions concerning intake and exposure. Conservative assumptions are generally appropriate to assure protection of public health and the environment, because there is some uncertainty inherent in any evaluation of risk. Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen in mg/kg-day and the expected duration of chronic exposure, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. Values for these parameters are included in the RI Report. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer

potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g. the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Maximum individual risks calculated for the indicator chemicals in ground water are as follows:

methylene chloride	6.5×10^{-5}
1,2-dichlorethane	1.4×10^{-5}
vinyl chloride	6.0×10^{-3}
1,1-dichlorethene	1.8×10^{-4}
benzene	2.0×10^{-4}
trichloroethene	1.6×10^{-6}

If on-site water bearing units from the shallow portion of the aquifer were to be used as a domestic drinking water supply in the future under the upper bound exposure scenario (worst case) the incremental lifetime cancer risk would be 6×10^{-3} and would exceed the highest level of the acceptable cancer risk range described in the NCP. This represents a reasonable, conservative exposure scenario, since the remedial objective is to return the aquifer at the site to beneficial use Drinking water or other wells could therefore be installed in the upper 30 feet (the shallow aquifer). This worst case is determined using the highest contaminant levels detected. This risk is due largely to the presence of indicator chemical vinyl chloride which was detected in two wells near the old drum landfill at concentrations up to 1,400 ug/l. No calculated incremental non-carcinogenic hazard index exceeds the acceptable level of 1. Technology for treatment of contamination to address cancer risks will also necessarily treat contamination that poses non-carcinogenic hazard.

EPA and the State have determined that treatment of the contaminated ground water in the shallow portion of the aquifer to the following levels will reduce the excess cancer risk from exposure to each chemical in the ground water in the shallow portion of the aquifer to 1 X 10^{-6} and any non-carcinogenic health risks will be reduced to acceptable levels:

methylene chloride	5.0	ug/l
1,2-dichloroethane	0.4	ug/l
vinyl chloride	0.02	ug/l
1,1-dichloroethene	7.0	ug/l
benzene	1.0	ug/l
trichloroethene	3.0	ug/l

These cleanup levels were determined following standards set forth in Rule 299.5709 of the Michigan Environmental Response Act (Act 307) for compliance with type B criteria for ground water in aquifers and are based on individual risk for each compound.

These levels cannot always be conclusively reached in practice because of practical limitations imposed by the available analytical procedures. The risk-based levels may be below the current analytical detection levels for these indicator chemicals. Therefore, the cleanup levels for these indicator chemicals will be determined by the available analytical procedures or the risk-based levels defined above, which-ever is higher. Method detection limits ("MDL") applied here based on Analytical Detection Level Guidance for Environmental Contamination Response Activities under Act 307 Rules (memorandum of James G. Truchan, MDNR, April 1, 1991) using best practical judgement based on the capabilities of the reference method and capabilities of government and commercial labs.

Based upon the health based standards and MDLs as shown by MDNR guidance for the implementation of Act 307 Rules the following cleanup levels are established subject to possible revision if analytical procedures with lower detection limits are developed:

methylene chloride	5	ug/l (1×10^{-6})
1,2-dichloroethane	1	ug/l (MDL)
vinyl chloride	1	ug/l (MDL)
1,1-dichloroethene	7	ug/l (1×10^{-6})
benzene	1	ug/l (1×10^{-6})
trichloroethene	3	ug/l (1×10^{-6})

Treatment of the ground water will continue until the concentrations of indicator compounds reach these standards.

The upper bound scenario for soil exposure is based on residential use of the site area. People would be exposed through dermal exposure, direct ingestion and inhalation of the contaminated soil. This scenario assumes, among other residential activities, that a basement, 8 feet deep would be excavated and the soils spread onto the ground surface around the residence. Under this exposure scenario, significant volumes of soil would be exposed, and would present a cancer risk of 5.8×10^{-4} that is significantly greater than the risk level of 1×10^{-4}. When that risk level is exceeded, the NCP (300,430(e)(2))presumes that cleanups will reduce risks to the 1×10^{-6} level. Although this risk is due largely to the presence of arsenic, lead, and C-66; benzene, ethylbenzene, toluene, and xylene also contribute to the overall risk. People would be exposed through dermal exposure and direct ingestion of the contaminated soil and sediment.

The concentrations of any hazardous substances, pollutants, and contaminants remaining in the soil and sediments at and adjacent to Berlin and Farro at the conclusion of the remedial work shall not:

1. Pose an excess lifetime carcinogenic risk for children and adults greater than 1.0×10^{-6};

2. Present a maximum chronic Hazard Index for children and adults greater than 1; and

3. Exceed any federal or state ARARs including MCLs.

Based on currently available information, U. S. EPA and the State have identified several contaminants as among the primary contaminants at the site and as suitable preliminary indicators of the levels of concentration of all of the hazardous substances, pollutants, and contaminants in the soil and in the sediment.

EPA and the State have determined that by disposing of and treating the soil and sediments at the Berlin and Farro site which exceed

the concentrations shown in the following table, the excess lifetime cancer risk from exposure to each chemical in the soil and sediment will be reduced to 1 X 10^{-6} or background and non-carcinogenic health risks will be reduced to acceptable levels or background:

arsenic	10.6	mg/kg
lead	20.8	mg/kg
benzene	0.02	mg/kg
ethylbenzene	1.4	mg/kg
toluene	16.0	mg/kg
xylene	6.0	mg/kg
C-66	1.4	mg/kg

CERCLA requires the adoption of promulgated State cleanup standards if those standards are applicable, or relevant and appropriate requirements that are more stringent than equivalent Federal requirements. Soil cleanup levels at Berlin and Farro meet the requirements for cleanup under Michigan Act 307. Levels for arsenic and lead are based on natural background as determined in the FS. Background levels were determined through a statistical method that uses the concentrations from actual background samples and calculates the mean plus three times the standard deviation to arrive at target cleanup levels. Benzene and C-66 soil cleanup levels are health based and reduce risk to less than 1 X 10^{-6}. Cleanup levels for ethylbenzene, toluene, and xylene contamination have been determined by application of Rule 299.5709 provides for establishing standards to prohibit levels of contamination which impart adverse aesthetic characteristics to ground water. Those standards were established using U.S. EPA Method 140.1 of the "Methods for Chemical Analysis of Waste and Water" (March 1979) (EPA-600-4-79-020) (40 CFR 143.4(b)(7)). The proposed secondary maximum contaminant levels identified in the 1990 Proposed Plan have not been finalized and are therefore inappropriate for use in establishing ARARs for these constituents.

These cleanup levels, determined in accordance with Rule 299.5711 of Michigan Act 307 for compliance with type A or type B criteria for soils, will bring the probability of contracting cancer as a result of exposure to the contamination in the soil and sediments to within the accepted range for materials of this nature. Compliance may be demonstrated by leachate testing or by cleanup of the contaminated soils to a concentration no greater than 20 times the Type A or Type B criterion for that compound in ground water pursuant to Rule 299.5711 (2).

The upper bound scenario for surface water did not identify any risks in excess of 1 X 10^{-6}. As a result, surface water will not be addressed in the remedy, except as an adjunct to remediating contaminated sediments.

Actual or threatened releases of hazardous substances from this site, if not addressed by the selected alternative, may present an imminent and substantial endangerment to public health, welfare or the environment.

VII. DESCRIPTION OF ALTERNATIVES

The alternatives analyzed for the remedial action at the Berlin and Farro site are presented below. These are numbered to correspond with the numbers in the RI/FS Report. The alternatives which have been assembled to include remedial activities which address both the ground water contamination and the contaminated soil and sediment are as follows:

* **Alternative 1:** No Action.

* **Alternative 2:** Institutional Controls.

* **Alternative 3:** Containment to include capping, silt barriers, and slurry wall.

* **Alternative 4:** Excavation of soil and sediment with greater than 1 X 10^{-4} risk and disposal off site and capping of the untreated lower risk area. Contaminated ground water with greater than 1 X 10^{-6} risk will be extracted and treated by air stripping to meet cleanup levels in the intermediate zone.

* **Alternative 5:** Excavation of soil and sediment with greater than 1 X 10^{-4} risk and incineration on site followed by capping of the untreated lower risk area and extraction and air stripping of the contaminated ground water with greater than 1 X 10^{-6} risk to meet cleanup standards in the intermediate zone.

* **Alternative 6:** Excavation of soil and sediment with greater than 1 X 10^{-6} risk and stabilization with fly ash and disposal on site and extraction and air stripping of contaminated ground water with risk greater than 1 X 10^{-6} to meet cleanup standards in the intermediate zone.

* **Alternative 6A:** Excavation of soil and sediment with greater than 1 X 10^{-6} risk and disposal off site with treatment by stabilization and extraction and air stripping of the contaminated ground water with risks greater than 1 X 10^{-6} to meet cleanup standards in the intermediate zone.

* **Alternative 7:** Excavation of soil and sediment with greater than 1 X 10^{-6} risk and stabilization by the Hazcon process prior to disposal in an on-site cell and extraction and air stripping of the contaminated ground water with risks greater than 1 X 10^{-6} to meet cleanup standards in the intermediate.

* **Alternative 7A:** Excavation of soil and sediment with greater than 1 X 10^{-6} risk and stabilization by the Hazcon process prior to disposal in an on-site cell and extraction of ground water with greater than 1 X 10^{-6} risk to meet cleanup standards in the intermediate zone followed by treatment in a POTW.

* **Alternative 8:** Excavation of Slocum Drain sediments with greater than 1 X 10^{-6} risk, stabilization of those sediments with Class C fly ash followed by capping along with the on-site 1 X 10^{-6} risk soil and sediment, and extraction and air stripping of the contaminated ground water with risks greater than 1 X 10^{-6} to meet cleanup levels in the intermediate zone.

* **Alternative 9:** Excavation of Slocum Drain sediments with greater than 1 X 10^{-6} risk, stabilization of these sediments with Class C fly ash followed by capping along with the on-site 1 X 10^{-6} risk soil and sediment, and extraction and air stripping of the contaminated ground water with risks greater than 1 X 10^{-6} to meet cleanup levels in the shallow zone of the aquifer.

Common Elements

Except for alternatives 1, 2, and 3, all of the alternatives now being considered contain one or more common elements. Alternatives 4, 5, 6, 6A, 7, 8, and 9 include extraction of contaminated groundwater and air stripping before discharge to the surface water. The common element in the soil and sediment alternative is the volume of material to be treated. Alternatives 4 and 5 propose excavation and treatment of an estimated 15,000 to 18,000 cubic

yards of material. This volume is composed of Central Site area soil and sediment contaminated to 1 X 10^{-4}risk level. Alternative 6, 6A, 7, and 7A have elements which excavate and treat an estimated 38,000 to 48,000 cubic yards of soil and sediment with risk levels exceeding 1 X 10^{-6}. Alternatives 8 and 9 include the excavation and treatment of Slocum Drain sediments followed by capping along with 1 X 10^{-6}soils on site. Each alternative also includes long term groundwater monitoring consistent with requirements of RCRA Subpart F, 40 CFR §264.100. These monitoring activities will be conducted to gauge the effectiveness of the selected remedy. In addition, the State, which owns the site, will place a deed restriction on the site to prohibit soil excavation and construction of buildings or wells at the site pending completion of the ground water remedy.

ALTERNATIVE 1:
NO ACTION

Capital Cost: $25,000
Annual Operation and Maintenance (O&M) Costs: $5,000
O&M Present Worth (PW): $75,000
Net PW: $100,000

The Superfund program requires that the "No Action" alternative be evaluated at every site to establish a baseline for comparison. Under this alternative, U.S. EPA would take no further action to prevent exposure to the soil, sediment, or groundwater at the site or to prevent migration of the contamination off site. However, long term monitoring of the site would be necessary to monitor contaminant migration. Monitoring can be implemented by using previously installed monitoring wells and residential wells.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 2:
INSTITUTIONAL CONTROLS

Capital Costs: $200,000
Annual O&M Costs: $15,000
O&M PW: $225,000
Net PW: $425,000

This alternative would not require implementation of remedial actions to address ground water or soil contamination. Deed restrictions would be imposed to prevent excavation in areas of contamination. Ground water use restrictions would be implemented in the affected areas to prevent the use of contaminated ground water for drinking or agricultural purposes. These institutional controls would also alert future property owners to potential site

related risks. A long term monitoring program as described in Alternative 1 would also be implemented. Deed and ground water restrictions can be implemented by state and local authorities. The alternative also provides institutional controls and additional fencing at Slocum Drain. The major components of the institutional controls are:

* Use of additional fencing around the impacted open areas of Slocum Drain to restrict access, thereby reducing potential exposure and risk to human health, and

* Use of deed restrictions to limit the development and use of land and groundwater on the Berlin and Farro Site.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 3:
CONTAINMENT

Capital Costs: $5,540,000
Annual O&M Costs: $100,000
O&M PW: $1,505,000
Net PW: $7,045,000

The response actions and technologies specified in this alternative are primarily to confine, impede, and/or isolate constituents within the affected media. The contaminated areas of concern are the soil and sediment in the Central Site area, the sediments in Slocum Drain, and the groundwater in the Old Drum Landfill area and northern Central Site area.

The principal containment technologies include slurry walls and multi-media capping. Slurry walls will be constructed around the Central Site area and the Old Drum Landfill area down to the lower till. Fourteen hundred feet of soil/bentonite slurry wall approximately 3 feet wide and 70 feet deep will be located to surround and contain the contaminated groundwater areas.

Two multi-media caps will be constructed to cover the areas bounded by the slurry walls. The capped area over the Old Drum Landfill area is approximately 6 acres. The capped area over the Central Site area is approximately 17 acres. The caps will consist of a base of 2 ft (minimum) of compacted clay overlain with a 40 mil high density polyethylene geomembrane. An infiltration drainage zone consisting of 1 ft of sand will be constructed on top of the geomembrane. The sand will be covered with 1½ ft of uncompacted clay to form a root growth zone. A ½ ft thick topsoil zone will be placed over the cap. The top soil will be seeded, fertilized and

mulched. New monitoring wells will be installed to determine the effectiveness of the containment system. That monitoring system will be operated for 30 years. The installation of silt barriers, slurry walls, and multimedia cap is expected to be completed within 1 year.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

This alternative also includes use of the institutional controls described in Alternative 2.

ALTERNATIVE 4:
AIR STRIPPING AND EXCAVATION WITH OFF SITE DISPOSAL

Capital Costs: $5,795,000
Annual O&M Costs: $175,000
O&M PW: $1,625,000
Net PW: $7,420,000

This alternative consists of two components: contaminated soil and sediment are disposed of off site in a RCRA cell and contaminated groundwater is treated on site and discharged to Slocum Drain.

Extraction trenches are planned in the vicinity of the Old Drum Landfill and north of the Central Site area near MW-44. A riser and pump will be used to extract groundwater from the 3 ft wide by 25 ft deep gravel filled trench. The trenches will have a bentonite floor and a clay cap. The water will be treated in a polypropylene tripack tower designed to process approximately 10 to 20 gallons per minute (gpm) of groundwater. Emissions from the air stripper will be treated to meet Federal and State standards. Water treated to meet permit standards will be discharged to Slocum Drain through piping installed for that purpose. All air and surface water discharges would comply with state and federal standards.

Tentative maximum base limits (TMBL) for surface water discharges under a NPDES permit as provided by MDNR Surface Water Quality Division are as follows:

Compound	TMBL (ug/l)
vinyl chloride	3.0
methylene chloride	5.0
1,1-dichloroethene	2.6
benzene	5.0
toluene	10.0
ethylbenzene	30.0
barium	0.5
cadmium	151.0
cyanide	4.0
lead	27.0
hexachloroethane	0.1
hexachlorobenzene	0.0019
pH	6.5-9.0

These limits have been provided for screening of alternatives and do not necessarily represent the effluent limits that will need to be met in order to meet NPDES requirements. Actual limits will be provided during the design.

Environmental monitoring would be required during the life of the treatment process. In addition, monitoring of the ground water at the site and its environs would continue for at least 5 years after the remedial action cleanup goals have been met.

A contingency has been made for non-continuous air stripper operations due to expected low, long-term extraction rates. Two 25,000 gallon storage tanks, insulated and equipped with warmers, will be erected on-site. These will be used for ground water storage in compliance with state and federal standards, until an adequate quantity of water is available for periodic air stripper operation.

The extraction and air stripping treatment of the ground water to meet health based cleanup levels in the lower portion of the aquifer is assumed to take 10 years for cost projections. An estimated 13.5 million gallons of ground water will be treated during that period. The actual time required to reach the necessary cleanup standards may be considerably longer. Ground water monitoring will continue for a 30 year period to determine the effectiveness of treatment.

Central Site area soil and sediment and Slocum drain sediments contaminated to levels which represent 1 X 10^{-4} risk will be excavated and transported to a RCRA facility for treatment by solidification and disposal. Soil in the Central Site area will be excavated, as well as sediment remaining in the South Lagoon and tank excavation pond.

The Central Site area soil not planned for removal and treatment will be left in place and capped with a minimum of 2 ft of clay.

The bare areas of the site and the cap will have ½ ft of topsoil, and will be seeded, fertilized and mulched.

The removal and off-site disposal of the soils and the installation of silt barriers and clay caps is expected to take approximately 1 year. An estimated 15,000 to 18,000 cubic yards of soil and sediment may be excavated for treatment, although the precise volume cannot be determined until the excavation and sampling to demonstrate attainment of cleanup levels is completed. Costs presented in the FS used a volume of 15,000 cubic yards.

This alternative also includes use of the institutional controls described in Alternative 2.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 5:
AIR STRIPPING AND ON SITE INCINERATION

Capital Costs: $7,020,000
Annual O&M Costs: $175,000
O&M PW: $1,625,000
Net PW: $8,645,000

This alternative is similar to Alternative 4, with the exception that soil and sediment with a risk of greater than 1 X 10^{-4} and contaminated Slocum Drain sediments will be excavated and incinerated on-site in compliance with all federal and state requirements, and the treated materials will be placed into the Central Site area excavation. The need for further treatment of incineration residuals will be dependent on the nature of the residuals. Capping of remaining soil containing residual chemicals and site revegetation is utilized to minimize migration of site constituents and to reduce exposure risks.

This alternative also utilizes extraction trenches for ground water collection and air stripping for on-site treatment of ground water to permit standards, with discharge of the treated water to Slocum Drain.

The ground water remediation time is the same as estimated for alternative 4. The same institutional controls and monitoring would also be applied. Soil remediation, including excavation, transportation, and incineration is expected to take about 1 year.

Because this alternative would result in contamination remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 6:
AIR STRIPPING, SOLIDIFICATION, AND ON SITE DISPOSAL

Capital Costs: $7,770,000
Annual O&M Costs: $220,000
O&M PW: $2,645,000
Net PW: $10,415,000

This alternative integrates on-site treatment and on-site containment of soil and sediment, that have a potential risk greater than 1 X 10^{-6} under the future residential exposure scenario. Groundwater will be collected from extraction trenches as presented in alternative 4. The ground water is treated on-site by air stripping to meet permit standards and discharged to Slocum Drain.

Soil and sediment with contaminant concentrations which represent greater than 1 X 10^{-6} risk levels will be solidified with Class C fly ash and placed in an on-site RCRA cell. The waste will be staged within the area of contamination for treatment before disposal in the on-site cell. The solidification process will increase the volume by a 2.2 to 1 ratio. An estimated 38,000 to 48,000 cubic yards will be treated, although the precise volume cannot be determined until the excavation and sampling to demonstrate attainment of cleanup levels is completed. The volumes to be treated may be greater than the 42,500 cubic yards estimated in the FS due to increases caused by inclusion of cleanup standards for VOCs. Cost of the remedy is approximated using the volumes in the FS. The cell after capping will cover approximately 3½ acres.

The construction of a liner, the solidification of the soils and sediments, and the construction of a multi-media cap is expected to be completed within 2 years. The extraction and air stripping treatment of the contaminated ground water to meet cleanup levels is assumed to take 20 years, but will continue until cleanup levels are met. It is estimated that 27 million gallons of ground water will be treated during a 20 year period.
This alternative also includes institutional controls.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 6A:
AIR STRIPPING, EXCAVATION, AND OFF SITE DISPOSAL

Capital Costs: $10,915,000
Annual O&M Costs: $190,000
O&M PW: $2,185,000
Net PW: $13,100,000

This alternative meets the same soil and sediment and ground water remedial objectives as alternative 6. The ground water component of the alternative includes the same pump and treat elements as Alternative 4.

Soil and sediment with contaminant levels at greater than 1 X 10-6 will be excavated and treated by solidification and disposed of off-site.— Volume estimations are the same as for Alternative 6. The excavated area will be back filled with clean fill and revegetated. Treatment and disposal will be at a RCRA compliant facility.

Ground water treatment is projected to continue for 10 years, but will continue until cleanup levels are reached. Removal and off-site disposal of the soil and sediment will be completed within 1 year although this time may be longer if larger than anticipated volumes of material must be removed.

This alternative will permit the site to be returned to productive use after the conclusion of the ground water treatment and monitoring program.

ALTERNATIVE 7:
AIR STRIPPING, EXCAVATION, AND SOLIDIFICATION ON-SITE

Capital Costs: $8,990,000
Annual O&M Costs: $220,000
O&M PW: $2,645,000
Net PW: $11,635,000
This alternative is the same as Alternative 6 except that it incorporates innovative technology for the treatment of sediment and soil. Soil and sediment will be excavated and treated and disposed of on site. All soil and sediment with contaminant levels greater than a 1 X 10^{-6} risk will be included for treatment as in Alternatives 6 and 6A.

The process uses Portland cement with a chemical additive to encapsulate organics and solidify the soil and sediment. The treated material will be treated on-site and disposed of in the same way as Alternative 6. The waste will be staged within the area of contamination for treatment before disposal in the on-site cell. The bulking ratio for the treated material is estimated to be 1.6, which is somewhat less than the 2.2 for Alternative 6. The

treated volume will require a disposal cell about 25 percent smaller than for the solidification alternative using fly ash.

The time for completion of the soil and sediment component of this alternative is the same as for alternative 6 - approximately 2 years. Ground water objectives are projected to be reached in about 10 years, but treatment will continue until cleanup levels are met.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 7A:
POTW, EXCAVATION, AND SOLIDIFICATION ON SITE

Capital Costs: $8,880,000
Annual O&M Costs: $230,000
O&M PW: $2,730,000
Net PW: $11,610,000

This alternative treats the sediment and soil in the same manner as Alternative 7. Ground water in this alternative is extracted and stored as in Alternative 4, and treated off site at the Genesee County Water Drain Commission (POTW). Extracted ground water will be trucked to the POTW. Pretreatment standards, which for organic compounds are determined on a case by case basis, will be met. The ground water treatment is planned to continue for as long as necessary to meet the cleanup levels (estimated for planning purposes to be 10 years).

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 8:
AIR STRIPPING AND MULTIMEDIA CAP

Capital Costs: $3,290,000
Annual O&M Costs: $220,000
O&M PW: $2,640,000
Net PW: $5,930,000

This alternative integrates on-site solidification of sediments using fly ash and on-site containment of soils and treated sediments, that have a potential excess carcinogenic risk greater than 1 X 10^{-6} under the future residential scenario. The excavated sediments from Slocum Drain (approximately 1,500 cubic yards) and the Central Site area sediments will be treated in the Central Site area ponds by Class C fly ash solidification/fixation process. The soil in the Central Site area with risk levels greater than 1 X 10^{-}

^{6}, together with the treated sediments, will be contained with a multi-media cap as in Alternative 3. Groundwater is collected and treated as presented in alternative 6 and 7 where the period of treatment is planned for 10 years.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

ALTERNATIVE 9:
AIR STRIPPING AND MULTIMEDIA CAP

Capital Costs: $3,290,000
Annual O&M Costs: $255,000
O&M PW: $4,160,000
Net PW: $7,450,000

This alternative is similar to alternative 8 except that the ground water exposure point is in the shallow portion of the aquifer. Under this exposure scenario, remediation by ground water collection from extraction trenches is planned for 30 years, although treatment will extend until cleanup levels are reached. It is estimated that approximately 3 million gallons per year of ground water would be treated during a 30 year period.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed at least every five years.

VIII. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

A. The Nine Evaluation Criteria

The FS examined eleven alternatives, and evaluated them according to the evaluation criteria outlined in the NCP. From these alternatives the U.S. EPA has selected a remedy that combines the the soil and on-site sediment excavation element of Alternative 6 and the off-site sediment excavation and the ground water treatment elements of Alternative 9. For the selected alternative approximately 48,000 cubic yards of on-site contaminated soil and sediment and Slocum drain sediments will be disposed of on-site in a cell which will meet the applicable or relevant and appropriate technical requirements of the Resource Conservation and Recovery Act ("RCRA") Subtitle C and Michigan Act 64. The proposed cell will have more long-term effectiveness and permanence than the engineered cell described for Alternative 6 in the FS Report. Treatment will be required for materials which exhibit the characteristic of RCRA hazardous waste. Excavation, treatment and disposal of these materials in this manner will reduce carcinogenic risk levels to less than 1 X 10^{-6} and risk of non-carcinogenic adverse health effects to acceptable levels.

Ground water contaminated to 1 X 10^{-6} risk levels will be collected and treated in an on-site air stripper (Alt. 9). Of the ground water alternatives, only the preferred alternative and Alternative 9 utilize the more protective point of compliance. Use of this point of compliance is essential for protection from exposure to contaminated ground water under a residential exposure scenario which considers the shallow portion of the aquifer a usable source of drinking water. Alternatives 4, 5, 6, 6A, 7, 7A and 8 reduce the risk of exposure by applying the same cleanup standards, but at a point of compliance deeper in the aquifer.

The cost of the preferred remedy is estimated to be:

Capital Costs: $4,767,300
Annual O&M Costs: $280,700
O&M PW: $3,352,000
Net PW: $8,119,300

Based on current information, this combination of alternatives appears to provide the best balance of trade-offs among the alternatives with respect to the nine criteria that EPA uses to evaluate alternatives. This section profiles the performance of the preferred alternative against the nine criteria and explains the rationale for the selection of the final remedial action. These nine criteria are:

1) **Overall Protection of Human Health and Environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls or institutional controls.

2) **Compliance with ARARs** addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provide grounds for invoking a waiver.

3) **Long-term Effectiveness and Permanence** refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once the cleanup goals have been met.

4) **Reduction of Toxicity, Mobility, or Volume Through Treatment** is the anticipated performance of the treatment technologies that may be employed in a remedy.

5) **Short-term Effectiveness** addresses the period of time needed to achieve remediation levels set out in the ROD, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period, until cleanup levels are achieved.

6) **Implementability** is the technical and administrative feasibility of the remedy, including the availability of materials and services needed to implement the chosen solution.

7) **Cost** includes estimates of capital and operation and maintenance costs.

8) **State Acceptance** indicates whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

9) **Community Acceptance** will be assessed in the Record of Decision following review of the public comments received on the RI/FS report and the Proposed Plan.

B. Comparative Analysis

Overall Protection of Human Health and Environment. All of the alternatives, with the exception of the "no action" and limited action alternatives, would provide protection of human health and the environment by eliminating, reducing, or controlling risk through treatment, engineering controls, institutional controls, or a combination of these measures. The selected alternative disposes of contaminated soil and sediment with risk levels above 1 X 10^{-6} (the most conservative end of U.S. EPA's generally acceptable range) in a hazardous waste cell thereby reducing the risk of adverse health effects associated with ingestion and direct contact. The selected alternative will excavate soil and sediment contaminated at greater than 1 X 10^{-6} risk levels and dispose of it in an on-site disposal cell. The selected alternative treats the areas of contaminated ground water to levels which reduce the risk through consumption of ground water to health based standards.

The selected alternative combines the ground water remedy using the shallow portion of the aquifer as the point of compliance, and a soil and sediment remedy which addresses all contamination posing a risk greater than 1 X 10^{-6} (the most conservative end of U.S. EPA's generally acceptable risk range).

Of the ground water alternatives, only the selected alternative and Alternative 9 utilize the more protective point of compliance. Use of this point of compliance is essential for protection from exposure to contaminated ground water under a residential exposure scenario which considers the shallow portion of the aquifer a usable source of drinking water. The selected remedy treats the areas of contaminated ground water to levels which reduce the risk through consumption to health based standards or method detection limits. Alternatives 4, 5, 6, 6A, 7, 7A and 8 reduce the risk of exposure by applying the same cleanup standards, but at a point of compliance deeper in the aquifer. Alternative 3 reduces ground water migration and contaminant leaching through containment, but

provides less certainty over the long term than the treatment alternatives. All of the treatment alternatives are combined with institutional controls, which further reduce the risk of ingestion or direct contact with contamination, although they do not eliminate the risk. Alternative 2, which provides only for institutional controls, provides inadequate overall protection from such exposure. Alternative 1 provides no protection.

The selected alternative and Alternative 6 excavate and dispose of all contaminated soil and sediment posing a risk in excess of 1 X 10^{-6} on-site. Alternative 6 however disposes of waste in an engineered cell and does not provide for a full Subtitle C/Act 64 cell. The selected remedy is an improvement on, and a natural extension of the cell components described in the FS. Alternative 6A excavates all contaminated soil and sediment posing a risk in excess of 1 X 10^{-6} and transports them to an off-site facility for disposal. Alternatives 7 and 7A also treat all soils and sediments that pose risk in excess of 1 X 10^{-6} Alternatives 4 and 5 provide protection by treating soils and sediments that pose risks in excess of 1 X 10^{-4} and relying on containment to protect against risks below that level. Alternatives 8 and 9 provide protection by relying only on limited partial treatment and capping of the remaining contaminated soils and sediments.

Because the "no action" and institutional controls only alternatives are not sufficiently protective of human health and the environment, these alternatives will not be considered further in this analysis as options for the site.

Compliance with ARARs. The site was never an operating RCRA facility. Site records do not demonstrate that the materials received and disposed of at the site during its operation are listed RCRA wastes. RCRA Land Disposal Restriction (LDRs) are nonetheless applicable or relevant and appropriate for certain of the alternatives if the materials to be excavated are found to be characteristic wastes. If the wastes are determined to be characteristic, and the wastes are not able to be treated to meet the LDR treatment standard, a treatability variance will be obtained.

The State of Michigan has promulgated rules pursuant to Michigan Environmental Response Act (Act 307). The substantive provisions of Part 6 and Part 7 of the rules establish general standards for cleanup of sites of contamination in Michigan. These substantive provisions are considered to be an ARAR for this response action. These rules provide, among other things, that remedial actions be protective of human health, safety and welfare and the environment. The MDNR's rules establish criteria for three acceptable cleanup types which could be applied to satisfy the substantive requirements of Part 7. Under the rules, a Type A cleanup generally achieves cleanup to background levels, a Type B cleanup

generally achieves specific standard risk-based cleanup levels, and a Type C cleanup is based on a site-specific risk assessment that considers specific criteria.

Under the NCP, U.S. EPA is responsible for determining how this ARAR applies to the site. Because these new rules are the central element of a regulatory program of substantial importance to the State, U.S. EPA asked the State to provide its interpretation of how the Act 307 rules apply to the site. The State provided an explanation to U.S. EPA detailing that only those remedies (including the selected remedy) which dispose of all materials which exceed Type B cleanup standards in a cell that satisfies Michigan Act 64 and RCRA minimum technology requirements meet the Type C criteria for remediation of soil and sediment at the site. The State further explained that only the selected alternative and Alternative 9 meet the Type B criteria for remediation of ground water at the site. While U.S. EPA is responsible for determining whether a remedy complies with ARARs, it is noted that the substantive provisions of the Act 307 rules are new, and are of great importance to the State's regulatory program. U.S. EPA has examined this ARAR and has determined that the State's interpretation is reasonable.

All alternatives would be designed to meet their respective applicable or relevant and appropriate requirements of Federal and State environmental laws. The selected remedy and alternatives 6A, 7, and 7A may require a waiver from the siting requirements since space requirements exceed the 100 foot limit from the property boundary and the depth to the water table is slightly less than the minimum 10 foot separation limit. Off-site disposal of soil, sediment and treatment residuals would trigger RCRA land disposal restrictions (LDRs) to the extent those materials were characteristic wastes. The excavation and on-site disposal of Slocum Drain sediments and site soils does not constitute "placement" triggering RCRA land disposal restrictions since the activities merely consolidate materials within the same area of contamination (Figure 3). The LDR requirement that characteristic waste be treated to remove that characteristic will nonetheless be complied with as relevant and appropriate. These requirements are well-suited to help prevent leaching of contamination from an on-site containment cell. Tables in the FS discuss in more depth the ARARs that would be met for each remedial alternative.

Long-term effectiveness and permanence. Long-term effectiveness of the selected alternative is high for soils and sediments and groundwater. Hazards posed by the contaminated soil and sediment are reduced through on-site containment in a disposal cell which is designed to meet the technical requirements of RCRA Subtitle C and Michigan Act 64 for a hazardous waste containment cell. This cell includes a leachate collection and treatment system. In addition, treatment of contaminated soils and sediments to remove free liquids and to stabilize characteristics wastes will further reduce

the possibility of leachate migration. The selected remedy for contaminated ground water provides long term effectiveness and permanence by removing contaminants from the groundwater by air stripping, controlling the off-gas contaminants rather than releasing them to the atmosphere, and properly handling treatment residues. Long-term effectiveness is maximized by using the most protective point of compliance.

Alternative 4 and Alternative 6A would remove waste to a permitted, off-site landfill, and contain the residual contamination thereby reducing the long term exposure risks from that waste at the site. Alternative 6A removes the larger volume. As with all containment cells for long-term effectiveness the containment system may require continued maintenance. While the off-site disposal option reduces the on-site risks, off-site disposal without treatment is the least preferred option under CERCLA. Moreover, off-site disposal of a large volume of material poses significant transportation risks.

The cap, silt barriers, and slurry wall that would be implemented in Alternative 3 would provide long term reductions in the amount of water that otherwise would pass through the contaminated soil and would reduce the potential for exposure through ingestion and dermal contact. The alternative's effectiveness would be evaluated through long-term monitoring. The cap, silt barriers, and slurry wall would require long-term maintenance, and portions might need to be replaced in the future.

Alternative 5 provides permanence and effectively reduces risk by destroying the organics through incineration of contaminated soils and sediments with risks in excess of 1×10^{-4}. The technology is less effective in the treatment of metals.

Alternative 6, Alternative 7, and Alternative 7A would stabilize contaminated soil and sediment by addition of chemical additives in processes to reduce the mobility of the contaminants. The technology is considered to have good long-term reliability. Both yield treated soil and sediment with a moderate to high compressive strength and low leachability potential.

Alternatives 5, 6, 7, and 7A include capping components to further reduce risk from exposure to contaminated soil and sediment and to reduce the potential of leaching of hazardous constituents from material remaining on site. For continued long-term effectiveness and permanence maintenance of the cap would be required. It should be noted that the containment areas provided in these alternatives do not include the double liner/double leachate collection system that is part of the selected remedy.

Long-term effectiveness for containment of the soils and sediments in Alternatives 8 and 9 is expected to be good to moderate.

Partial treatment and multi-media capping of the affected areas, combined with institutional controls, will reduce the probability of exposure to site constituents. Permanence can be expected for the cap if maintenance and renewal requirements are followed.

The ground water components of Alternatives 4 through 9 can be expected to provide long-term effectiveness and permanence. At completion, ground water at the point of compliance in the shallow portion of the aquifer is expected to have contaminant concentrations below the health based standards for a 1×10^{-6} risk level or method detection limits for a future drinking water ingestion scenario. However, the selected alternative and Alternative 9 have a higher effectiveness and permanence because of their focus on the shallow aquifer. The selected remedy provides long-term effectiveness and permanence by removing contaminants from the ground water by air stripping and control of the off-gas contaminants rather than release to the atmosphere.

Ground water monitoring is planned to continue for 30 years. The overall remaining risk of this scenario is low assuming the deed restrictions are maintained and enforced. The permanence and long-term effectiveness of the selected alternative and of Alternative 9 for ground water is also greater because these minimize the amount of residual and/or untreated waste. The effectiveness and permanence of the deed restrictions are likely to be high because the property is owned by the State.

Reduction of Toxicity, Mobility, or Volume of the Contaminants Through Treatment. The selected alternative and alternatives which may require treatment through removal of free liquids and stabilization of characteristic materials, reduce mobility and toxicity in contaminated soils and sediments by encapsulation and bonding of metals and reduction of the leachability of all substances. The toxicity of some of the metals will be reduced due to bonding to the pozzolan material. Moreover, with solidification, all of the substances and metals will be encapsulated in a hard, solidified mass and exposure to the substances will be highly unlikely; therefore, the toxic effects of the substances will be reduced. VOCs can be released during the excavation and solidification. These releases can be controlled through collection and treatment if emission standards are being exceeded to reduce toxicity. In addition, the collection system in the containment cell will capture leachate from the cell, and thus reduces the mobility of the contaminants. Treatment of the leachate will also serve to reduce the toxicity of the contaminants.

Alternatives 3 and 4 do not provide for reduction of toxicity, mobility or volume through treatment although some reduction in the mobility of constituents is provided by capping.

Alternative 6, Alternative 7, and Alternative 7A reduce contaminant mobility through stabilization with chemical additives. Volume is increased by the addition of significant quantities of stabilizing materials. Alternative 5 reduces the toxicity, mobility and volume of some of the site constituents, but may tend to concentrate the metals in the incinerator ash.

Alternatives 8 and 9 provide response actions and utilize technologies which reduce the toxicity or mobility associated with each site media. On-site treatment reduces the mobility of the contaminants in the limited volume of sediments that are treated.

The ground water treatment element of assembled alternatives 4 through 9 will significantly reduce the mobility, toxicity and volume of contamination in the ground water by removing the volatile organics from the ground water followed by collection and treatment of the process off-gases. The selected remedy and Alternative 9 provide the greatest extent of reduction by utilizing a point of standards application in the shallow zone of the aquifer. Since Alternative 3 does not provide treatment for ground water, there will be no reduction in the toxicity, mobility, or volume of contamination.

Short-term effectiveness. The selected alternative requires no transportation of hazardous materials through local neighborhoods or over public highways. The process is performed on site so that exposure of workers, the public, and the environment to contaminated materials can be minimized through good engineering practice. Soil and sediment remediation is estimated to be complete within one year. Although there is some short-term risk associated with the construction of the disposal cell and the excavation and disposal of the contaminated soil and sediment, these risks will be managed through careful engineering practice. The VOC emissions that might occur during excavation can be controlled by working during the cooler months.

Alternatives 4 and 6A require transportation of excavated materials through local neighborhoods and over public highways. The short-term risks related to these activities can be reduced by establishing and following a project specific safety plan in addition to strict adherence to all local, State and federal regulations regarding the transportation of hazardous materials, but those risks may still be significant.

Soil and sediment remediation is estimated to be complete within one year, although for off-site disposal that time is dependent on the disposal facility's capacity for stockpiling waste delivered for disposal.

Alternative 3 has some short-term effects since excavation for the slurry wall will provide a potential for exposure to contaminated materials. Construction of the alternative would not require

extended time periods. All other alternatives which involve excavation and treatment of soils should be completed in a matter of months and represent some short-term effects due to the need for excavation and treatment on site. Alternatives involving caps for containment also pose transportation risks for delivery of materials to the site. There is a potential for exposure of the public and the on-site workers to contaminated materials during the excavation, during any on-site treatment, and during transportation off-site depending upon the details of the alternative. Management practices would be implemented for all such alternatives to minimize these exposure pathways and risks.

Under Alternative 5, risks associated with the operation of the incinerator will be controlled through precise operation and monitoring of the facility. These controls will be required during the estimated two years of operation.

Time of implementation may be as long as 30 years for ground water cleanup and during treatment some small risk can be expected during the operation of the collection system and the air stripping facility.

Standard safety precautions will be taken during implementation to minimize potential short-term impacts of these Alternatives, including proper covering of trucks, dust control, air monitoring and personal protective equipment.

Implementability. The selected alternative uses common construction equipment and readily available technologies. The technologies for Alternative 3 are readily implementable, requiring the use of proven, readily available engineering and construction expertise. Implementability of Alternative 4 and Alternative 6A may be significantly limited by the availability of disposal capacity at RCRA compliant facilities. The solidification technologies used for the selected alternative, Alternative 6, Alternative 7, Alternative 7A, Alternative 8, and Alternative 9, and the incineration technology used for Alternative 5, are readily implementable.

The ground water treatment component for Alternatives 4 through 9 depend on proven and readily available equipment and expertise. The collection and transport systems may require innovative design features but would be implementable.

Implementability of access restrictions and other institutional controls is high because the State owns the property , so that there is no need to require a private landowner to agree to such controls.

Cost. So that direct comparisons can be made all costs are based on the treatment volumes determined in the FS. The present-worth costs shown below are taken directly from the FS or calculated

independently using unit costs from the FS where larger volumes are to be treated:

*Alternative 3	$ 7,045,000
*Alternative 4	$ 7,940,000
*Alternative 5	$ 8,645,000
Alternative 6	$11,140,000
Alternative 6A	$13,100,000
Alternative 7	$12,360,000
Alternative 7A	$12,395,000
*Alternative 8	$ 5,930,000
*Alternative 9	$ 7,450,000
Selected Alternative	$ 8,119,300
**Proposed Plan Alternative	$19,594,000
***Proposed Plan Alternative	$19,166,000

* = does not treat or contain all 10^{-6} contaminated soil
** = soil incineration - July 20, 1990
*** = off-site disposal of soil - September 12, 1990

Two additional alternatives which were included as part of the detailed analysis, were also considered by U.S. EPA. These are:

in-situ vitrification (ISV)	$ 23,000,000 to $31,000,000
off-site incineration	> $150,000,000

Of those alternatives that relied primarily on containment (Alternatives 3, 8, and 9), Alternative 8 is the least expensive.

Of those alternatives that treated the lesser volume of waste, (Alternatives 4 and 5) Alternative 4 costs less.

Of those alternatives that treated the greater volume of waste on-site using solidification, Alternative 6 was the least expensive.

Of the remaining alternatives that treat the greater volume of soil (ISV, on-site incineration (the Proposed Plan Alternative) and off-site incineration, and off-site treatment/disposal), the off-site treatment and disposal alternative and the on-site incineration alternative are the least expensive. Cost differentials were determined based on the calculations provided in addition to the FS and are included in the administrative record.

State Acceptance. The State of Michigan supports the selected remedial alternative and agrees with EPA that the selected alternative complies with the Act 307 rules.

Community Acceptance. Community acceptance of the selected alternative has been evaluated in the Responsiveness Summary which is a part of this Record of Decision. Comments from the local

community generally favor remedies which include removal of all waste from the Berlin and Farro site. U.S. EPA however, must consider the impact of its remedial activities in the broadest sense because it is obligated to provide protection of human health and the environment equally in all communities. In so doing, U.S. EPA uses appropriate evaluation criteria, to balance long-term and short-term effects of cleanup activities. Because analysis using these criteria indicates the effects of the on-site remedy on the local community are not measurably greater than the effects on another community in which the waste would be disposed if one of the off-site remedies were implemented, U.S. EPA can not justify an off-site remedy in response to community comments.

IX. THE SELECTED REMEDY

U.S. EPA believes that the selected remedy, a combination of the soil and on-site sediment excavation component of Alternative 6 and the off-site sediment and the ground water components of Alternative 9, is the most appropriate solution for the site because of its performance against the nine evaluation criteria previously discussed. The major components of this combined remedial alternative include the following:

* Excavation of contaminated soil and sediment above cleanup levels from the central site area and sediment from Slocum Drain (approximately 48,000 cubic yards).

* Disposal of the excavated materials in a containment cell to be constructed on site, with treatment of the materials to remove free liquids and to render characteristic waste non-characteristic.

* Treatment of any leachate collected from the containment cell.

* Back-filling, topsoil cover, and revegetation of the excavated on-site areas and regrading of the excavated areas of Slocum Drain.

* Extraction of contaminated ground water from the shallow portion of the aquifer through a system of collection trenches and treatment of the ground water by air stripping, including control of the off gases and proper management of all residuals.

* Site deed restriction that prevent installation of drinking water wells on the site during the remediation.

* Ground water monitoring to assess the state of the remediation and assure containment of the plume of contamination.

The goal of the ground water element of this remedial action is to restore ground water to its beneficial use, which is, at this site, use for residential purposes. Based on information obtained during

the remedial investigation and on a careful analysis of all remedial alternatives, U.S. EPA and the State of Michigan believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the ground water extraction system, that contaminant levels have ceased to decline and are remaining constant at levels higher than their remediation goal. In such a case, the system performance standards and/or the remedy may be reevaluated.

The operating system may include:

a) discontinuing operation of extraction trenches in areas where cleanup goals have been attained;

b) alternating pumping at trenches to eliminate stagnation points; and

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into ground water.

The goal of the soil and sediment element of this remedial action is to dispose of and appropriately treat those materials which are demonstrated to exceed contaminant levels which pose unacceptable risks to human health and the environment.

The selected remedy will include ground water extraction for an estimated period of 30 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation.

The estimated cost for this remedy is as follows:

Capital Costs: $4,767,300
Annual O&M Costs: $233,100
O&M PW: $3,352,000
Net PW: $8,119,300

A detailed summary of the costs is shown in the table below.

	COST			
Element	Capital	Annual O&M	O&M PW	Net PW
Institutional Control	$167,700	$15,000	$230,600	$398,300
Trenches	326,500	2,000	20,800	347,300
Ground water treatment & monitoring	401,800	93,200	1,432,700	1,834,500

Ground water & surface water monitoring	374,500	82,500	1,268,200	1,642,700
Excavation	771,000	15,400	15,400	786,400
Landfill Construction	2,725,800	25,000	384,300	3,110,100
Total	$4,767,300	$233,100	$3,352,000	$8,119,300

X. DOCUMENTATION OF SIGNIFICANT CHANGES

A Proposed Plan was released for public comment in July 1990. The Proposed Plan identified on-site incineration of approximately 38,000 cubic yards of contaminated soil and sediment and ground water extraction and treatment to be appropriate for the Berlin and Farro Site.

During the public comment period residents near the site and potentially responsible parties expressed strong opposition to the use of on-site incineration. This opposition was based on the short term risk presented by the estimated 380 days of operation of the on-site incinerator. In addition, information was provided indicating that much of the volume of soil proposed to be remediated was to be treated based only on metals contamination. Incineration is not generally considered an effective treatment with metals, and in fact, may produce treatment residuals that could require significant additional treatment. As a result, U.S. EPA, in consultation with MDNR, considered excavation and off-site disposal of the contaminated soil and sediment.

After evaluation of all current information including uncertain implementability due to questionable availability of adequate disposal capacity, the advisability of using hazardous waste disposal capacity for materials with relatively low levels of contamination, and the transportation risks associated with off-site disposal, U.S. EPA has selected excavation and on-site disposal as the alternative which best addresses the soil and sediment contamination at the site and meets the requirements of the NCP and of Michigan Act 307. The selected alternative will provide protectiveness and long term effectiveness equivalent to that which would be provided by an off-site facility since the technical design requirements are the same for both.

The selected alternative for soils and sediments incorporates the excavation element of alternative 6 in the FS and disposal in an on-site cell which will meet the technical requirements of RCRA and Michigan Act 64 and is considered a logical outgrowth of that alternative. The solidification prior to disposal will be required if the excavated soils exhibit characteristics of RCRA hazardous waste. The selection also takes into account the fact that under

the NCP off-site disposal of hazardous substances or contaminated materials without treatment should be the least favored alternative where practicable treatment technologies are available.

XI. STATUTORY DETERMINATIONS SUMMARY

1. Protection of Human Health and the Environment

The selected remedy provides adequate overall protection of human health and the environment, by removal and off-site treatment and disposal of contaminated soils and sediments and by pumping and treating the ground water. Institutional controls will be implemented during remediation to assure protection until confirmation sampling and analyses indicate that a health based cleanup has been achieved.

Any short term risks associated with excavation and transportation of contaminated soils and sediments (dust generation) will be minimized by the use of standard construction practices. Air monitoring will be conducted to assess possible exposure during remedial action.

No environmental impacts have been identified for the site. This is largely due to the fact that impacts from the site have been to the ground water, soil, and sediment in the site areas where disposal activities took place.

2. Attainment of ARARs

The selected remedy will be designed to meet all applicable or relevant and appropriate requirements (ARARs) of Federal and more stringent state environmental laws. The following discussion provides the details of the ARARs that will be met by the selected alternative.

Action-Specific ARARs:

Clean Water Act (CWA) of 1977, as amended [33 U.S.C. 1251]

40 CFR 122 and 40 CFR 125 - The National Pollutant Discharge Elimination System (NPDES), which specifies the scope and details of the NPDES permit applications, including limitations, standards, and other permit conditions which are applicable to all permits including specified categories of NPDES permits, Also specifies schedules of compliance and requirements for recording and reporting monitoring results. Administered by MDNR under Michigan Public Act 245, Part 21. The substantive requirements of these parts will apply to the ground water to be discharged after treatment in the air stripper.

Act 348 of the Public Acts of 1965, as amended: Air Pollution Act

Part 2 - Air Use Approval, which specifies information required for a permit to install, construct, reconstruct, relocate, or alter any process, fuel burning or refuse burning equipment, or control equipment which may be a source of air contamination. The substantive requirements of this part will apply to construction of the air stripper.

Parts 3, 7 and 9 - Emissions, which specifies emission limitations for particulates, fugitive dust, VOCs, and or contaminants which may be injurious to or adversely affect human health or welfare, animal life, vegetation, or property, or interfere with normal use and enjoyment. The substantive requirements of these parts will apply to the operation of the air stripper and construction and excavation activity performed to implement the remediation of contaminated soil and sediment.

Part 10 - Intermittent Testing and Sampling, which may require performance of acceptable performance tests. The substantive requirements of this part will apply to the air stripper.

Resource Conservation and Recovery Act, Subtitle C (RCRA), 1976; U.S.C. 6901; Michigan Hazardous Waste Management Act, PA 64

40 C.F.R. 264 - Subpart F - Ground Water Protection Standards, which provide technical requirements for long-term monitoring. These requirements will apply while the ground water treatment element is active and for at least the first five year review period following completion of the ground water cleanup.

40 C.F.R. 262 - Regulations for Hazardous Waste Generators, Michigan Hazardous Waste Management (MHWM) rules, Part 3, R299.9301 - Generators of Hazardous Waste, provide requirements for the shipment of wastes to treatment, storage or disposal facilities. These requirements may apply to off-site shipment of treatment residuals.

40 C.F.R. 263 - Department of Transportation (DOT) Hazardous Materials Transportation Act, 49 U.S.C. 1801; MHWM Rules, Part 4, R299. 9401 to 9412; Transporters of Hazardous Waste, require record keeping, reporting, and manifesting of waste shipments. These requirements may apply to off-site shipment of treatment residuals.

40 C.F.R. 264 - Subpart B - General Facility Requirements, which establish substantive requirements for security, inspection, personnel training, and materials handling are relevant and appropriate for on-site activities involving excavations and handling of hazardous soils and sediments.

40 C.F.R. 264 - Subpart D - Contingency Plan and Emergency Procedures, which establish substantive requirements for emergency planning are relevant and appropriate for on-site activities involving excavation and handling of hazardous soils and sediments.

40 C.F.R. 264, Subpart G - Closure and Post-closure, which establishes substantive requirements for closure performance and equipment decontamination, is relevant and appropriate for on-site activities involving handling of hazardous soils and sediments, and the construction and maintenance of the on-site containment cell and cap.

40 C.F.R. 264, Subpart N; MHWM Rules, Part 6, R. 299.9619-22 - Landfills, which establish standards for construction of hazardous waste landfills are relevant and appropriate to construction of the on-site cell and cap.

40 C.F.R. 268 - Landfill Disposal Restrictions, which may require that wastes meet identified treatment standards before they can be land disposed are applicable to any treatment residues to be land disposed off-site and are relevant and appropriate to the extent that contaminates soils and sediments to be put in the on-site cell exhibit any of the characteristics of hazardous wastes under 40 C.F.R. Part 261.

Chemical-Specific ARARs:

Clean Water Act (CWA) of 1977, as amended [33 U.S.C. 1251]

40 CFR 129 - Toxic Pollutant Effluent Standards, which establish toxic pollutant effluent standards and prohibitions of specific compounds for specified facilities discharging into navigable waters. 40 CFR 129.104 sets the ambient water criterion in navigable waters. These requirements may apply to the discharge of treated ground water after treatment in the air stripper.

Clean Air Act of 1963, as amended [42 U.S.C. 7401]

40 CFR 50 - National Primary and Secondary Ambient Air Quality Standards, which establish national primary and secondary ambient air quality standards. The appendices provide methods and procedures for measuring specific air pollutants. These standards may apply to the operation

of the air stripper.

40 CFR 61 - National Emission Standards for Hazardous Air Pollutants, which identifies substances that have been designated hazardous air pollutants, and for which a Federal Register notice has been published, and specifies prohibited activities, describes procedures for determining whether construction or modification is involved, prescribes methods of applying for approval, and covers the manner in which start-up notification is to be provided. The substantive requirements of this part may apply to operation of the air stripper.

Act 245 of the Public Acts of 1929, as amended: Water Resources Commission Act

Part 4, Rule 57 - Water Quality Standards (Surface Water Quality Standards), which establishes limits for all waters of the State for the following components: dissolved solids, pH, taste and odor producing substances, toxic substances, total phosphorous and other nutrients, and dissolved oxygen. These requirements will apply to the discharge of ground water after treatment in the air stripper.

Rule 98 - Antidegradation, requires maintenance and protection of existing waters when water quality is better than water quality standards. These requirements will apply to the discharge of ground water after treatment in the air stripper.

Part 22 - The State has identified this rule as an ARAR. The State concurs with the remedy selected, and has stated that in applying Act 307 requirements to the ground water treatment, the remedy selected will satisfy the requirements of Act 245. The United States disagrees that Act 245, as interpreted and applied by the State in this matter, is an ARAR. This issue is the subject of litigation in U.S. v. Akzo Coatings of America, appellate case numbers 89-2902 and 80-2137, and may be reassessed after a decision has been rendered.

Act 348 of the Public Acts of 1965, as amended: Air Pollution Act

Part 3 - Emission Limitations and Prohibitions - Particulate Matter, which establishes standards for the density of emissions and emission of particulate matter. These standards will apply to operation of the air stripper.

Act 307, Michigan Environmental Response Act. The rules promulgated pursuant to the Act set requirements for evaluating remediation of hazardous waste sites in Michigan. There are three types of remediation specified by this act; Type A, B, and C. The Type C substantive requirements apply to the soil and sediment remedy and Type A and Type B substantive requirements apply to the ground water remedy.

Act 347 of the Public Acts of 1972: Soil Erosion and Sedimentation Control Act

Part 17 - Soil Erosion and Sedimentation Control - Establishes general soil erosion and sedimentation control procedures and measures. Also, specifies earth change requirements and soil conservation district standards and specifications. The substantive requirements of this part may apply to the soil and sediment remediation.

3. **Cost-Effectiveness**

The selected remedy provides overall cost-effectiveness. A high degree of permanence is achieved by excavation,treatment, and on-site disposal of the contaminated soil and sediments in a hazardous waste cell and by extraction and treatment of the contaminated ground water and of any leachate from the containment cell. The selected remedy can be implemented at a cost 27-58 percent less than other remedies which address the 1 X 10^{-6}risk level soil and provide effectiveness and permanence equal to that provided by off-site remedies.

4. **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable**

The selected remedy provides the best balance with respect to the nine evaluation criteria as described in Section IX of this Record of Decision. Treatment technologies are utilized to the maximum extent practicable by excavation, and on-site treatment when required and disposal of the contaminated soil and sediment in a secure cell were any leachate will be collected and treated, and by treatment of contaminated ground water by pump and treat, which includes treatment of stripped volatiles. This alternative is further balanced with respect to the nine criteria because a permanent solution which utilizes treatment technologies is being selected. The ground water monitoring component of the selected remedial action will assure that concentrations of contaminants do not increase during implementation.

5. Preference for Treatment as a Principal Element

By treating the contamination in the ground water and soil where required for on-site disposal, and treatment of any accumulated leachate, the selected remedy satisfies the statutory preference for remedies that employ treatment of the principal remaining threat which permanently and significantly reduces toxicity, mobility, or volume of hazardous substances as a principal element.

The selected remedy reduces the principal threats at the site, direct contact with and ingestion of contaminated soil and sediment by the use of on-site containment in a hazardous waste disposal cell, with some treatment. Treatment of all of the remaining threats due to soil and sediment contamination at the site was not found to be appropriate based on site-specific risk factors. Treatment is a principal element of the ground water remedy which reduces the risk of exposure through ingestion and direct contact with the contamination in the ground water by use of pump and treat technology.