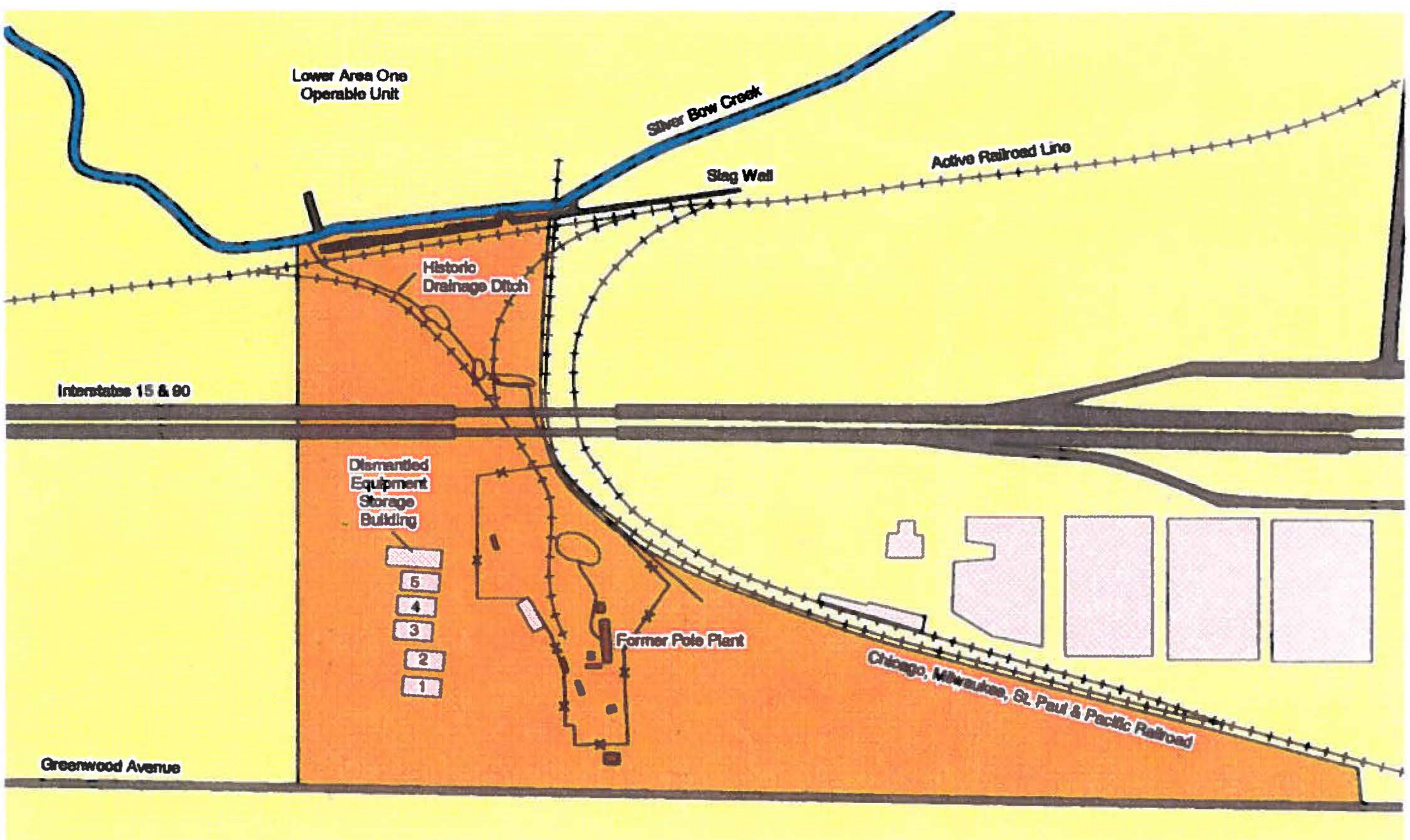
Final
Feasibility Study
Montana Pole and Treating Plant NPL Site
Butte, Montana

March 1993



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MONTANA POLE AND TREATING PLANT NPL SITE

Final Feasibility Study - Revision 1
Volume I

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EXECUTIVE SUMMARY

The Montana Pole and Treating Plant (MPTP) site, located in Butte, Montana, was listed on the National Priorities List (NPL) in July 1987 as a result of potential and actual releases of hazardous substances from the site. An Administrative Order of Consent was issued to the Atlantic Richfield Company (ARCO) by the Montana Department of Health and Environmental Sciences (DHES) on June 4, 1990 requiring ARCO to perform a remedial investigation/feasibility study (RI/FS) on the site. Keystone Environmental Resources, Inc. (Keystone) was contracted by ARCO to perform the RI. James M. Montgomery, Inc. (JMM) was contracted to perform the FS. This report documents the FS, which was performed in accordance with guidance published by the U.S. Environmental Protection Agency (USEPA) (1988) for sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The purpose of an FS is to develop, screen, and evaluate remedial alternatives potentially capable of meeting requirements proposed by the State and federal regulatory agencies.

Nature and Extent of Contamination

Seven different media were sampled during the RI: soils (surface, subsurface, and removed), groundwater, surface water, sediments, process equipment, miscellaneous oils, and miscellaneous sludges. The samples were typically analyzed for pentachlorophenol (PCP), polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), dioxins/furans, and metals. The removed soils and miscellaneous oils and sludges were also analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) methods for metals and organic compounds.

In general, organic wood-treating compounds were found in the surface and subsurface soils in the former process area, along the surface water drainage ditch which bisects the site and empties into Silver Bow Creek, in soils previously removed during USEPA removal actions, and in soils impacted by a nonaqueous phase liquid floating on the water table at the site. PCP concentrations as high as 2,300,000 μg/kg were found in surface soil samples. PCP was detected in samples collected as deep as 36 feet in several locations. The highest concentrations of PCP (and other organic compounds) in the subsurface were generally found in samples collected at or near the water table. The concentrations of PCP and other organic compounds were generally near their detection limit in soil samples collected from the former eastern and western pole storage yards.

PCP contamination in the groundwater is fairly widespread throughout the site. Light non-aqueous phase liquid (LNAPL) was observed in nine of the 39 wells sampled during the RI. The highest LNAPL thickness measured in the wells was 2.2 feet. This thickness measurement is considered an apparent thickness, the actual thickness in the aquifer is typically much less. The LNAPL is migrating towards Silver Bow Creek, the northern boundary of the site, as evident by the oily seeps observed along the streambank.

Regulations Analysis

An analysis of the applicable or relevant and appropriate requirements (ARARs) for the MPTP site was performed by DHES and is presented in Appendix A. Certain wastes at the MPTP site are considered listed-hazardous wastes, classifications FO32 and FO34. Treatment and disposal standards for FO32 and FO34 wastes have not been promulgated by the USEPA.

Risk Analysis

A baseline risk assessment (BRA) for the site was performed by Camp Dresser & McKee, Inc. (CDM) for DHES. Excess cancer risk to current on-site trespassers was estimated at 1.96×10^{-5}, which is within the USEPA risk range of 10^{-4} to 10^{-6}. The noncancer risk level (hazard index) was 0.1, which is below the USEPA benchmark of 1 for acceptable risk. Risks to the current on-site worker were not calculated but were expected to be less than the future on-site worker. Excess cancer risks to future on-site workers were estimated at 6.92×10^{-5}, which is within the USEPA risk range of 10^{-4} to 10^{-6}. The noncancer risk level or hazard index was estimated at

0.25, which is below the acceptable benchmark of 1. Cancer and noncancer risks were evaluated by CDM for the future residential scenario. Both the cancer and noncancer risks to the future resident were above the USEPA acceptable risk levels.

Preliminary Remedial Action Objective and Goals

Preliminary remedial action objectives (PRAOs) and preliminary remedial action goals (PRAGs) were developed by DHES based on ARARs, the results of the BRA, and potential future uses of the site. The PRAOs for soil, groundwater and LNAPL, surface water, and sediments are summarized as follows:

Soil:

- Prevent human exposure to carcinogens in soil that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.
- Prevent human exposure to noncarcinogens in soil that would result in a hazard index greater than 1.
- Prevent contaminant releases from soil that results in groundwater, surface water, or air contamination greater than allowable limits based on ARARs and protection of human health and the environment.
- Minimize impact of contaminated soils adversely affecting terrestrial or aquatic species.

Groundwater and LNAPL:

- Prevent human exposure to carcinogens in groundwater and LNAPL that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.
- Prevent human exposure to noncarcinogens in groundwater and LNAPL that would result in a hazard index greater than 1.
- Remediate site groundwater for use as a drinking water supply.

- Prevent contaminant releases from groundwater and LNAPL that result in surface water contamination greater than allowable limits based on ARARs and protection of human health and the environment.

- Prevent contaminated groundwater and LNAPL migration that results in adjacent aquifer contamination greater than allowable limits based on ARARs and protection of human health and the environment.

Surface Water:

- Prevent human exposure to carcinogens in surface water that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.

- Prevent human exposure to noncarcinogens in surface water that would result in a hazard index greater than 1.

- Prevent contaminant releases that result in surface water contamination greater than allowable limits based on ARARs and protection of human health and the environment.

Sediments:

- Prevent human exposure to carcinogens in sediment that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.

- Prevent human exposure to noncarcinogens in sediment that would result in a hazard index greater than 1.

- Prevent contaminant releases from sediment that result in groundwater, surface water or air contamination greater than allowable limits based on ARARs and protection of human health and the environment.

- Minimize impact of contaminated sediments adversely affecting terrestrial or aquatic species.

The remedial action objectives for equipment and debris stored on-site are to minimize exposure to contamination and prevent releases that would cause soil or groundwater contamination above health-based target levels.

Preliminary remedial action goals (PRAGs) have been developed by DHES based on the above PRAOs. The PRAGs are provided in detail in Section 3.0.

Technology Screening

Applicable remedial technologies and process options were evaluated and screened based on previous screening documents (Keystone, 1991a; Murray Lamont, 1992) and treatability studies (Keystone, 1991b through e; Keystone, 1992a through d; and GRC, 1991) performed for the MPTP site. These technologies and process options were evaluated and combined to form five remedial alternatives that were screened on the basis of effectiveness, implementability, and cost. Four remedial alternatives were retained from that initial analysis for detailed analysis and comparative analysis based on the nine criteria identified by the USEPA (1988). Alternative 2, Institutional Controls, was eliminated from further consideration as a stand-alone alternative, although institutional controls are included in the other alternatives evaluated. This detailed analysis and comparative analysis will be used by the regulatory authorities to select a remedial alternative for the MPTP site.

Alternatives Development

The technologies and process options included in the four remedial alternatives retained for detailed analysis are summarized on Table E-1. Groundwater monitoring; institutional controls; grading, and revegetation; off-site incineration of oils and sludges; and decontamination and disposal of dismantled equipment and debris were included in all of the remedial alternatives retained for detailed analysis, except the no-action alternative (Alternative 1). Institutional controls currently in place at the MPTP site (zoning limitations, floodplain regulations, subdivision regulations, building codes, and the well ban) limit development at the site and prohibit the groundwater from being used as potable supply. Modifications to the existing controls and additional institutional controls, such as private property rights, were included to further limit the uses of the site.

Alternatives 3, 4, and 5 each include three different soil treatment technologies. Alternatives 3A, 4A, and 5A include on-site incineration of excavated soils. Alternatives 3B, 4B, and 5B include on-site bioremediation of excavated soils, and Alternatives 3C, 4C, and 5C include soil washing with biological treatment of residuals.

The primary difference between Alternatives 3, 4, and 5 is the volume of soil and LNAPL that is excavated. All three of the alternatives include excavation of soils north of the physical groundwater barrier (Gundwall) constructed by USEPA in September 1992. These soils near Silver Bow Creek (referred to as near-creek soils) would be excavated to address the adverse affect of the seeps on the creek. Alternative 3 also includes excavation of distinct areas of surface soils in the east and west pole treating yards that have high concentrations of PCP, referred to as "hot spot" soils. These soils would be consolidated in the former process area and capped. The cap would extend from the former process area down to the creek along the historic drainage ditch. As stated above, the excavated soils, which include the bagged soils previously excavated in 1985, the near-creek soils, and the soils excavated as part of the groundwater remediation system (e.g., soils from installing wells and digging trenches) would be treated by either on-site incineration, bioremediation, or soil washing, and backfilled on site.

For Alternative 4, surface and subsurface soils would be excavated to 4 feet below the water table within the former process area and along the historic drainage ditch. The objective of excavation is to remove the LNAPL within the soil matrix. The hot spot soils, near-creek soils, and soils associated with the groundwater treatment system would also be excavated. The excavated soils and the bagged soils (total of about 115,000 cubic yards) would be treated by either on-site incineration (Alternative 4A), on-site bioremediation (Alternative 4B), or soil washing (Alternative 4C), and backfilled on site.

In addition to the soils excavated under Alternative 4, Alternative 5 includes all soils (to a depth of 4 feet below the water table) impacted by the LNAPL plume. The aerial extent of the interpretive plume of LNAPL is about 767,000 square feet and spreads out from the former process area as it migrates towards Silver Bow Creek. Some of the soils impacted by the LNAPL plume are beneath uncontaminated soils. The uncontaminated soils would be separated from the contaminated soils during excavation. The contaminated excavated soils and the bagged

TABLE E-1

REMEDIAL ALTERNATIVES THAT PASSED INITIAL SCREENING

General Response Action	Media	Process Option	Alternative 1	Alternative 3 A	Alternative 3 B	Alternative 3 C	Alternative 4 A	Alternative 4 B	Alternative 4 C	Alternative 5 A	Alternative 5 B	Alternative 5 C
No Action			•									
Monitoring	Groundwater			•	•	•	•	•	•	•	•	•
Institutional Controls		Deed Restrictions		•	•	•	•	•	•	•	•	•
		Zoning	•	•	•	•	•	•	•	•	•	•
		Floodplain Regulations	•	•	•	•	•	•	•	•	•	•
		Building Codes	•	•	•	•	•	•	•	•	•	•
		Well Ban	•	•	•	•	•	•	•	•	•	•
Containment	Soil	Grading		•	•	•	•	•	•	•	•	•
		Revegetation		•	•	•	•	•	•	•	•	•
		Clay Cap		•	•	•						
	Groundwater	Physical/Hydraulic Barriers		•	•	•	•	•	•	•	•	•
Removal/Extraction	Soil	Minimal Excavation		•	•	•						
		Limited Excavation					•	•	•			
		Total Excavation								•	•	•
	Groundwater	Extraction Wells & Trenches		•	•	•	•	•	•	•	•	•
In Situ Treatment	Soil and Groundwater	Bioremediation		•	•	•	•	•	•	•	•	•
	LNAPL	Soil Flushing								•	•	•

TABLE E-1 (Continued)

REMEDIAL ALTERNATIVES THAT PASSED INITIAL SCREENING

General Response Action	Media	Process Option	Alternative 1	Alternative 3			Alternative 4			Alternative 5		
				A	B	C	A	B	C	A	B	C
Ex Situ Treatment	Soil	On-site Incineration		•			•			•		
		Landfarming			•			•			•	
		Soil Washing				•			•			•
	Groundwater	Oil/Water Separator		•	•	•	•	•	•	•	•	•
		Bioreactor		•	•	•	•	•	•	•	•	•
		Carbon Polishing		•	•	•	•	•	•	•	•	•
	Oily Wastes and Sludges	On-site Incineration		•			•			•		
		Off-site Incineration		•	•	•	•	•	•	•	•	•
	Equipment and Debris	Wet Washing		•	•	•	•	•	•	•	•	•
		HEPA Vacuuming		•	•	•	•	•	•	•	•	•
		Wipe Methods		•	•	•	•	•	•	•	•	•
		Scarification		•	•	•	•	•	•	•	•	•
Disposal	Treated Soil	Backfill		•	•	•	•	•	•	•	•	•
	Treated Groundwater	Surface Water Discharge		•	•	•	•	•	•	•	•	•
		Recharge		•	•	•	•	•	•	•	•	•
	Decontaminated Equipment & Debris	Off-site Landfill		•	•	•	•	•	•	•	•	•

soils (total of about 209,000 cubic yards) would be treated by either on-site incineration (Alternative 5A), on-site bioremediation (Alternative 5B), or soil washing (Alternative 5C), and backfilled on site.

Alternatives 3, 4, and 5 include groundwater containment via physical and hydraulic barriers, and groundwater treatment. Groundwater treatment includes pretreatment of extracted groundwater with oil/water separation to separate the LNAPL and aqueous phase followed by biological treatment with carbon polishing of the aqueous phase. Extracted, treated groundwater would then be recharged to the aquifer or discharge to Silver Bow Creek. In situ bioremediation will be utilized to provide for long-term remediation of the aquifer.

Comparative Analysis of Alternatives

A summary of the comparative analysis of the alternatives retained for detailed analysis follows.

Overall Protection of Public Health and the Environment. Alternative 1 is not expected to provide adequate protection of public health and the environment. Alternatives 3A through 5C would be protective of public health and the environment. However, the degree of protection provided by Alternatives 3A, 3B, and 3C is dependent upon effective long-term maintenance of the cap and the groundwater system.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Alternative 1 does not meet chemical-specific ARARs for groundwater or surface water. Alternatives 3, 4, and 5 would meet chemical-specific ARARs for surface water, location-specific ARARs, and action-specific ARARs. Achieving chemical-specific ARARs for groundwater is not likely under Alternative 3 because most source areas would remain in place. Achieving chemical-specific ARARs in groundwater under Alternative 4 is uncertain because, although a large volume of source material is removed, a substantial amount of source material would remain in place and require long-term remediation. DHES believes that chemical-specific

ARARs for groundwater can be achieved under Alternative 5 because all accessible source areas are removed.

Long-Term Effectiveness and Permanence. Alternative 1 provides no long-term effectiveness or permanence for reducing risks to human health and the environment beyond those currently in existence at the site. Alternatives 3, 4, and 5 permanently reduce risks to human health and the environment for oils and sludges, and contaminated equipment and debris.

Excavated soils are most effectively and permanently treated by incineration under Alternatives 3A, 4A, and 5A. Biological land treatment and soil washing under Alternatives 3B, 3C, 4B, 4C, 5B, and 5C are not expected to be as effective as incineration but would permanently reduce the levels of contamination and are expected to reduce contamination to allowable levels. Capping under Alternative 3 is subject to deterioration over time, and requires long-term maintenance. Groundwater containment and treatment systems under Alternatives 3, 4, and 5 can be designed to be effective for containing contaminated groundwater, limiting contaminant migration, and reducing impacts to Silver Bow Creek to allowable levels. Under Alternative 3, the groundwater system is expected to require operation and maintenance indefinitely, because only minimal soil excavation and treatment is planned. Under Alternative 4, DHES believes that the overall effectiveness of groundwater remediation is expected to be greater than under Alternative 3, because a large volume of contaminated soils and associated LNAPL is excavated and treated. Operation and maintenance of the groundwater system under Alternative 4 is expected to be required for a shorter period of time than under Alternative 3. Groundwater treatment under Alternative 5 is anticipated to have the greatest effectiveness of the alternatives because all accessible contaminated soils and LNAPL are excavated and treated. Under Alternative 5, operation and maintenance of the groundwater system is expected to be required for a shorter period of time than under either Alternative 3 or Alternative 4.

Reduction of Toxicity, Mobility and Volume. Alternative 1 provides no reduction of mobility, toxicity, or volume through treatment beyond that provided by the actions currently in place at the site. Alternatives 3, 4, and 5 reduce the toxicity and volume of oils and sludges through either on-site incineration or off-site incineration. The toxicity of contaminated equipment and debris is reduced by decontamination under Alternatives 3, 4, and 5.

The toxicity, mobility, and volume of contaminants in excavated soils is effectively reduced by incineration under Alternatives 3A, 4A, and 5A. Biological land treatment and soil washing under Alternatives 3B, 3C, 4B, 4C, 5B, and 5C reduce the toxicity and volume of contaminants in soils but not to the degree provided by incineration.

Alternative 3 provides minimal reduction of toxicity, mobility, and volume of contaminated site soil. Alternative 4 provides a greater reduction of toxicity, mobility and volume of contaminated site soil than Alternative 3 because a large amount of contaminated soils and associated LNAPL are excavated and treated. Alternative 5 provides the greatest reduction of toxicity, mobility, and volume of contamination in soils of all the alternatives because all accessible contaminated soils and associated LNAPL are excavated and treated.

Alternatives 3, 4, and 5, groundwater treatment systems, provide reduction of toxicity, mobility, and volume of groundwater contamination. Alternative 4 provides greater reduction of toxicity, mobility, and volume of groundwater contamination than Alternative 3 because large sources of groundwater contamination (contaminated soils and LNAPL) are excavated and treated. Alternative 5 provides the greatest reduction of toxicity, mobility, and volume of groundwater contamination of all the alternatives because all accessible sources of groundwater contamination (contaminated soils and LNAPL) are excavated and treated.

Short-Term Effectiveness. Under Alternative 1, there is potential for workers and site visitors to be exposed to hazardous chemicals during implementation of the current removal actions being performed by USEPA at the MPTP site. Adhering to safe work practices and using health and safety equipment is designed to limit the exposure to workers and visitors to within allowable levels.

During implementation of Alternatives 3, 4, and 5 there is potential for workers, site visitors, and nearby residents to be exposed to hazardous chemicals. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers and visitors to within allowable levels. Dust and vapor release control activities can be implemented to limit this exposure potential. The incinerator used under Alternatives 3A, 4A, and 5A can be designed to ensure emissions meet allowable standards. Given this and the short duration that the incinerator would be on-site, health risks to nearby residents would be low.

Implementability. Alternatives 1 through 5 are all technically implementable. For Alternatives 3, 4, and 5 the technologies for soil and groundwater treatment are readily implementable and have all been used in full-scale application at other sites. Prior to full-scale implementation of any of these treatment technologies at the MPTP site, design optimization studies are appropriate. On-site incineration may not be acceptable to the local community and off-site incineration can be difficult to implement since off-site incinerator operators are reluctant to accept wastes containing dioxin. Under Alternative 3, maintenance of a clay cap and operation and maintenance of the groundwater system will be required indefinitely. Operation and maintenance of the groundwater systems under Alternative 4 may be required indefinitely. Operation and maintenance of the groundwater system under Alternative 5 may be required beyond 30 years.

Cost. Alternative 1 is the least costly to implement. Alternative 5A is the most costly to implement. The 30-year present worth of Alternative 3 ranges from $21.0 million to $60.1 million; Alternative 4 ranges from $24.8 million to $110.8 million; and Alternative 5 ranges from $27.5 million to $156.2 million. These costs are based on a 30-year present worth. The groundwater treatment systems included in Alternatives 3, 4, and 5 are expected to operate longer than 30 years.

State agency acceptance. Based upon the information provided in this FS, the State (DHES) will coordinate with USEPA and develop a preferred remedy.

Community acceptance. After the public comment period, DHES and USEPA will complete the evaluation of the alternatives based on public comments received.

MONTANA POLE AND TREATING PLANT NPL SITE
FEASIBILITY STUDY

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ACRONYMS AND ABBREVIATIONS

APEG-PLUS	alkaline polyethylene glycolate-plus
ARAR	applicable or relevant and appropriate requirements
ARCO	Atlantic Richfield Company
BCD	base-catalyzed decomposition
BDAT	best demonstrated available technology
BDL	below detection limits
bgs	below ground surface
BRA	baseline risk assessment
BTEX	benzene, toluene, ethylbenzene, and xylene
CDM	Camp, Dresser, & McKee, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	chemicals of concern
cPAH	carcinogenic polynuclear hydrocarbons
CWA	Clean Water Act
DAF	dissolved air flotation
DHES	Montana Department of Health and Environmental Services
DNAPL	dense non-aqueous phase liquid
E&E	Ecology and Environment, Inc.
EMSL	Environmental Monitoring Systems Laboratory
ERA	ecological risk assessment
FR	Federal Register
FS	feasibility study
ft^3	cubic feet
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
GRA	general response action
HEAST	health effects assessment summary tables
HEPA	high efficiency particulate
IRIS	Integrated Risk Information System
JMM	James M. Montgomery, Consulting Engineers, Inc.
KPEG	potassium polyethylene glycolate
LAO	Lower Area One
LDR	land disposal restrictions
LNAPL	light non-aqueous phase liquid
MAC	maximum allowable concentrations
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MPTP	Montana Pole and Treating Plant
MSE	MultiTech Services, Inc.
msl	mean sea level
NCP	National Contingency Plan
ND	not detected

ACRONYMS AND ABBREVIATIONS
(Continued)

NOAA	National Oceanic and Atmospheric Administration
nPAH	noncarcinogenic polynuclear aromatic hydrocarbons
NPL	National Priorities List
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbons
PCP	pentachlorophenol
POTW	publicly owned treatment works
ppm	parts per million
ppt	parts per trillion
PRAG	preliminary remedial action goals
PRAO	preliminary remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
SARA	Superfund Amendments and Reauthorization Act of 1986
SVOC	semivolatile organic compound
TAL	target analyte list
TBC	"to be considered" criteria
TCDD	tetrachlorodibenzo-p-dioxin
TCE	tetrachloroethylene
TCLP	toxicity characteristic leachate procedure
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbon
UBC	Uniform Building Code
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UV	ultraviolet
VOC	volatile organic compound
yd^3	cubic yards

1.0 INTRODUCTION

The Montana Pole and Treating Plant (also referred to as "Montana Pole" or MPTP) site, located in Butte, Montana, was listed by the U.S. Environmental Protection Agency (USEPA) on the National Priorities List (NPL) in July 1987 [52 Federal Register (FR) 17623]. An Administrative Order on Consent (Consent Order) (Docket No. SF-90-0001) was issued to Atlantic Richfield Company (ARCO) by the Montana Department of Health and Environmental Sciences (DHES) on June 4, 1990, requiring ARCO to perform a Remedial Investigation/Feasibility Study (RI/FS) at the site. Keystone Environmental Resources, Inc. (Keystone) was contracted by ARCO to perform the RI. James M. Montgomery, Inc. was contracted to perform the FS. This report documents the FS, which was performed in accordance with guidance published by the USEPA for sites that are regulated by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (USEPA, 1988).

The purpose of an FS is to develop, screen, and evaluate remedial alternatives potentially capable of meeting the remedial action objectives and any other requirements proposed by state and federal regulatory agencies. Figure 1-1 outlines the FS process. The first step is to identify the remedial action objectives and general response actions for each medium of interest (e.g., soil, groundwater, surface waters, etc.). Remedial action objectives consist of medium-specific or operable unit-specific goals for protecting human health and the environment. General response actions describe those actions that will satisfy the remediation goals.

The second step in the FS process is to identify and screen technologies. In this step, the universe of potentially applicable technology types and process options (e.g., institutional controls, disposal options) is reduced by evaluating the options based on applicability. In the third step, the treatment technologies and process options are combined to form remedial alternatives potentially capable of meeting the remedial objectives applicable to the particular site. The remedial alternatives are screened in step four on the basis of effectiveness, implementability (both technical and administrative), and cost. The purpose of this screening is to reduce the number of alternatives that must undergo a more thorough and extensive evaluation. The detailed evaluation of the remedial alternatives retained in step four is performed in step five. The remedial alternatives must be evaluated against nine criteria developed by the USEPA to address CERCLA requirements (USEPA, 1988). The results of this evaluation are the basis for selecting an appropriate remedial action.

1.1 REPORT ORGANIZATION

The organization of this report follows the diagram presented in Figure 1-1. The remainder of Section 1.0 summarizes the pertinent background information from the RI report for the MPTP site (ARCO, 1992e). The background information includes site location and site history, geologic and hydrogeologic information as well as current and potential future land use. A description of the nature and extent of the contamination is presented in Section 2.0. The fate and transport of contamination, state and federal requirements for the MPTP site, and a summary of the baseline risk assessment are also discussed in Section 2.0. Most of the information presented in Section 2.0 are summaries of previous documents prepared for the MPTP site.

Section 3.0 presents the applicable remedial action objectives identified for the MPTP site and the corresponding general response actions (GRAs). Section 4.0 screens potentially applicable technologies and process options based on effectiveness, implementability, and costs. Results from treatability studies and previous technology screening documents are utilized extensively in Section 4.0. In Section 5.0, the technologies that passed the screening process are combined to form remedial alternatives which are then screened to reduce the number of alternatives requiring detailed evaluation. Section 6.0 presents the detailed evaluation of the selected remedial alternatives retained from the initial screening process.

1.2 LOCATION AND SITE HISTORY

The MPTP site is located at 202 West Greenwood Avenue, immediately west of the Butte, Montana, city limits in the southeast quarter, Section 24, T3N, R8W (Figure 1-2). A map showing the site layout and features as of 1989 is presented in Figure 1-3. Some features of the site have recently been altered due to ongoing USEPA actions. The site is bounded on the north by Silver Bow Creek, Greenwood Avenue to the south, and a railroad right-of-way granted to Burlington Northern to the east. The western site boundary is approximately 300 feet west of the soil storage buildings. Interstates 15 and 90 traverse the site in an east-west direction, and partition the site into northern and southern sections.

The plant initially included a pole-peeling machine, two butt treating vats, and related ancillary facilities. In April 1947, the first load of treated timbers was shipped off site.

Major modifications to the plant occurred between 1949 and 1951, and again around 1956. Sometime between 1949 and 1951, a 73-foot-long, 6-foot-diameter retort was installed to increase timber treatment production efficiency. A second retort, which was 66 feet long with a 7-foot diameter, was installed around 1956. The retorts were used both to dry green timber using the Boulton process, and to pressure-treat timber with a petroleum/pentachlorophenol (PCP or penta) mixture. Drying timber by the Boulton process generated steam which was condensed. The condensate was discharged to two hot wells where the condensate partially separated into an oil and a water phase. The water phase from the hot wells was reportedly discharged into an on-site unlined drainage ditch (which no longer exists) and flowed northward toward Silver Bow Creek.

The retorts and butt treatment vats were in continuous operation until May 1969. On May 5, 1969, an explosion occurred while a charge of poles was being treated in the east butt-treating vat. The explosion generated a fire destroying the east vat, boiler room, and retort building. Although the boiler, retorts, and auxiliary equipment were damaged, the plant was rebuilt and functional by December 1969. The west butt-treating vat was not destroyed by the fire and was thereafter used for some timber treatment and mixing the petroleum/PCP product used in the retorts. Petroleum/PCP product reportedly spilled from the east butt-treating vat as a result of the explosion and fire. Additional seepage of product occurred from both retorts as a result of broken pipes and valves damaged by the fire. On-site tanks were not ruptured as a result of the fire.

A small on-site sawmill was constructed in the fall of 1978 and was fully operational by the fall of 1979. Additionally, in response to implementation of the Resource Conservation and Recovery Act (RCRA), a closed-loop-process water system was constructed in 1980. The primary function of this system was to eliminate overland discharges of Boultonizing water (generated from the drying of green timber). The closed-loop water recovery system operated by collecting wastewater in storage tanks, recirculating this water through the condensing system, and evaporating excess water using aeration sprays.

On May 17, 1984, the MPTP ceased operations. With the exception of coal tar creosote used for a short period of time in 1969, the solution used to treat timber products from 1949 to 1984 consisted of 5 percent pentachlorophenol (PCP or penta) dissolved in 95 percent petroleum product (similar in characteristics and composition to diesel fuel).

In March 1983, a citizen complaint was filed with the DHES which indicated that an oily seep was discharging into Silver Bow Creek near the MPTP site [Ecology and Environment, Inc. (E&E), 1987]. The DHES responded on March 7, 1983, by collecting water samples from Silver Bow Creek upstream and downstream of the seep, in addition to sampling the seep itself. Results of the analyses indicated concentrations of PCP and oil and grease at the seep and downstream of the seep.

USEPA commenced an emergency removal action on July 10, 1985, with the U.S. Coast Guard. Removal action activities occurred during the 1985 and 1986 field seasons, and are discussed in Section 1.2.3 of the RI Report (Keystone, 1992e). Removal activities included excavation and on-site storage of soils, dismantling of equipment, interception of extracted groundwater contamination, recovery of portions of petroleum/PCP contaminants from the groundwater by physical separation, and reinjection of separator underflow in infiltration galleries. The groundwater recovery system was maintained and operated by DHES until February 1993.

In June 1992, the USEPA proposed an emergency response action to control and recover the light non-aqueous phase liquid (LNAPL) (floating product) found during the RI. The action included the installation of an 890-foot Gundwall (sheet piling) on the south side of Silver Bow Creek. The Gundwall is approximately 50 feet south of the creek. Ten recovery wells were installed on site. Eight of the wells are located south of Silver Bow Creek in a north/south line running perpendicular to the creek. Two wells were installed parallel to the creek; one on each end of the Gundwall. The wells are 12-inch casings and approximately 25 feet in depth. Each well has two pumps: one to collect free-floating product and pump the product to an on-site storage tank and the other to pump contaminated groundwater to an on-site granular activated carbon (GAC) treatment facility built by the USEPA. The water treatment facility went on-line January 22, 1993.

1.3 CLIMATE

The climate of Butte and the surrounding area is characterized by short, cool, dry summers and cold winters. Total annual precipitation measured at the Butte airport averages 11.7 inches. Records dating back to 1905 indicate that annual precipitation varies between 6.4 and 20.6 inches. May and June are generally the wettest months, during which approximately 35 percent of the total annual precipitation occurs. During an average year, over two-thirds of the precipitation falls between April and September. The net annual evaporation is estimated at 26 inches per year (NOAA, 1939-1987).

Based on records from 1951 to 1984, average annual temperatures measured at the Butte airport range between 34 and 42.6 degrees Fahrenheit (°F), with a mean of 38.9°F. The lowest recorded temperature was -55°F during 1933, and the highest was 100°F during July 1931. July and August are the warmest months with average temperatures above 60°F. January, with an average temperature of 15.5°F, is the coldest month. The normal frost-free period lasts approximately 60 days. However, freezing temperatures can occur at any time of the year. Temperatures of 0°F have been recorded as early as October and as late as April (NOAA, 1939-1987).

Climate in the higher elevations surrounding the MPTP site is alpine to subalpine, characterized by colder temperatures and heavier precipitation, often in the form of snow. Melting of the mountain snowpack, in spring and early summer, provides the majority of the surface water supply within the Butte area (MultiTech, 1987). Snow cover in the lower valleys usually melts during March to early April, with the mountain snowpack normally remaining through May into June.

1.4 SURFACE WATER HYDROLOGY/GENERAL TOPOGRAPHY

The general Butte area, including the MPTP site and the Silver Bow Creek Basin, is located within the Northern Rocky Mountains physiographic province (Fennemann, 1946). This area can be characterized as having deeply dissected mountain uplands with intermont basins. According to Botz (1969), the Silver Bow Creek Basin area can be further divided into two subdivisions. These are the relatively flat alluvial valley and the surrounding mountains.

The central valley of the Silver Bow Creek drainage basin is approximately 3.5 miles wide, 7 miles long, and occupies an area of approximately 23 square miles. The axis of the valley trends to the north, with a slope of 30 to 50 feet per mile (Botz, 1969). At the confluence of Silver Bow Creek and Blacktail Creek, the valley trend changes from northward to westward. The valley floor is at an approximate elevation of 5,400 feet mean sea level (msl) at the downstream border of the valley.

The Silver Bow Creek Basin is bounded to the east by a steep ridge, known as the East Ridge. This ridge exceeds 8,000 feet in altitude. The southern, northern, and western borders of the basin are also mountainous, with altitudes ranging from 6,000 to 8,000 feet msl.

The surface water runoff regime involves high snowmelt flows in April through early June and low flows during the late summer months of July and August. Average annual flow between 1984 and 1986 at USGS Station 12323170 (Silver Bow Creek above Blacktail Creek), was 0.09 cubic feet per second (cfs) with the maximum flow of 1.7 cfs in April 1985 and a minimum flow of zero cfs which occurred at least one day in all months of record. The drainage area for this gauge is 20 square miles. At USGS station 12323250 (Silver Bow Creek below Blacktail Creek), average annual flow over the 1984 to 1986 period of record was 24 cfs. A maximum flow of 100 cfs occurred in April 1985 and a minimum flow of 14 cfs occurred in August and September 1985. The drainage area for this gauge, including the Blackfoot and Missoula Gulch areas, is 125 square miles (CDM, 1989).

Groundwater measurements indicate that Silver Bow Creek, which is the northern boundary of the site, is a losing stream adjacent to the site (Keystone, 1992e). For June 27, 1990, the flow was 6.15 cfs and 4.8 cfs upstream and downstream, respectively. For the November 12, 1990 flow study, the flows were 12.6 cfs upstream and 9.07 cfs downstream.

There are other sources that significantly increase the flow downstream of the site between the downstream flow study location and the USGS station (#12323250). One such source is the discharge pipe for the publicly owned treatment works (POTW). For the June 27, 1990 flow study, the flows were 4.8 cfs and 21.2 cfs for the downstream and USGS station, respectively. Also, for the November 12, 1990 flow study, the flows were 9.07 cfs and 20.1 cfs for the downstream and USGS station, respectively.

The main drainage ditch on the site runs from Greenwood Avenue along the east of the site fenced area, then follows the elevated railroad grade to pass under the I-15/90 overpass. After a western turn through a concrete conduit and under a set of railroad tracks, the ditch continues north-northwest until it enters Silver Bow Creek, just to the western end of the slag wall along the creek. Various areas of potential surface water ponding and drainage have been observed on the site (Keystone, 1992e). Inside the excavated soils area, near the old treatment buildings, a large area of surface water ponding was created from previous emergency soils removal actions to contain the ditch runoff from that area. Three additional areas of potential ponding are found at various locations along the drainage ditch (Figure 1-4). Since the 1992 USEPA removal, MPTP site topography and drainage features have been altered. Figures and descriptions used in this FS report do not reflect the recent site changes by USEPA.

1.5 GEOLOGY

This section summarizes the regional geology and site-specific geology presented in the draft RI report (Keystone, 1992e).

1.5.1 Regional Geology

The Butte area is underlain by granitic rocks of the Boulder Batholith. These rocks are primarily quartz monzonite which have been intersected by aplite, pegmatite, granoaplite, breccia, and quartz porphyritic dikes and plugs (Miller, 1973). The granitic rocks are fractured and faulted, with resulting mineralization and alteration. A weathered zone is generally present in the upper 100 to 200 feet of the bedrock which, in mineralized zones, is underlain by a deep sulfide zone. This sulfide zone contains disseminated and vein deposits of copper and other metals within mineralized zones (Botz, 1969).

The depth to bedrock and nature of the bedrock surface is quite variable within the Silver Bow Creek valley area. Data from geophysical surveys conducted as part of the Phase II RI for the Silver Bow Creek - Area One Operable Unit suggests that the depth to bedrock decreases from greater than 200 feet east of Montana Street, to approximately 25 feet within the Colorado Tailings area (Chen-Northern and CH2M Hill, 1990). Several geophysical soundings within the immediate area northeast and north of the site (Butte Reduction Works) determined the depth to bedrock to be 60 and 40 feet, respectively. However, an additional sounding further north, within the Butte Reduction Works, determined that the bedrock was 30 feet in depth, showing a general constriction of the valley to the north.

Unconsolidated/alluvial sediments of Tertiary to Quaternary age are present in the valleys and drainages throughout the area, particularly along Silver Bow Creek and the drainages along the East Ridge. These deposits include valley fill, landslide debris, talus and fan gravels. The unconsolidated/alluvial deposits throughout the Silver Bow Creek drainage area are composed of discontinuous layers and lenses of sandy clay, clayey silty sand, and scattered sand and gravel (Botz, 1969). Published reports (Chen-Northern and CH2M Hill, 1990) suggest that valley fill and alluvial deposits range in thickness from over 300 feet near the Butte Civic Center area on the east, to less than 40 feet within the area of the Colorado Tailings. The Colorado Tailings area, located immediately northwest of the MPTP site, is within the area of the valley constriction. According to Dames & Moore (1990), the large range of accumulated thicknesses of unconsolidated deposits is thought to occur possibly as a result of:

- Downwarping of the bedrock in the eastern portion of the valley caused by a hinge line fault located west of the Colorado Tailings and east of the Rocker Fault. A hinge line fault would cause a gradual deepening of the bedrock to the east.

- Downdropping of the bedrock in the eastern portion of the valley caused by a normal fault. The upthrown block would be approximately in the area between the Rocker Fault and Montana Street.

1.5.2 Site Geology

A diversity of general soil types is present within the MPTP site area. Soils within the Butte area were developed primarily on upland slopes under conifer forests or on valley fill sediments under grassland vegetation. Soils within the site consist of thin, gravel-textured to thick, fine-grained alluvial soils. Along Silver Bow Creek, soils consist of a mixture of natural alluvial-derived soils and varying thicknesses of organic-rich peat. However, the soils within the immediate vicinity of the creek channel have been altered due to the various mining activities which have taken place over time. Mining-related wastes are generally fine-grained, sandy textured materials with higher metals and sulfide concentrations than natural soils in the vicinity of the site.

An overview of the site geology can be inferred from the various geological cross-sections presented in the RI. Geologic cross-section locations are shown on Figure 1-5. Cross-section A-A' portrays geologic conditions in a west to east direction (Figure 1-6), parallel to the orientation of Silver Bow Creek. Figure 1-7 shows the interpreted geologic conditions in a west to east direction, through the main wood treating operations. Figure 1-8 portrays the site geologic conditions in a general north to south direction, roughly parallel to the groundwater flow direction.

Based on the results from the borings and monitoring wells drilled at the site, two lithologic zones and two water-bearing zones (aquifers) have been identified beneath the MPTP site. These materials are described below.

Alluvial Deposits consist of upper and lower interbedded sands, sand and gravels, clays, and silts. The alluvial deposits vary in thickness from 11 feet in the southwest, 35 feet in the northern portion of the site (near Silver Bow Creek), and over 47 feet on the eastern portion of the site. The occurrence of clay lenses encountered during drilling correspond to low spots of the weathered bedrock surface, such that the topography of these clays resemble the weathered bedrock topography. The water table is found at approximate depths of 5 to 10 feet below ground surface (bgs).

In the alluvial deposits, the clay units grade laterally from silty to sandy clays and sandy to silty clays. The first clay unit encountered at each boring/monitoring well location, is generally a grey to light black sandy/silty clay and is inferred to be a semi-continuous unit across the study area, based on similar field descriptions. The other clay unit, which appears to be semi-continuous, is a greenish-brown to reddish-brown sandy/silty clay beneath the first; however, field observations suggest that this unit pinches out on the eastern portion of the site. In general, the sand, silt and gravel percentages within the subsurface vary vertically, with larger amounts of coarser sands and gravels near the weathered bedrock surface grading upward to higher percentages of finer grained sands and gravels near the ground surface.

Weathered Bedrock Deposits are described as an orangish-brown to whitish-gray grus; a friable medium to fine gravel sized, angular quartz and feldspar with abundant micas and a trace of hornblende in a slightly kaolinitic matrix.

Examination of field data gathered during the RI drilling program, as well as use of previous site data, suggests that the topography of the weathered bedrock surface varies significantly throughout the site (Figure 1-9). A local bedrock high is present in the southwestern portion of the site, near Greenwood Avenue, indicating intrusion by the Boulder Batholith. At soil boring location B-7, the weathered bedrock/bedrock contact was encountered at a depth of 11 feet below the ground surface, which corresponds to approximately 5,434 feet above msl. From this location, the bedrock surface appears to descend to the northeast at an average slope of 0.061 (unitless), until reaching the center half of the study area. The remaining bedrock surface on the northeast half of the site appears as a nearly horizontal plane with the lowest elevation at approximately 5,395 feet above msl.

1.6 HYDROGEOLOGY

This section summarizes the regional hydrogeology and site-specific hydrogeologic conditions discussed in the final RI report (ARCO, 1993).

1.6.1 Regional Hydrogeology

The City of Butte, as well as the surrounding land areas, lie within the Pacific Northwest Groundwater Region (Todd, 1983). Groundwater occurrence within the vicinity of Butte is generally associated with two water-bearing units: 1) the unconsolidated sediments associated with the Tertiary and Quaternary age valley fill deposits, and 2) the weathered and fractured bedrock deposits associated with the Boulder Batholith. According to published reports (Chen-Northern and CH2M Hill, 1990), the depth to water in the unconsolidated valley fill ranges from 2 to greater than 30 feet. Botz (1969) reported that well yields for the valley typically range from 3 gallons per minute (gpm) to over 30 gpm.

1.6.2 Site-Specific Hydrogeologic Conditions

Evaluation of hydrogeology for the MPTP site was developed primarily from installation of monitoring wells at varied depths across the site and from stratigraphic information obtained during the soil boring/well installation program. Water level measurements of monitoring wells provided data relative to the position of the potentiometric surface, water level fluctuations, and groundwater gradients across the site. Soil boring data were utilized to evaluate site hydrogeologic transmissive units and to characterize the lithology and geometry of the units.

The uppermost aquifer encountered at the site is composed of the Quaternary age alluvial valley fill sediments. Groundwater is present at the site under unconfined conditions, with depth to water measurements ranging from approximately 5 to 20 feet.

1.6.2.1 **Hydraulic Properties.** Groundwater elevation data collected during the RI from wells monitoring the alluvial aquifer system indicate that the direction of groundwater flow is generally towards the northwest. Monitoring wells penetrating the alluvial aquifer zone indicate a range in water levels from elevations of approximately 5,439 feet msl to 5,426 feet msl.

Contours of the potentiometric surface in the southeastern portion of the site show that the hydraulic gradient is approximately 0.003 ft/ft, while within the northwestern portion of the site it is approximately 0.007 ft/ft. The average hydraulic gradient across the entire site is approximately 0.005 ft/ft. These values are similar to those for the Lower Area One (LAO) (Chen-Northern and CH2M Hill, 1990).

In addition to the regional west to northwest groundwater flow direction, the presence of groundwater mounds in the vicinity of the southeast and south infiltration galleries alter the general flow patterns for the MPTP. To closely investigate the possibility of mounding, ARCO ~~installed a number of monitoring wells in the vicinity of the southeastern infiltration gallery.~~ Figure 1-11 presents a vertical cross section parallel to the overall site groundwater flow direction (southeast to northwest), through the wet well of the southeast infiltration gallery. The listed water level elevations are the average of hourly values measured over a four-day period including June 6, 1991. The input of water to shallow zones in the vicinity of the infiltration gallery is demonstrated by the water level elevation in the south wet well and in adjacent shallow observations wells. Similarly, the creation of significant downward gradients is indicated by the generally lower potentiometric elevations measured in observation wells completed in deeper strata.

While the mounding of groundwater associated with the southeast infiltration gallery is most conspicuous in the shallowest zones of the aquifer, comparison of water level elevations in wells GW25 and W16 indicates an "off-mound" gradient was created at a depth of 20 feet or more. Water input through the infiltration gallery would have moved downward and outward in response to prevailing horizontal and vertical gradients.

Three monitoring wells were screened totally within the lower, water-bearing, weathered bedrock zone. A detailed potentiometric surface map based on these three data points has been developed and is shown in Figure 1-12. The direction of groundwater flow in this deep water-bearing zone is to the north-northeast, similar to the shallow zone, and the gradient is approximately 0.004 ft/ft.

The results of vertical gradient measurement data collected as part of the November 1990 groundwater sampling event ranged from 0.007 ft/ft to 0.03 ft/ft. Groundwater elevation data from well nest M-7 and M-8 showed a downward vertical gradient of 0.002 ft/ft. Water level measurements at the well nest formed by wells GW-2 and GW-3, which monitor the base of the alluvial aquifer and the weathered bedrock, respectively, also showed a small downward, vertical hydraulic gradient.

An evaluation of vertical groundwater flow at the MPTP site in relation to the LAO Operable Unit was conducted using groundwater elevations for well nests BMW-1A/B, GS-17S/D, and GS-25/GS-25C. Groundwater elevation measurements were obtained from past reports. Each of these locations showed that wells within LAO were found to have a slight upward hydraulic gradient. Although these data were not collected at the same time as water levels at the MPTP site and were not collected from a single measurement episode, they do indicate that this is a regional groundwater discharge area. This evidence is supported by data gathered in the LAO investigation (Chen-Northern and CH2M Hill, 1990) which determined that Silver Bow Creek is a gaining stream within LAO.

In-situ rising and falling hydraulic conductivity tests (slug tests) were performed at 28 well locations across the site during the RI. Slug test data results provide information for the specific locations in which the tests are conducted. Slug test results do not provide information on the overall aquifer characteristics.

Horizontal hydraulic conductivities were determined for monitoring wells screened within the top of the alluvial aquifer, the base of the alluvial aquifer, and the weathered bedrock. Horizontal hydraulic conductivity for the site ranged from 3.8×10^{-5} cm/sec to 4.2×10^{-2} cm/sec. Average horizontal hydraulic conductivity values for the alluvial aquifer were calculated to be 5.7×10^{-3} cm/sec using the method of Bouwer and Rice (1976) for an unconfined aquifer condition. Because slug tests are subject to error due to factors such as screen blockage, entrained gas bubbles, and conduct seepage, the calculated conductivities are considered to be approximate. Slug test data results indicate that the central portion of the site exhibits higher hydraulic conductivities than surrounding areas of the site. The effective porosity is estimated to be 20 percent based upon an average total soil porosity of 32 percent. This value is typical for silt and sand (Driscoll, 1986).

1.6.2.2 Groundwater Movement. The hydraulic gradient across the site varies depending upon location and point in time. The average hydraulic gradient across the site is approximately 0.005 ft/ft, with average gradients of approximately 0.003 ft/ft and 0.007 ft/ft in the southern and northern halves of the site, respectively.

Using these data, the average interstitial groundwater velocity may be estimated. Using an average hydraulic conductivity of 12 feet/day and an average hydraulic gradient of 0.005 ft/ft, the average groundwater velocity across the site is estimated to be 0.3 ft/day (110 ft/year). The average groundwater velocity north of the interstate is estimated to be 0.42 ft/day (153 ft/year). The average groundwater velocity south of the interstate is estimated to be 0.18 ft/day (66 ft/year). Assuming a distance of 1,200 feet from the site of the plant process area to Silver Bow Creek, the corresponding groundwater flow travel time across the site is approximately 11 years. The actual rate of groundwater flow may be greater or less than these approximate ranges given the heterogeneity of the alluvial aquifer and assumptions implicit in this simplistic analysis.

1.7 VEGETATION

Vegetation in the Butte area has been characterized by Culwell (1977), ECON (1980), MERDI (1980), Montana Department of State Lands (1981), Hydrometrics (1983), and Keystone (1990). The bluebunch wheatgrass (Agropyron spicatum)/bluegrass (Poa spp.)/rubber rabbitbrush (Chrysothamnus nauseosus) plant community is most predominant and best describes the pre-disturbed vegetation for the Montana Pole and Treating Plant site. Other major plant species included in the community type are Idaho fescue (Festuca idahoensis), needle-and-thread (Stipa comata), prairie Junegrass (Koeleria cristata), western wheatgrass (Agropyron smithii), threadleaf sedge (Cares filifolia), and big sagebrush (Artemisia tridentata) (Veseth and Montagne 1980).

Vegetation along Silver Bow Creek and its tributary streams includes cottonwood (Populus deltoides), willow (Salix spp.), rushes (Juncus spp.) and cattails (Typha latifolia). Plant communities associated with Silver Bow Creek have been extensively affected by past urban and industrial activity. The major impact to the plant communities near the MPTP site has been industrial facility construction. Inspection of the floodplain boundary of the site indicates that an impact to plant communities may have been caused by deposition of metal-enriched materials covering the original alluvial soils. In areas with extensive deposition, vegetative cover is sparse with only intermittent areas supporting communities of inland salt grass (Distichlis stricta), scorpion plant (Phacelia hastata), and willows. Where the metal-enriched materials have eroded away (exposing original alluvial soil), willows, tufted hairgrass (Deschampsia caespitosa), and bentgrass (Agrostis spp.) have recolonized the substrate (Hydrometrics, 1983).

Additional disturbances to vegetation resulted from activities associated with the construction of the railroad and treatment plant facility buildings located on the site. A storage yard, previously used for stockpiling treated and untreated timbers, is an associated disturbance. Traffic and mechanical activities in the facility and storage yard areas eliminated the original vegetation and hindered natural regrowth. Surface soils within the plant area were unvegetated during most of the site's operations, exposing the soils to wind and water erosion.

1.8 LAND USE

The predominant land use in the vicinity of the site is heavy industry; however, residential neighborhoods are present immediately east of the site and approximately 1,000 feet west of the site. One residence, a single occupancy office building, and an auto repair shop are also present on the site. Mining-related wastes are found to the west and north of the Montana Pole site within the LAO. The former Butte Reduction Works is located directly north. The Montana Power Company's storage areas are located to the north and east of the site. A POTW is northwest of the site. A partially reclaimed gravel pit and a blasting and explosive powder company (LaVelle Powder) are located to the south of the site. An equipment maintenance company (Roberts Equipment) is located east of the site and a former oil refinery (Russel Oil Refinery) is located to the south of the site. A cemetery lies directly southeast of the site.

The MPTP is the only known industry associated with historical land use at the site. Land at the MPTP site is currently zoned M-1 and M-2 industrial. M-1 zoning allows for a caretaker residence for a business on the site. The existing home is a legal nonconforming use.

2.0 CONTAMINANT ASSESSMENT

A description of the nature and extent of the contamination at the MPTP site is presented in Section 2.1. The fate and transport of contamination, state and federal requirements, and a summary of the baseline risk assessment are discussed in Sections 2.2, 2.3, and 2.4, respectively.

2.1 NATURE AND EXTENT OF CONTAMINATION

This section of the report summarizes the nature and extent of contamination at the MPTP site as presented in the final RI report (ARCO, 1993). The USEPA has been performing removal action at the site since this data was collected. Therefore, the data presented in this section does not reflect current or future conditions at the site.

The discussions in this section are organized by media sampled at the site. These media include:

- Surface soils
- Subsurface soils
- Removed soils
- Groundwater
- Surface water and sediments
- Process equipment
- Miscellaneous oils and sampling sludges

Potential sources of contamination are spillage around the plant site (especially by the mixing tank), drippings from the treated wood, leaking pipelines used to transfer products, the drainage ditch that received process wastewater from the plant, the catchment area below the retorts (concrete sumps were not used), the water discharged from clarifying tanks, the mixing vat, or areas where condensate pooled during discharge (ARCO, 1993). Groundwater, soil, and surface water sampling locations are shown in Figures 2-1 and 2-2.

2.1.1 Surface Soils

Surface soils include those soils between a depth of 0 to 6 inches up to 0 to 2 feet bgs. The ranges and average concentrations of contaminants detected in the surface soils are presented in Table 2-1. Figure 2-3 outlines the areas with pentachlorophenol (PCP) concentrations greater than 15,000 μg/kg and total petroleum hydrocarbon (TPH) concentrations greater than 100 mg/kg. The volume of surface soils at PCP concentrations greater than 15 mg/kg is approximately 30,000 cubic yards.

2.1.1.1 Surface Water Drainage Soil Samples. Analyses of five soil samples (SL101B through SL105B) for PCP and TPH collected along the main ditch running from south to north were used to characterize the surface soils in the surface water drainage areas on the site. Concentrations of PCP along the length of the ditch ranged from 8,300 to 54,900 μg/kg. The highest concentration of PCP measured (54,900 μg/kg) was from a sample (SL101B) taken immediately north of the former retort building. TPH was only detected in the soil sample collected from the northwestern area at a concentration of 286 mg/kg.

2.1.1.2 Backhoe Test Pit Soils. Analysis of soil samples from 15 backhoe test pits within and around the area of the previous emergency soil removal activities for PCP and TPH were used to characterize the vertical extent of contamination. Only 11 of the pits had visible contamination and were sampled. For the surface soil samples collected from the test pits, PCP concentrations ranged from 3,100 to 743,000 μg/kg with the lowest concentrations found along the perimeter of the site. The surface soils (0 to 3 feet) analyzed for TPH indicated the presence of fuel oils #4 and #6. TPH concentrations ranged from 198 to 39,600 mg/kg.

2.1.1.3 Stained and Opportunistic Soil Samples. Seventeen surface soil samples were collected from areas displaying visual evidence of contamination. These samples had detected PCP concentrations ranging from 141 to 1,510,000 μg/kg. Of the TPH constituents, fuel oil #4 was found in nine of the 17 samples. The maximum concentration of TPH (71,500 mg/kg) was found at a location approximately 150 feet northeast of the former pole plant.

2.1.1.4 Surface Grids. Surface soil samples were collected about every 10 feet over the eastern and western treated wood storage yards in the southern portion of the site. These samples were analyzed for PCP and TPH. With the exception of four sampling locations, PCP concentrations within the western treated wood storage yard were below 1,000 μg/kg. The highest PCP concentration detected was 144,000 μg/kg in the soil sample collected northwest of the pole barns. This high concentration of PCP appears to be an isolated incident because soil samples collected around that sample had PCP concentrations less than 1,000 μg/kg. Concentrations of PCP in surface soil samples collected along Greenwood Avenue ranged from 1,190 to 22,400 μg/kg. Concentrations of PCP in three soil samples collected along the southern side of Greenwood Avenue (off site) ranged from below detection limits (less than 11 μg/kg) to 36.3 μg/kg.

PCP concentrations in most of the 28 surface soil samples collected throughout the eastern treated wood storage yard were less than 1,000 μg/kg. This indicates contamination resulting from dripping wood rather than distinct source areas. Surface soil samples collected from three areas had PCP concentrations greater than 1,000 μg/kg: the former wood treating process area; just south of the former pole plant; and approximately 800 feet east of the former pole plant along the Chicago, Milwaukee, St. Paul, and Pacific Railroad. The highest concentrations are within the former wood treating operations area where PCP concentrations ranged from 163 to 30,700 μg/kg.

One surface soil grid sample collected from the western treated wood storage yard had a TPH concentration of 1,370 mg/kg. This sample was characterized as fuel oil #6.

2.1.1.5 Near Surface Soil Borings. Surface soil samples (0- to 2-foot interval) were collected from soil borings. These surface soil samples were analyzed for PCP, PAHs, TPH, benzene, toluene, ethylbenzene, and xylene (BTEX), metals, and dioxins/furans. PCP concentrations in the near surface soil borings were found to exceed 10,000 μg/kg in the former process area and along the historic drainage ditch. The maximum PCP and TPH concentrations measured were 1,160,000 μg/kg and 55,600 μg/kg, respectively. The samples were taken in the northern portion of the site along the historic drainage ditch. Elevated TPH concentrations (greater than 10 mg/kg) in near surface soil borings were found in the former process area and north of interstates I 15/90. The maximum TPH concentration (9,130 mg/kg) was found within the former process area. The maximum BTEX concentration (2,400 μg/kg) was also measured in the former process area. Inorganic chemicals were detected in all of the surface soil samples. Arsenic concentrations ranged from 3,620 to 356,000 μg/kg. Cadmium concentrations ranged from 214 to 3,310 μg/kg. Chromium concentrations ranged from 4,640 to 15,000 μg/kg. Copper concentrations ranged from 23,800 to 1,140,000 μg/kg. Lead concentrations ranged from 6,620 to 264,000 μg/kg. Zinc concentrations ranged from 42,200 to 1,720,000 μg/kg. Near surface soil boring results indicate elevated concentrations of the contaminants of concern in the former process area and along the historic drainage ditch.

2.1.2 Subsurface Soils

Thirty-five subsurface soil samples were collected and analyzed for PCP, polycyclic aromatic hydrocarbons (PAHs), TPH, BTEX, and metals. Table 2-2 summarizes the range and average concentrations of PCP, TPH, PAH, and BTEX detected in the soil samples.

A total of 12 surface and subsurface soil samples were collected and analyzed for dioxins/furans. Total 2,3,7,8 - TCDD equivalent concentrations ranged from below detection limit to 16 ppb.

Metals were detected in subsurface soil samples throughout the site. The maximum arsenic concentration (220,000 μg/kg) was taken just south of Silver Bow Creek. The maximum cadmium concentration (3,270 μg/kg) was measured within the historic drainage ditch at the 18- to 28-foot interval (west of the pole barns). Elevated concentrations of chromium (22,700 μg/kg) and zinc (1,720,000 μg/kg) were detected. The maximum lead concentration (1,280,000 μg/kg) was measured in a sample collected just west of the historic drainage ditch. Concentrations of metals at the site, above naturally occurring background levels, are considered to be related to historic mining operations in the vicinity of the site rather than MPTP related activities. Figures 2-4 through 2-7 show the location and concentration of contaminants. The nature and extent of subsurface soil contamination is discussed for each of the four areas that make up the site: the former wood treatment process area, the eastern treated-wood storage yard, the western treated-wood storage yard, and the northern area.

2.1.2.1 Former Wood Treatment Process Area. Six subsurface soil borings and seven backhoe test pits were completed within the former process area of the site. The highest concentration of PCP in the former process area collected from either test pits or borings was 743,000 μg/kg in test pit SL212C. LNAPLs were observed during the subsurface investigation in the former process area. Similar trends were noted for total PAH and TPH. BTEX concentrations remained fairly constant with depth and ranged from 8,390 μg/kg at 6 to 8 feet to 1,862 μg/kg at a depth of 41 to 43 feet. Subsurface soil contamination concentrations in the former wood treatment process area is consistently greater than in any other area on the MPTP site.

2.1.2.2 Eastern Treated-Wood Storage Yard. A total of 10 subsurface soil borings were completed in the eastern treated-wood storage yard. PCP and PAHs were detected in only the surficial soil samples collected from this area. Petroleum hydrocarbons were not detected in any of the soil samples collected. BTEX was detected in samples collected from two soil borings which were located in close proximity to the former process area and near the southeast infiltration gallery. No obvious hot spots, represented by elevated concentrations of contaminants, were observed in the subsurface soils in the eastern treated-wood storage yard.

2.1.2.3 Western Treated-Wood Storage Yard. A total of 11 subsurface borings were completed in the western treated-wood storage yard. As was observed in the eastern treated-wood storage yard, PCP was detected in only the surficial soils located within the western area, with the exception of two locations in which concentrations ranged from less than 35 to 389 μg/kg. A subsurface soil sample collected within an area where a light oil component had been consistently measured in nearby monitoring well W-8 was found to have a detected PCP concentration of 2,290 μg/kg. This elevated concentration is believed to be indicative of the presence of a free oil layer at the water table surface. PCP concentrations measured in samples collected from the water table and above the weathered bedrock surface were all below detection limits.

TPH concentrations in the subsurface soil samples collected throughout the western treated-wood storage yard were all below detection limits. PAH concentrations ranged from below detection limits to 4,904 μg/kg at the subsurface boring location near monitoring well W-8. BTEX constituents were detected in four subsurface boring locations in the western treated-wood storage yard with concentrations ranging from 0.36 μg/kg to 742 μg/kg. Concentrations throughout the western treated-wood storage yard are fairly constant with the exception of elevated concentrations measured in the hot spot surrounding monitoring well W-8.

2.1.2.4 Northern Area. Elevated contaminant concentrations exist in subsurface soil samples taken along the historical drainage ditch which runs through the site in the northern area. A total of nine subsurface borings were completed in the northern area. Three of the sampling locations (A-2, A-4, and A-14) were located within the historical drainage ditch which ran through the site. PCP concentrations detected in the drainage ditch samples ranged from 976 to 96,000 μg/kg at 6 to 8 feet bgs, and below detection to 174 μg/kg at the top of the weathered bedrock (30 to 42 feet bgs). The highest PCP concentration detected in subsurface soil borings in the northern area is 300,000 μg/kg which was measured at a depth of about 8 feet bgs approximately 400 feet west of the north oil/water separator. The PCP concentrations detected are from those samples not removed from the drainage ditch during the EPA removal action. TPH concentrations were detected in six of the borings in the northern area ranging from 71.6 mg/kg to 55,600 mg/kg. PAH concentrations in each of the eight subsurface borings ranged from 3.5 μg/kg to 364,500 μg/kg at a depth of 2 to 6 feet bgs from a sampling location approximately 20 feet west of the north oil/water separator and within the historical drainage ditch. BTEX concentrations ranged from below the detection limit of 2 to 1,390 μg/kg. BTEX is present throughout the surface and subsurface soils and at the base of the alluvial deposits.

2.1.3 Removed Soils

As part of the 1985 USEPA emergency response actions, approximately 10,000 cubic yards (yd^3) of soil were removed, bagged, and stored in the five pole barns. Keystone characterized these soils by analyzing one bag of soil from each barn. Table 2-3 summarizes contaminant concentrations.

The soil samples were analyzed for PCP, TPH, PAHs, VOCs, BTEX, metals, and dioxins and furans. Results indicate that aromatic VOCs are not present in the bagged soils (detection limits vary from 2.1 to 7.0 μg/kg) except for chlorobenzene, which was detected at a concentration of 2.2 μg/kg. PCP concentrations in the bagged soils ranged from 116,000 μg/kg in the Building 2 sample to 1,450,000 μg/kg in the Building 5 sample. Bagged soils used in the treatability studies were found to contain PCP concentrations of approximately 18,000,000 μg/kg (Keystone, 1991a). PAH concentrations within the bagged soils ranged from 16,600 μg/kg in the Building 2 sample to 441,600 μg/kg in the Building 5 sample. Fuel oil #4 was the only TPH detected in the removed soil samples. TPH concentrations ranged from below detection to 23,600 mg/kg in the Building 3 sample. Total 2,3,7,8-TCDD equivalent concentrations measured in the removed soil samples ranged from 2.12 to 9.45 μg/kg.

Metals analyses were performed on one soil sample collected from Building 3 and a composite sample from all five pole barns. Toxicity Characteristics Leachate Procedure (TCLP) for extracted metals were less than the USEPA established TCLP regulatory limits of 5 mg/l for arsenic, 100 mg/l for barium, and 1 mg/l for cadmium. Total metals concentrations detected were 183 mg/kg for copper, 0.644 to 0.742 mg/kg for cadmium, and 194 mg/kg for zinc.

2.1.4 Groundwater Quality

Elevated contaminant concentrations have been detected in groundwater samples collected throughout the MPTP site. The estimated areal extent of groundwater contamination is 2,680,000 square feet. A total of 52 on-site monitoring wells, 16 off-site monitoring wells located within the LAO Operable Unit, and two off-site residential or irrigation supply wells (Mount Moriah Cemetery and Bontempo) were sampled to determine the extent of groundwater contamination. The groundwater samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), TPH, PAHs, dioxins/furans, metals, total organic carbon (TOC), and total dissolved solids (TDS). The average and range of concentrations of contaminants detected in the groundwater samples are listed in Table 2-4. Figures 2-8 through 2-15 indicate the locations of the elevated concentrations. To facilitate the description of the nature and extent of groundwater contamination, the site is split at I-15/90 into the northern and southern areas. A discussion of metals concentrations is included because of the relationship of the MPTP site with the LAO Operable Unit. A discussion of the LNAPL, which was detected in some of the groundwater samples, is presented at the end of this section because of its continuing affect on groundwater quality.

2.1.4.1 Volatile Organic Compounds. BTEX constituents (benzene, toluene, ethylbenzene, and xylenes) were analyzed during sampling rounds 1, 2, and 3. Approximate boundaries of the total BTEX concentrations greater than 5 μg/l are indicated on Figure 2-8. Analytical data are shown on Figure 2-9.

BTEX was detected in the majority of the groundwater samples collected from the shallow monitoring wells, and in each of the deeper wells which were located either at the base of the alluvial deposits or within the weathered bedrock. In general, those wells containing a LNAPL layer contained the highest concentration of BTEX. For example, well W-8 located immediately northwest and downgradient of the former process area, displayed the greatest total VOC concentration in groundwater: 1,300 μg/l. BTEX concentrations decreased with depth, as illustrated in the well nest located in the former process area, which measured 122 μg/l at 19 feet and below detection limits of 6.0 μg/l at 40.5 feet and 69.5 feet. BTEX was detected in only one well located off-site at a concentration of 0.39 μg/l approximately 1,400 feet northwest of the MPTP site.

2.1.4.2 Semivolatile Organic Compounds. Semivolatile compounds detected in the groundwater included 2-methylnaphthalene, 2-chloronaphthalene, 2-nitroaniline, dibenzofuran, bis(2-ethylhexyl)phthalate, and di-n-octyl phthalate. No pesticides, herbicides, or PCBs were detected in any groundwater samples. Acid extractable phenols, including PCP, were detected in groundwater samples. Each of the 12 phenol-based constituents are present in the groundwater system; however, PCP is the most dominant. PCP was detected in the majority of the shallow and deeper monitoring wells within the northern and southern portion of the site, and five of the LAO wells north and west of Silver Bow Creek. Figure 2-10 shows areas where PCP concentrations were greater than 10,000 μg/l, 1,000 μg/l, and 1.0 μg/l. Figure 2-11 shows PCP concentrations measured throughout the site. The two areas with concentrations greater than 10,000 μg/l are centered around wells in which LNAPL was detected. The northwestern boundary of the plume drawn in Figure 2-10 is based on a detected concentration of PCP of 4.37 μg/l in a sample collected during Round 2 from GS-22. PCP was not detected in GS-22 in sampling Round 3.

PCP concentrations decrease in a downgradient direction from the former pole treating area, with the exception of the previously mentioned well W-8. This well had the highest detected PCP concentration in groundwater of 880,000 μg/l, far in excess of the PCP saturation limit in water of approximately 14,000 μg/l at standard temperature and pressure. The presence of LNAPL in this well may be the result of a possible preferential flow path resulting from the historical drainage ditch or the presence of a source area.

Within the northern area, the highest concentrations of PCP were measured in the groundwater samples collected from the three drainage ditch wells. LNAPL has also been observed in these wells. Concentrations of PCP in these wells ranged from 2,960 to 106,000 μg/l at a depth of 30 feet. These elevated concentrations are characteristic of the drainage ditch only as concentrations in surrounding wells ranged from below detection (<1.0 μg/l) to 6,320 μg/l. In general, PCP concentrations in wells in the northwest portion of the site are an order of magnitude higher than the southern area with the exception of several hot spots in the southern area.

Off-site PCP concentrations ranged from below 1.0 μg/l to 21.1 μg/l at a location northwest of the site along Silver Bow Creek. PCP was not detected in the groundwater samples collected from the Mount Moriah Cemetery well composite and the Bontempo residential well which are upgradient from the MPTP site.

2.1.4.3 Polycyclic Aromatic Hydrocarbons. PAHs were detected in several of the monitoring wells at the site. PAHs can be divided into two categories: noncarcinogenic and potentially carcinogenic. Noncarcinogenic PAHs (nPAHs) include acenaphthene, acenaphthylene, anthracene, carbazole, pyrene, benzo(g,h,i)perylene, fluoranthene, fluorene, phenanthrene, and naphthalene. Potentially carcinogenic PAHs (cPAHs) include chrysene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-c,d)pyrene and dibenzo(k)fluoranthene. This section presents only total PAH values calculated by summing detected, individual PAH concentrations. Concentrations below detection limits were considered to be zero for calculation purposes. Total PAH concentrations and an approximate boundary of the total PAH concentrations greater than 1 μg/l are mapped on Figure 2-12. Analytical results are shown on Figure 2-13.

PAHs were detected in 19 of the 26 monitoring wells located in the southern portion of the site. The concentration of PAHs ranged from below detection limits (wells GW-3, GW-4, GW-7, GW-9, GW-10, GW-27, and W-16) to 3,668,000 μg/l (well W-8, Round 1). In addition, elevated concentrations were observed in wells W-13 (57,800 μg/l), W-15 (50,000 μg/l), and GW-1 (2,800 μg/l).

Within the northern area, wells having the highest detected PAH concentrations were located immediately north of the I-15/90 overpass. The occurrence of elevated PAH concentrations in groundwater coincides with monitoring wells which historically have or continue to show the presence of a distinct oil phase on the water table surface. These wells are W-2, W-4, W-5, W-6, M-4, and M-5. PAH concentrations within these six wells ranged from 2,100 μg/l (well W-6, Round 1) to 559,000 μg/l (well W-4, Round 1).

2.1.4.4 Total Petroleum Hydrocarbon. A hydrocarbon scan was used to determine if one or more hydrocarbon fractions exist in the groundwater. Results for the MPTP site indicate fuel oil #4 is the dominant hydrocarbon. The approximate extent of the TPH plume and hydrocarbon scan results are shown on Figure 2-14.

A maximum TPH concentration of 5,080 mg/l was detected in a groundwater sample collected in the southern area from a well in which floating product had been observed. TPH concentrations in samples collected from three wells downgradient of this well, ranged from less than 0.1 mg/l at a depth of 69.5 feet to 37.1 mg/l at a depth of 19 feet, suggesting TPH migration within the horizontal plane. Samples collected from the other monitoring wells in the south had TPH concentrations ranging from below detection limits to 911 mg/l.

In the northern area, the maximum TPH concentration of 4,250 mg/l was detected in a groundwater sample collected from a shallow well located along the historic drainage ditch. TPH concentrations throughout the rest of the northern area ranged from below the 0.2 mg/l detection limit (0.2 mg/l) to 639 mg/l (well W-4).

The maximum TPH concentration detected in LAO groundwater wells was 3.09 mg/l in offsite well GW-NE-2. Concentrations in additional off-site wells ranged from below detection limits to 0.359 mg/l (well GW-NE-1).

2.1.4.5 Dioxins/Furans. Groundwater samples were collected for dioxin/furan analysis from wells W-2 and W-11. Total 2,3,7,8-TCDD equivalent concentrations detected in the groundwater sample from W-2 was 0.013 μg/l and 0.053 μg/l from well W-11.

2.1.4.6 Metals. The presence of inorganics in groundwater is either naturally occurring or related to historic mining operations in the vicinity. The analytical results for dissolved metals are shown in Figure 2-15. Generally, wells located near Silver Bow Creek contain trace elements such as arsenic, cadmium, chromium, copper, lead, and zinc, which are likely the result of mining-related wastes. Arsenic concentrations detected in the shallow groundwater samples ranged from below 0.010 mg/l (majority of site wells) to 1.57 mg/l. The maximum concentration was detected in the groundwater sample collected approximately 1,500 feet northwest of the site. Cadmium was detected in two on-site wells in the northern area at concentrations of 0.0084 and 0.029 mg/l. Cadmium concentrations detected in off-site wells located northwest of the site ranged from 0.00599 to 0.232 mg/l. Using the target analyte list (TAL) testing method, chromium was not detected in on-site groundwater wells. Copper concentrations in the shallow groundwater ranged from below 0.025 mg/l to 34.6 mg/l. Generally, copper was detected only in the monitoring wells within the northern area. Off-site measurements ranged from below 0.025 mg/l to 21.9 mg/l northwest of the MPTP site. Lead was not present in any on-site monitoring wells using detection limits of 0.003 and 0.005 mg/l. However, subsequent analysis below the detection limit of 0.002 mg/l indicated the presence of lead at or slightly above the detection limit in three on-site wells: one in the former process area, another just north of I-15/90, and one along Silver Bow Creek. Zinc concentrations within the alluvial aquifer system were fairly consistent throughout the site ranging from below 0.020 mg/l to 11.6 mg/l. Off-site zinc concentrations ranged from below 0.020 mg/l to 75.2 mg/l. Elevated metals concentrations in groundwater were likely the result of mining operations in the area and not activities conducted at the MPTP site.

2.1.4.7 **Total Organic Carbon and Total Dissolved Solids.** Total dissolved solids concentrations ranged from 325 to 1,500 mg/l in groundwater samples collected from well 8. Total organic carbon concentrations ranged from 1.71 to 76.1 mg/l in groundwater samples collected in the northern area.

2.1.4.8 **Light Non-Aqueous Phase Liquid.** During the groundwater sampling program, water levels were measured at several monitoring well locations with an oil/water interface probe to determine the presence of distinct phases of hydrocarbon fluid. Light, non-aqueous phase liquid (LNAPL) was evident in eight of the 39 site monitoring wells measured. In all of the wells where non-aqueous phase liquids were detected, only a light oil (floating) phase was observed. A dense non-aqueous phase liquid (DNAPL) has not been measured historically, and evidence gathered during the RI did not indicate the existence of a DNAPL phase. Historically, LNAPL has been observed in several monitoring wells as well as at creek seeps. The LNAPL was found to contain wood-treating chemicals as well as petroleum hydrocarbons.

LNAPL thickness ranged from a sheen (wells W-2, GW-11, and GW-16) to 2.19 feet (well W-8). With the exception of well W-15, each of the wells where an oil layer was detected are located in the area extending from immediately south of the I-15/90 overpass to just south of the northern recovery trench. However, it should not be assumed that LNAPL is present on the water table throughout this area. A floating hydrocarbon layer has never been observed in several monitoring wells (wells W-3, W-6, M-6-87, M-7-87, M-8-87) within this area, while in other wells (W-2 and W-10), LNAPL has intermittently been observed. Monitoring well locations and measured product thickness are shown in Figure 2-16. The measurements presented in Figure 2-16 are "apparent thicknesses." An apparent thickness is not considered a true or actual hydrocarbon thickness within the soil formation. This apparent thickness is caused by inflow into the well over time and the subsequent accumulation of hydrocarbon fluids around the well screen. According to Kueper and McWhorter (1987), the difference between the apparent and true (formation) thickness is the result of the differences in capillary pressures and density of the fluids.

The estimated extent of the LNAPL plume is shown in Figure 2-16. The LNAPL contamination area is approximately 1,600 feet by 500 feet. The volume of LNAPL potentially present in the subsurface was calculated by assuming a weighted average LNAPL thickness based on the number of wells with similar thickness measurements and the approximate area of the plume represented by the well(s). The actual LNAPL thickness in the aquifer was assumed to be one-third the thickness measured in the well (Abdul, et al., 1989), and the porosity was assumed to be 0.3. Based on these assumptions, the estimated volume of LNAPL present in the subsurface is about 370,000 gallons. The estimated volume is considered an upperbound on the possible LNAPL present in the subsurface. The actual volume of LNAPL present could be substantially less because of the uncertainty associated with the estimated extent of LNAPL and average thickness. It is possible that the LNAPL flows preferentially within the subsurface.

2.1.5 Surface Water and Sediments

During the RI, surface water and sediment samples were collected from Silver Bow Creek located along the northern boundary of the MPTP site. These samples were collected near the seeps, upstream of the site, and immediately downstream of the site and were analyzed for PCP, PAH, TPH, and metals. An upstream sample was used as background, and a downstream sample was used to assess possible site related effects to Silver Bow Creek. In addition, surface water and sediment samples were collected beyond the Colorado Tailings approximately 4,400 feet downstream of the site. The sampling locations and analytical results for the surface water and sediment samples are shown on Figures 2-17 through 2-20. The average and range of concentrations of contaminants for surface water and sediments are listed in Tables 2-5 and 2-6.

2.1.5.1 Surface Water. PCP, PAH, and TPH concentrations detected in the surface water samples are shown in Figure 2-17. PCP concentrations ranged from below the detection limit (1.0 μg/l) to 591 μg/l at the seep located farthest downstream which has the largest influence on contaminant levels in the creek. The Round 2 PCP surface water data are considered to more accurately represent conditions in Silver Bow Creek in the area of the Montana Pole site, compared to Round 1 data. In essence, for Round 2, an elevated PCP concentration was found in stream surface waters at the site with a trend of diminishing concentrations with distance downstream. The source of this contamination is contaminated groundwater including LNAPLs which are migrating from the Montana Pole site to Silver Bow Creek. The extent of PCP contamination downstream of sampling location SW-004 has not been determined and will be investigated under the Streamside Tailings RI/FS.

PAH concentrations in surface water samples are below detection limits except for one sample collected from the seep located within the containment boom which had a maximum concentration of 49.53 μg/l.

Metals concentrations detected in the surface water samples are shown in Figure 2-18. Arsenic and lead displayed similar upstream and downstream surface water concentrations with the highest concentrations (0.0252 and 0.0303 mg/l, respectively) measured at the seep location. Zinc concentrations ranged from 0.262 to 1.12 mg/l at the farthest downstream location with concentrations increasing approximately two-fold throughout the site. Copper concentrations ranged from 0.0936 to 0.220 mg/l at the seep location. As discussed earlier, Silver Bow Creek has been impacted by historic mining and mineral processing activities in the area. Elevated metals concentrations are not a result of wood-treating operations.

TPH concentrations measured in the surface water samples collected in the seep area indicated the presence of fuel oil #6 at a concentration of 0.593 mg/l and fuel oil #4 at a concentration of 2.17 mg/l.

2.1.5.2 Sediments. PCP, PAH, and TPH concentrations detected in sediment samples are shown in Figure 2-19. PCP concentration in the background sample is below detection limits (<274 μg/kg). The PCP concentration detected in the seep sample is 673 μg/kg. PCP concentrations of 1,820 μg/kg and 333 μg/kg, were detected directly downstream of the seep and at the farthest downstream location, respectively. Fuel oil #4 was present in the sediments at the farthest downstream location at a concentration of 161 μg/kg.

Detected PAH concentrations in the sediment samples are highest immediately downstream of the seep location. The maximum concentration of 4,958.3 μg/kg was detected in a sediment sample (SD002) collected adjacent to an asphalt production and storage area located off-site.

Detected metals concentrations in the sediment samples are shown on Figure 2-20. Arsenic concentrations in the creek sediment samples ranged from 31 mg/kg at the farthest downstream sampling location to 842 mg/kg at the seep location. Copper and lead followed similar trends with the highest concentration at the seep and incrementally lower towards the downstream sampling location. Copper concentrations ranged from 656 mg/kg downstream of the source seep to 5,210 mg/kg at the seep. Lead concentrations ranged from 362 mg/kg immediately downstream of the seep to 714 mg/kg at the seep. Cadmium, chromium, and zinc displayed the same trend. Cadmium concentrations ranged from 4.44 mg/kg downstream of the seep to 21.9

mg/kg at the seep. Chromium concentrations ranged from 5.55 to 18.7 mg/kg and zinc concentrations ranged from 1,360 to 6,220 mg/kg.

2.1.6 Plant Process Equipment

Former plant process equipment and debris are stored on the premises at the MPTP site. During the RI, selected pieces of equipment were steam cleaned and then wiped over a 100 cm^2 area, These wipe samples were analyzed for PCP, PAHs, and dioxins/furans. Analytical results for the phenolics indicated that PCP was the most prevalent contaminant, ranging from 3.09 μg/wipe for a large pipe to 317 μg/wipe for a steel tank. PAH concentrations ranged from 16.46 μg/wipe for a nickel tank to 20.76 μg/wipe for a steel tank. Total 2,3,7,8-TCDD equivalent concentrations for a large pipe ranged from 4×10^{-5} to 0.00719 μg/wipe. HNu readings, which assess the presence of any VOCs, were at or very near background.

2.1.7 Miscellaneous Oils and Sludges

The following miscellaneous oils and sludges are stored on site: oil skimmed from groundwater recovery systems; waste oil; sludges from tanks, both treatment vats, and retorts; sludges from the KPEG treatability tests; and treated oil/sludge. The approximate volumes of each are presented in Table 2-7. The samples collected from the different oils and sludges were analyzed for VOCs, PCP, and PAH. Select samples were analyzed for total metals, TCLP metals, TCLP semi-volatiles, TCLP pesticides/herbicides, and dioxins. The range of chemical concentrations for each media are presented in Table 2-8.

High concentrations of BTEX, PCP, PAH, and lead were detected in the separator oils. Pesticides and congeners of dioxins and furans were also detected but at relatively low concentrations. Barium was detected in the separator oil TCLP extract but at concentrations less than the regulatory limits for hazardous waste designations established by the USEPA (40 CFR 261). Only one herbicide (2,4-TP) and two SVOCs (2,4,6-trichlorophenol and pentachlorophenol) were detected above their respective detection limits.

High concentrations of PAH, lead, and low concentrations of BTEX were detected in KPEG-treated oils. Cogeners of dioxins and furans were all below detection limits. Concentrations of metals, herbicides, and SVOCs in the TCLP extract were all below detection limits, except for barium, detected at 251 μg/l in the TCLP extract of KPEG-treated oil sample.

High concentrations of BTEX and PAH were detected in KPEG reagent sludge samples. A total metals analysis indicated a detected cadmium concentration of 14 mg/kg in the KPEG reagent sludge. Concentrations of metals, herbicides, and SVOCs in the TCLP extract were below detection limits.

Miscellaneous sludge samples had high detected concentrations of PCP and cogeners of dioxins and furans; and low detected concentrations of PAH and BTEX. Barium was detected in the miscellaneous sludge TCLP extract but at concentrations less than the regulatory limits for hazardous waste designations. Concentrations of herbicides and SVOCs in the TCLP extract were below detection limits.

The miscellaneous liquid samples had high detected concentrations of PCP, PAH, BTEX, cogeners of dioxins and furans, and zinc. Concentrations of metals, herbicides, and SVOCs in the TCLP extract were below detection limits.

Miscellaneous liquid mixed with sludge samples had high detected concentrations of PCP, PAH, BTEX, and low concentrations of cogeners of dioxins and furans. Concentrations of metals, herbicides, and SVOCs in the TCLP extract were below detection limits.

2.1.8 Summary of Nature and Extent of Contamination

Seven different media were sampled during the RI for the MPTP site. These media include: soils (surface, subsurface, and removed), groundwater, surface water, sediments, process equipment, miscellaneous oils, and miscellaneous sludges. The samples were typically analyzed for PCP, PAHs, TPH, VOCs, dioxins/furans, and metals. The removed soils and miscellaneous oils and sludges were also analyzed using the TCLP method for metals and organics.

Elevated levels of PCP, PAHs, TPH, and dioxins were detected in the surface and subsurface soil samples collected from the plant process area and the historical drainage ditch. The maximum concentrations of PCP, TPH, and dioxins detected in the surface soil samples were 1,510,000 μg/kg, 71,500 mg/kg, and 8.18 μg/kg, respectively. The maximum concentrations of PCP, PAH, TPH, and dioxins detected in the subsurface soil samples were 1,160,000 μg/kg, 2,304,320 μg/kg, 55,600 mg/kg, and 11.36 μg/kg, respectively. Elevated levels of PCP and PAH were generally found to depths of 8 feet in the northern portion of the site and to depths greater than 15 feet in the southern portion of the site. PCP, PAH, and TPH were detected in surface soil samples collected from the former eastern and western wood storage yards at relatively low concentrations. PCP, PAH, and TPH were not detected in subsurface soil samples collected in the wood storage yards. The maximum concentrations of PCP, PAH, TPH, and dioxins detected in the bagged soils were similar to the concentrations detected in the surface and subsurface soils.

PCP in the groundwater is fairly widespread throughout the site (Figure 2-10). The TPH plume is less widespread than the PCP plume and is generally located beneath the plant process area and the historical drainage ditch. LNAPL was detected in eight of the 39 wells sampled. The maximum LNAPL thickness (2.2 feet) was measured in well W-8 which is located north of the pole barns.

PCP, PAH, and TPH were detected in the surface water and sediment samples collected near the seeps. The maximum concentration of PCP detected in the surface water samples (591 μg/l) was from the sample collected near the farthest seep. The maximum concentration of PCP detected in the sediment samples (1,820 μg/kg) was from the sample collected immediately downstream of the farthest seep.

Minimal wipe sampling was performed on the process equipment. The maximum concentrations of PCP, PAH, and 2,3,7,8-TCDD detected on the wipe samples (100 cm^2) were 317 μg/wipe, 10.76 μg/wipe, and 7.19 ng/wipe.

Approximately 26,000 gallons of oils and sludges are stored on site including oil recovered from

Approximately 26,000 gallons of oils and sludges are stored on site including oil recovered from the oil/water separator, oils treated by the KPEG process, reagent sludge from the KPEG processing operation, and miscellaneous oils and sludges presumably collected from various tanks used in the wood preserving operations. Elevated concentrations of PAHs, and VOCs were detected in all the oil and sludge samples. Elevated concentrations of PCP were detected in all but the KPEG treated oils and reagent sludge samples (Table 2-8). Low levels of 2,3,7,8-TCDD were detected in all but the KPEG treated oils and reagent sludge samples.

2.2 CONTAMINANT FATE AND TRANSPORT

This section summarizes the environmental fate and transport of the primary compounds of concern (PCP, PAHs, dioxins, and furans) at the MPTP site. Metals (i.e., arsenic, cadmium, chromium, copper, lead, and zinc) detected in soil and groundwater at the site are believed to be related to naturally occurring or from off-site sources and not due to any activities at the site. Therefore, the fate and transport of metals is not included in this discussion.

The conceptual model of contaminant fate and transport, developed in the final RI report, provides an overview of the site and describes the relationship between source areas, migration pathways, and potential receptors (ARCO, 1993). In summary, PCP, PAHs, dioxins, and furans at the MPTP site have entered the environment from several source areas by spillage, leaks, or infiltration and have migrated via various transport pathways (e.g., advective flow with the groundwater). Section 2.2.1 summarizes the major source areas at the MPTP site. Section 2.2.2 presents the primary migration pathways for contamination to migrate into and through the subsurface. A detailed discussion of the chemical and biological processes and an estimate of the rates of migration of different contaminants in the subsurface are presented in the final RI report (ARCO, 1993) and are not repeated here.

2.2.1 Major Sources of Contamination from Historical MPTP Operations

Based on historical information about former MPTP operations and data gathered during the RI, the major sources of contamination from historic MPTP operations are discussed below and include:

- Plant process area;
- Wastewater discharge ditch including the former waste sedimentation pond; and
- LNAPL plume.

2.2.1.1 Plant Process Area. Two retorts and two butt treatment vats were located within the plant process area, and spillage of product from these facilities during MPTP operations has been reported (see Section 1.2). Surface and subsurface soil samples from the plant process area indicate the presence of high concentrations of PCP and PAH compounds (Sections 2.1.1 and 2.1.2). Some of the soils in this area are saturated with wood-treating chemicals and carrier oils. In addition, PCP levels greater than 10,000 μg/l have been detected in groundwater beneath this area of the site, and an LNAPL layer is present on the water table.

2.2.1.2 Wastewater Discharge Ditch Area. Wastewater from the wood-treating process was discharged into on-site sedimentation pond(s) and an on-site drainage ditch. PCP mixed with petroleum (PCP/oil) was used to treat timber during the time these discharges occurred. A sedimentation pond is visible on the USEPA Environmental Monitoring Systems Laboratory Las Vegas (EMSL) aerial photograph, August 1983, as located on Figure 1-3. Evidence of the sedimentation pond no longer exists and may have been obscured by the 1985 USEPA removal actions (see Section 1.0) or other previous site activities.

The drainage ditch flow northward through the site toward Silver Bow Creek Soil was excavated from portions of the ditch area to a depth of up to 6 feet as part of USEPA's 1985 actions. Sampling conducted during the RI (Section 2.1) indicates that soils and groundwater beneath the drainage ditch are heavily contaminated throughout its length. Depth to groundwater varies along the length of the drainage ditch. Groundwater is at about 20 feet bgs near Greenwood

Avenue; about 8 feet bgs beneath the interstate; and at about 2 to 4 feet bgs near Silver Bow Creek.

2.2.1.3 LNAPL Plume. As presented in Section 2.1.4.8, an LNAPL plume consisting of PCP dissolved in petroleum carrier oils, extends from the process area to Silver Bow Creek. The LNAPL is a result of former MPTP waste disposal practices and spillage of wood-treating chemicals. LNAPL is discharging to Silver Bow Creek at several seep locations, and chemicals of concern are dissolving into groundwater from the NAPL plume.

2.2.2 Transport Pathways

Chemicals in one environmental medium may contribute to the presence of chemicals in other media through transport pathways. Chemicals present in surface soil may enter air, surface water, and groundwater. Chemicals in subsurface soil, depending upon the proximity of the water table, may impact groundwater. Chemicals in surface water and groundwater may in turn influence water quality in adjacent surface waters (e.g., stormwater run-off may affect an adjacent stream). Finally, substances of concern partition between water and sediments in surface water, between surface soil and surface water, and between groundwater and subsurface soils. The following transport pathways may have contributed to the transport of substances of concern from and at the MPTP site.

2.2.2.1 Infiltration. Infiltration of rainwater may carry soluble substances from surface or shallow soil into groundwater. Additionally, under the force of gravity, NAPLs such as PCP/oil will move downward through the soil column. Leaks and spills of product, and discharge of wastewater into the former drainage ditch and sedimentation pond contributed to the movement of organic chemicals through subsurface soils to groundwater.

2.2.2.2 Groundwater Transport. Groundwater flow contributes to the movement of both dissolved and nonaqueous-phase materials. These materials may migrate via groundwater movement. Nonaqueous and dissolved-phase materials entering the groundwater system can be transported downgradient to points of discharge (e.g., seeps into Silver Bow Creek).

2.2.2.3 **Surface Water Transport.** Storm water may carry substances of concern in the form of suspended particles, dissolved chemicals, or LNAPL. During heavy precipitation events, storm water may potentially reach Silver Bow Creek as overland flow or through a drainage ditch which is present along the eastern edge of the site.

Upon entering the surface water, dissolved substances may associate with sediment particles or remain in a dissolved phase. Chemical-containing soil particles may become a part of the sediment load of the stream and travel downstream, as will dissolved substances in surface water.

2.2.2.4 **Air Transport.** Wind transport of substances of concern associated with soil particles may occur in a localized area around the site. This process is expected to occur primarily in summer months.

2.2.3 LNAPL Recovery and Separated Water Infiltration Systems

USEPA commenced an emergency removal action on July 10, 1985, with the U.S. Coast Guard. Removal action activities occurred during the 1985 and 1986 field seasons, and are discussed in Section 1.2.3 of the RI Report (Keystone, 1992e). Removal activities included excavation and on-site storage of soils, dismantling of equipment, interception of extracted groundwater contamination, recovery of portions of petroleum/PCP contaminants from the groundwater by physical separation, and reinjection of separator underflow in infiltration galleries. Reinjecting separator underflow may have contributed to the total loading of dissolved contaminants in the groundwater which may discharge to Silver Bow Creek or migrate to the north beneath the creek. The groundwater recovery system was maintained and operated by DHES until February 1993.

In June 1992, the USEPA proposed an emergency response action to control and recover the light non-aqueous phase liquid (LNAPL) (floating product) found during the RI. The action included the installation of an 890-foot Gundwall (sheet piling) on the south side of Silver Bow Creek. The Gundwall is approximately 50 feet south of the creek. Ten recovery wells were installed on site. Eight of the wells are located south of Silver Bow Creek in a north/south line running perpendicular to the creek. Two wells were installed parallel to the creek; one on each end of the Gundwall. The wells are 12-inch casings and approximately 25 feet in depth. Each well has two pumps: one to collect free-floating product and pump the product to an on-site storage tank and the other to pump contaminated groundwater to an on-site granular activated carbon (GAC) treatment facility built by the USEPA. The water treatment facility went on-line January 22, 1993.

2.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) are environmental and public health statutes used to determine the appropriate extent of site clean-up and to develop remedial action alternatives at Superfund sites. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan (NCP), all set requirements for compliance with federal ARARs. SARA also requires attainment of state ARARs if they are more stringent than federal ARARs, legally enforceable, and consistently enforced statewide.

An ARAR may be either "applicable" or "relevant and appropriate," but not both. According to the NCP (40 CFR 300), "applicable" and "relevant and appropriate" are defined as follows:

> Applicable requirements are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by

a state in a timely manner and that are more stringent than federal requirements may be applicable.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

Non-promulgated advisories and guidance issued by state or federal government programs may represent "to be considered" (TBC) criteria or guidelines in the RI/FS process. Although TBC requirements are not legally binding, they may be evaluated along with ARARs to establish protective cleanup levels.

For portions of the remedial action that are performed on site, only the substantive portions of the requirements are considered ARARs. For any portions of the remedial action performed off-site (e.g., discharge to a publicly owned treatment works located off-site), both substantive and administrative requirements must be met.

Section 121(d)(4) of CERCLA, as amended by SARA, allows the following six waivers to attaining ARARs:

- The remedial action selected is only part of a total remedial action that will attain the ARAR when completed.
- Compliance with the ARAR will result in greater risk to human health and the environment than alternative options.
- Compliance with the ARAR is technically impracticable from an engineering perspective.
- The remedial action selected will attain a standard of performance that is equivalent to the ARAR through use of another method or approach.

- With respect to a state ARAR, the state has not consistently applied or demonstrated the intention to consistently apply the standard, requirement, criteria, or limitation in similar circumstances at other remedial action sites within the state.

- In the case of a remedial action to be undertaken solely under 42 USC § 9604 using the federal Superfund, selection of a remedial action that attains the ARAR will not provide a balance between the need for protection of public health and welfare and the environment at the facility with the availability of amounts from the Fund to respond to other sites which present or may present a threat to public health or welfare or the environment.

The Montana DHES, in consultation with the USEPA, prepared a list and description of the ARARs for the Montana Pole site. That document is included in Appendix A of this report. This section discusses some of the ARARs used specifically for developing remedial alternatives.

2.3.1 Safe Drinking Water Act

DHES has concluded that the National Primary and Secondary Drinking Water Standards, better known as "maximum contaminant levels" (MCLs), are not legally applicable to the remedial action at the site, but are relevant and appropriate. DHES stated that the groundwater in the area is a potential source of drinking water, and the aquifer feeds Silver Bow Creek, which is designated as a potential drinking water source. In addition, DHES concluded that the non-zero maximum contaminant level goals (MCLGs) are relevant and appropriate and that proposed MCLs that are not yet promulgated are to be considered (TBC) in developing remedial action goals. Table 2-9 lists the MCLs, MCLGs, and proposed MCLs identified by DHES for selected contaminants at the MPTP site.

2.3.2 Surface Water Quality Standards

The State of Montana has promulgated regulations to preserve and protect the quality of surface waters in the state under the state Water Quality Act. These regulations classify state waters, place restrictions on the discharge of pollutants, and prohibit the degradation of state waters. Silver Bow Creek is classified "I" for water use. The stated goal for I classification surface water is to support the following uses: drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply (ARM 16.20.623). Silver Bow Creek presently does not support a sustainable fishery.

The I classification standards limit discharges of toxic or deleterious substances from new point sources to the larger of either Gold Book levels or one-half the mean instream concentrations immediately upstream of the discharge point with the goal of ultimately attaining the Gold Book levels. Surface water quality standards identified by USEPA are summarized in Table 2-10 for selected inorganic compounds. DHES considers MCLs as ARARs for the organic compounds. Additional restrictions on discharges to surface waters require that industrial waste must receive, as a minimum, treatment equivalent to the best practicable control technology currently available (ARM 16.20.631). Other standards for the I classification are described in the ARARs document prepared by DHES (Appendix A).

2.3.3 Resource Conservation and Recovery Act (RCRA)

DHES concluded that certain RCRA Subtitle C requirements for the treatment, storage, or disposal of hazardous wastes are applicable at CERCLA sites if a combination of the following requirements are met: a) the waste is listed or characteristic waste under RCRA and b) either (1) the waste was treated, stored, or disposed of after the effective date of the RCRA requirements (November 8, 1980), or (2) the activity at the CERCLA site constitutes treatment, storage or disposal as defined under RCRA.

2.3.3.1 Waste Classifications. Currently, USEPA designates wastes as hazardous in one of two ways. If the waste is ignitable, corrosive, reactive, or toxic, it is classified as a characteristic hazardous waste. If the waste is generated by a specific process and contains significant levels of toxic or carcinogenic constituents, manifests one or more of the hazardous waste characteristics, or has the potential to exert specific detrimental effects on the environment, then the waste can be designated as hazardous by "listing." As of December 1990, wastewaters, process residuals, preservative drippage, and spent formulations resulting from wood preserving processes are listed RCRA wastes under the classification FO32 and FO34 (50 FR 50450). This classification specifically applies to the oils and sludges stored at the site and any of the oil recovered during remedial actions.

In addition to the classification of hazardous wastes, RCRA has promulgated three additional rules known as the "mixture," "derived from," and "contained-in" rules. These rules state that any material that is a mixture of a solid waste and a listed waste; or has been generated from treatment, storage, or disposal of a listed waste; or contains a listed waste is regulated under Subtitle C of RCRA. Based on the "contained in" rules, DHES has determined that soils, as well as equipment and debris, which are contaminated with the wood preserving process residuals or spent formulations are subject to management as RCRA listed F032 or F034 hazardous wastes.

2.3.3.2 Land Disposal Restrictions. Land disposal restrictions (LDRs) are typically concentration levels or treatment standards that RCRA hazardous wastes must meet before they can be land disposed. LDRs are considered relevant and appropriate at CERCLA sites where the contaminated waste is "placed." Placement occurs when hazardous waste is land disposed into a land-based unit. Placement does not occur if hazardous wastes are consolidated within an area of contamination, treated in situ, or when it is left in place (55 FR 8758). Once the waste has been removed from the area of contamination, it must meet LDRs before it can be land disposed (e.g., backfilled or placed in an off-site landfill).

Another criterion for the applicability of LDRs is whether the hazardous waste is restricted from land disposal at the time of placement. LDR treatment standards have not been finalized for FO32 and FO34 wastes (57 FR 37196).

DHES has determined, as stated in the ARARs document prepared for the MPTP site, that a treatability variance can be obtained for the contaminated soils and debris at the MPTP site to allow such materials to be land disposed. However, because there are currently no promulgated treatment standards for FO32 and FO34 waste, a variance is not required for remedial actions which may constitute land disposal.

Recently, USEPA promulgated LDRs for certain newly listed wastes and hazardous debris (57-FR 37196). The rules states that debris contaminated with a listed hazardous waste for which treatment standards have been promulgated would no longer be prohibited from land disposal if it is treated with a specified destruction or extraction technology and does not exhibit any characteristic of hazardous waste. The USEPA would consider the treated debris to no longer be or contain a hazardous waste. Such treated debris could be disposed in a Subtitle D facility. In the absence of treatment standards for debris contaminated with a newly listed waste, such equipment and debris may be land disposed without further treatment. Furthermore, codification of the contained in principle for contaminated debris at 40 CFR 261.3 provides for a case by case determination by USEPA, made upon request, that debris does not contain hazardous waste at significant levels, and would not be subject to Subtitle C regulation (57 FR 37226).

2.4 BASELINE RISK ASSESSMENT

This section summarizes the baseline risk assessment (BRA) as prepared by Camp, Dresser, & McKee, Inc. (CDM) for Montana DHES. The objective of the BRA was to identify and quantify the potential public health and environmental risks that may be posed via exposure to site related compounds.

The approach for the human health risk assessment performed by CDM follows federal guidance for Superfund Sites (USEPA, 1989a) and was comprised of the following steps:

- evaluating available data
- identifying chemicals of concern for quantitative analysis
- developing exposure scenarios
- developing exposure point concentrations
- assessing toxicity
- estimating carcinogenic and noncarcinogenic health risks
- developing an uncertainty analysis

The ecological assessment utilized similar methodology and was also performed in accordance with USEPA guidance for Superfund Sites (USEPA, 1989b).

Only the exposure assessment and risk characterization for both the human health and ecological assessments are summarized in this FS.

Table 2-11 lists the chemicals of concern (COCs) for human health identified by CDM for this site. Elevated metals concentrations are present at the site, particularly near Silver Bow Creek. The elevated metals concentrations are considered to be due to historical mining and ore processing activities in Butte, rather than from wood treating operations at the MPTP site. Associated risks from metal were evaluated in the BRA because these constituents are present on the site and will need to be considered during remedial activities. The likely sources of inorganic substances will also need to be considered in evaluating remedial options for the MPTP site.

2.4.1 Exposure Assessment

The exposure assessment addressed the potential pathways by which human and environmental receptors could be exposed to contaminants at, or originating from, the Montana Pole site. In identifying potential pathways of exposure, both current and future land use of the site and surrounding study area were considered by CDM. The site has historically been used for industrial purposes and is currently zoned industrial.

2.4.1.1 Current Land Use Conditions. The Montana Pole site includes several abandoned buildings and six pole barns in which contaminated soils and dismantled equipment are stored. Some portions of the site are currently restricted from public access. A fenced area is located south of the interstate and east of the pole barns. This area cannot easily be accessed by trespassers or other unauthorized individuals. Silver Bow Creek is the northern boundary ~~of the Montana Pole site. It was reported by CDM (1993) that the creek is frequently used for~~

recreational purposes. The site is mostly open space with loose sand, gravel, and small brush occupying much of the land.

One residence is located at the south-eastern corner of the site and is occupied by the previous owner/operator of the MPTP. There is also an autobody shop on site with one to two workers and an architect's office with one employee.

The majority of the Montana Pole site is zoned M-2 (heavy industrial) with the remainder zoned M-1 (light industrial). A detailed discussion of zoning is provided in Section 4.1.

Three human populations were considered by CDM (1993) to have potential for current exposure. These are:

- Trespassers that use the site for recreational purposes,
- Residents that live downwind of the site and who may be exposed to contaminants present in dust and air, and
- On-site workers (non-remedial).

Current land use exposure pathways that were considered include:

- Dermal absorption and incidental ingestion of surface water and sediments by trespassers and on-site workers, and
- Dermal absorption and incidental ingestion of surface soils by trespassers and on-site workers.
- Inhalation of dust and air by downwind residents and trespassers

As discussed in the BRA, screening calculations demonstrated that inhalation of contaminants by trespassers, residents located downwind (east or west) of the site, and on-site workers will not be a significant pathway of exposure. As a result, risks for this pathway were not quantified in the baseline risk assessment for any exposure scenario. Current exposures via groundwater were also eliminated from consideration in current exposure scenarios because this exposure pathway is not currently a complete exposure pathway. In addition, potential risks to the current on-site resident are assumed to be accounted for by the future on-site residential scenario. Similarly, exposures of current onsite workers are assumed to be negligible compared to exposure of theoretical future onsite workers. Thus, quantitative risk estimates for these current exposure scenarios were not developed separately in the baseline risk assessment.

2.4.1.2 Future Land Use Conditions. Possible future land uses of the study area were also considered by CDM in the BRA. Although future residential land use may be unlikely, residential development was considered in the baseline risk assessment. Institutional controls which may influence future land use at the site are discussed in Section 4.1. Receptor populations considered by CDM (1993) for future land use are: future on-site industrial workers and future on-site residents.

A summary of future land use exposure pathways considered in the baseline risk assessment is:

- Dermal absorption and incidental ingestion of surface soil by future workers and future on-site residents.
- Dermal absorption and incidental ingestion of surface water and sediments by future on-site residents.
- Ingestion of homegrown produce by future on-site residents.
- Ingestion of groundwater by future on-site residents.
- Inhalation of dust and air by downwind residents and trespassers.

As noted above, exposure via inhalation was not quantified at this site because this pathway was determined to be an insignificant contributor to the total exposure scenario. Exposure via surface water and sediment were not quantified for future on-site workers because these pathways were also determined to be negligible contributors to the total exposure scenario. Similarly, exposure of future residents to surface water and sediment was not quantified separately from exposure to these media calculated for the current trespasser scenario.

Groundwater is not currently being used at the site, however, future residential use of groundwater was considered in the BRA. For future residential use of groundwater only the ingestion route was considered by CDM. Because it is expected that exposure to contaminants of concern via showering, bathing, and dishwashing would be small (less than 30 percent of exposure via ingestion of groundwater), these pathways were not quantitatively evaluated. Quantitative exposure estimates were not calculated for future worker ingestion of groundwater because the calculations based on a residential exposure scenario were judged to provide the most conservative estimate of groundwater exposures. The City of Butte has recently enacted a well ban that prohibits wells from being used as potable supply. The well ban decreases the likelihood that contaminated groundwater would be ingested and is discussed further in Section 4.1.

For current exposure scenarios, quantitative risk estimates were developed for dermal absorption and incidental ingestion of surface water, sediments, and soils by trespassers. For future exposure scenarios, quantitative risk estimates were provided for dermal absorption and incidental ingestion of soil by future on-site workers and for dermal absorption and incidental ingestion of soil and ingestion of groundwater and homegrown produce by future residents. Exposure assumptions used in dose calculations are generally standard USEPA default parameters.

2.4.2 Risk Characterization

Potential adverse health effects considered by CDM were carcinogenic potential and chronic systemic toxicity. Toxicological profiles were provided for each compound of concern. Published slope factors and reference doses (RfDs) were used in risk calculations.

Exposure dose combined with toxicity values were used by CDM to characterize potential risk from site-related compounds. Both cancer and non-cancer risks were evaluated for the reasonable maximum exposure (RME) case. Risks across pathways were summed to provide a total estimate of risks for the site. The USEPA considers an excess cancer risk less than 10^{-6}

and a hazard index less than 1.0 to be the starting point for risk management decisions. An excess cancer risk between 10^{-4} and 10^{-6} may be acceptable depending on site-specific considerations as evaluated by the regulatory authorities. The USEPA generally considers an excess cancer risk greater than 10^{-4} or a hazard index greater than 1.0 to be unacceptable.

2.4.2.1 Risks Under Current Land Use, by Scenario.

On-site Trespassers. A summary of the total risks to current on-site trespassers is presented in Table 2-12. The total cancer risk to trespassers at the site was calculated as 1.96×10^{-5}. A total hazard index was calculated as 0.11. Risk estimates associated with specific media at the site are also presented in Table 2-12. The highest carcinogenic risk estimate for a single pathway (1.16×10^{-5}) was associated with dermal contact with surface water. The surface water risk estimate is based on the maximum observed chemical concentration. The highest noncarcinogenic risk estimate for a single pathway, (0.05) was associated with dermal contact with soil. None of the risk estimates exceeded the 10^{-4} to 10^{-6} risk range for carcinogens or the 1.0 benchmark for noncarcinogens.

Compounds contributing most significantly to the risk estimates are PCP, dioxins/furans, and arsenic.

On-site Workers. Exposure to the three current on-site workers (an architect and two automotive repair shop workers) is not expected to exceed those estimated for future on-site workers (see Table 2-13 and Section 2.4.2.2 for a summary of risks to future on-site workers).

2.4.2.2 Risks Under Future Land Use, by Scenario.

On-site Workers. A summary of the total risks to future on-site workers is presented in Table 2-13. The total cancer risk to workers at the site was calculated as 6.92×10^{-5}. A total hazard index was calculated as 0.25. Risk estimates associated with specific media at the site are also presented in Table 2-13. The highest carcinogenic risk estimate for a single pathway (2.42×10^{-5})

and the highest noncarcinogenic risk estimate for a single pathway (0.15) were associated with soil ingestion. For this scenario, the total cancer risk (6.92×10^{-5}) is within the 10^{-4} to 10^{-6} risk range, and the total hazard index (0.15) is well below the 1.0 benchmark. Compounds contributing most significantly to the risk estimates are PCP, dioxins/furans, and arsenic.

On-site Residents. Risks were calculated for the potential future resident in the northern area of the site (north of the interstate) and in the southern area. The likelihood of a residence in the northern area is low because of the close proximity of the interstate and active railway. Only the risks calculated for the resident in the southern area are presented here. A summary of the total risks to potential future on-site residents for the southern area is presented in Table 2-14. The total cancer risk to potential future residents at the site was calculated as 1.53×10^{-1}. A total hazard index was calculated as $6.16 \times 10^{+3}$. Risk estimates associated with specific media at the site are also presented in Table 2-14. Ingestion of groundwater poses the greatest carcinogenic risk and the greatest non-carcinogenic risk. Although the risk from ingesting groundwater is greater than the USEPA acceptable range, groundwater is not currently used for water supply and the future likelihood of ingesting groundwater is low because of the recently enacted well ban.

Consumption of produce grown in contaminated soil (and calculated based on uptake and deposition of contaminants from soil) would also pose a significant risk to residents, although relative to ingestion of contaminated groundwater risks, contributions from this pathway are only about 5 percent as great. Risks associated with exposures to soil were two to three orders of magnitude lower than those associated with groundwater ingestion. For both the groundwater ingestion and produce consumption pathways, virtually all risks are due to exposures to PCP and dioxins/furans. Compounds contributing most significantly to the carcinogenic risk estimates are PCP, dioxins/furans, and PAHs. Compounds contributing most significantly to the noncarcinogenic health effects potential are PCP, dioxins/furans, PAHs, and arsenic.

2.4.3 Ecological Assessment

The objective of the ecological risk assessment (ERA) performed by CDM was to evaluate the potential effects of contaminated surface water, soils, sediments and groundwater from the Montana Pole NPL site on terrestrial and aquatic plants and animals. This section summarizes the ERA performed by CDM.

Surface water was considered by CDM to be the significant pathway for potential exposure to environmental receptors.

For the surface water pathway, potential receptors and exposure routes to constituents present in surface water at the Montana Pole site, or leaving the site, included:

- Riparian vegetation within and downstream of the study area;
- Wildlife and livestock that use the creek as a source of water, either at the site or downstream of the site, including both resident and migratory species;
- Wildlife that feed on riparian vegetation that may have bioconcentrated contaminants from surface water or groundwater;
- Aquatic vegetation and benthic invertebrates present in the creek adjacent to the site and downstream of the site;
- Fish and other aquatic organisms that may move from Blacktail Creek into Silver Bow Creek;
- Wildlife that feed on aquatic vegetation or animals that may have bioaccumulated contaminants from surface water; and
- Wildlife that experience dermal contact with contaminated surface water while foraging for food.

Fish in Silver Bow Creek

Silver Bow Creek adjacent to the Montana Pole site and downstream to the Warm Springs Ponds does not support a fisheries population. Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and bull trout (*Salvelinus confluentus*) are reported to have once been caught in the vicinity of Butte prior to intensive mining activities. CDM concludes that excessive metals deposits still prevent the establishment of a fishery in Silver Bow Creek.

Benthic Invertebrates in Silver Bow Creek

Benthic invertebrate communities and algae have re-established themselves within the study area since the cessation of direct mine wastewater discharges to Silver Bow Creek. The current density and diversity of this aquatic community is unknown.

Terrestrial Biota On-site

No terrestrial communities within the Montana Pole site have been identified as critical habitat or communities of special concern. No rare or endangered plants were identified within the study area boundaries of the LAO Operable Unit of the Silver Bow Creek NPL site, nor downstream of this study area. Vegetation growing adjacent to Silver Bow Creek within the Montana Pole site is limited to willows (*Salix exigua*) and grasses. Shrubs indicative of dry conditions are found throughout the area.

Contaminants of Concern for Ecological Receptors

From the list of chemicals expected to occur at the MPTP site, seven chemicals or chemical groups were selected for evaluation in the ERA, based on mobility and persistence, bioaccumulation potential, adequacy of toxicological data to evaluate risks, comparisons of maximum detected concentrations with toxicity criteria values, and the use of these chemicals in the wood-treating process at the MPTP site. These chemicals, from the CDM report, are (CDM, 1992):

- PAHs
- PCP
- Dioxins/Furans
- Arsenic
- Cadmium
- Copper
- Zinc

For the MPTP site, each chemical of concern was evaluated for toxicity values for use in risk characterization.

Assessment of Effects

Impacts from organic chemicals of concern for Silver Bow Creek are expected to be limited to the reach of the creek adjacent to the Montana Pole site and extending for a relatively short distance downstream. Current information suggests that terrestrial wildlife using more distant reaches, or plants grown along these reaches, would not receive significant exposure.

Impacts from soil contamination on the Montana Pole site are probably limited to plants and small animals that grow or live on the site. Major predators and larger birds and mammals are not likely to find the site attractive, and the small size of the site would limit potential exposures to any such animals that might visit the site.

CDM concludes that aquatic communities in Silver Bow Creek are currently affected by high metal concentrations associated with historical mining activities near the MPTP site. Should remediation occur in the Silver Bow Creek watershed to reduce the amount of metals loading to the creek, CDM suggests that the aquatic communities near and immediately downstream of the MPTP site could then be at risk because of the elevated levels of PCP detected in the surface water and sediment samples collected during the RI.

3.0 PRELIMINARY REMEDIAL ACTION OBJECTIVES, PRELIMINARY REMEDIAL ACTION GOALS, AND GENERAL RESPONSE ACTIONS

The first step in the feasibility study process is to establish preliminary remedial action objectives (PRAOs) and develop general response actions (GRAs) (see Figure 1-1). Preliminary remedial action objectives are used to define the preliminary remedial action goals (PRAGs) for protecting human health and the environment. GRAs are those actions that will satisfy the remedial action objectives. Montana Pole site PRAOs, PRAGs, and GRAs have been developed by DHES. The PRAOs are presented in Section 3.1, the PRAGs are presented in Section 3.2, and the GRAs are discussed in Section 3.3.

3.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The PRAOs identified in this section serve as guidelines in the development and evaluation of remedial alternatives and are based on ARARs and health-based risk assessments provided by DHES. The ARARs identified by DHES for the MPTP site are provided in Appendix A and highlighted in Section 2.3. The risk assessment performed for this site is summarized in Section 2.4.

Remedial action objectives are medium-specific. The environmental media of potential concern for the MPTP site include soil, groundwater and LNAPL, surface water and sediment, equipment and debris, and miscellaneous oils and sludges. The primary chemicals of concern include PAHs, PCP, dioxins/furans, BTEX, and metals. The PRAOs identified for the environmental media at the MPTP site are described below.

3.1.1 Soil

Four PRAOs for protection of human health and the environment from contaminated soils are identified based on site-specific conditions and guidance from USEPA (1988):

- Prevent human exposure to carcinogens in soil that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.

- Prevent human exposure to noncarcinogens in soil that would result in a hazard index greater than 1.

- Prevent contaminant releases from soil that result in groundwater, surface water, or air contamination greater than allowable limits based on ARARs and protection of human health and the environment.

- Minimize impact of contaminated soils adversely affecting terrestrial or aquatic species.

The first two RAOs address the exposure scenarios that include the current on-site trespasser, the future on-site worker, and the future on-site resident. The on-site trespasser would be exposed to the surface soils (0 to 3 feet), the future on-site worker and on-site resident would be potentially exposed to soils from 0 to 10 feet below grade.

The third PRAO is associated with contamination that exists in the soils at fairly high concentrations (Figures 2-3 through 2-6). Although most of the contaminants detected in the vadose zone at the site are considered relatively immobile, there is a possibility that the contaminants could still be migrating towards the groundwater through infiltration. There is also a potential for contaminants in the surface soils to be released to air during remedial activities or to migrate towards Silver Bow Creek by erosion during sustained rainfall events.

The fourth PRAO addresses potential impacts to ecological receptors from contaminated soils and sediment. The Baseline Risk Assessment report (CDM, 1992) indicated that major impacts to aquatic communities in Silver Bow Creek are due to high metal concentrations in Silver Bow Creek water and sediment. The elevated metals concentrations in Silver Bow Creek are associated with historical mining activities in the Butte area and near the Montana Pole site.

3.1.2 Groundwater and LNAPL

Five PRAOs for protection of human health and the environment from contaminated groundwater and the LNAPL floating on top of the groundwater at the site are identified based on site-specific conditions and guidance from USEPA (1988):

- Prevent human exposure to carcinogens in groundwater and LNAPL that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.
- Prevent human exposure to noncarcinogens in groundwater and LNAPL that would result in a hazard index greater than 1.
- Remediate site groundwater for use as a drinking water supply.
- Prevent contaminant releases from groundwater and LNAPL that result in surface water contamination greater than allowable limits based on ARARs and protection of human health and the environment.
- Prevent contaminated groundwater and LNAPL migration that results in adjacent aquifer contamination greater than allowable limits based on ARARs and protection of human health and the environment.

The first three PRAOs address use of groundwater as a drinking water source and consider MCLs and other health-based cleanup criteria. The USEPA Office of Solid Waste and Emergency Response (OSWER) is aware of the difficulty of restoring some aquifers to health-based cleanup criteria and has issued two directives and a memorandum addressing this issue (OSWER Directives 9283.1-03 and 9355.4-03; Draft Memorandum #4326). These letters are a result of a study performed in 1989 to assess the effectiveness of groundwater extraction systems in achieving specified goals. The study evaluated 19 sites. The findings of that study indicated that extraction systems were generally effective in containing the contaminant plume and that significant mass removal was being achieved. However, although the concentration of contaminants decreased significantly after initiation of extraction, they tended to level off at concentrations above their cleanup goals (i.e., MCLs).

Based on the findings of the groundwater remediation study, the USEPA is now recommending that remedial actions that may not meet chemical-specific ARARs have contingency measures. These measures include engineered controls to contain the plume such as physical barriers and/or gradient control wells, institutional controls that restrict access, continued monitoring, and periodic reevaluation of remedial technologies. These contingency measures are evaluated for the MPTP site in Section 4.0.

The fourth PRAO addresses groundwater and LNAPL contamination that is migrating to Silver Bow Creek as evident by the oily seeps observed along the streambank. The fifth remedial action objective addresses the migration of the contaminated groundwater and LNAPL to adjacent aquifers. LNAPL is a continuing source of contamination to groundwater at the site and could potentially contaminate as yet unaffected soils near the groundwater table if the LNAPL migrates. In addition, fluctuations in the groundwater level have resulted in contaminants being adsorbed to the soils somewhat above and below the water table. Groundwater sampling data from samples collected in monitoring wells north of Silver Bow Creek show evidence of migration of contaminants in the shallow groundwater system beneath Silver Bow Creek.

3.1.3 Surface Water and Sediments

The PRAOs identified to protect human health and the environment from contaminated surface water and sediments are:

<u>Surface Water</u>

- Prevent human exposure to carcinogens in surface water that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.
- Prevent human exposure to noncarcinogens in surface water that would result in a hazard index greater than 1.

- Prevent contaminant releases that result in surface water contamination greater than allowable limits based on ARARs and protection of human health and the environment.

Sediments

- Prevent human exposure to carcinogens in sediment that would result in an excess cancer risk greater than 10^{-4} to 10^{-6}.

- Prevent human exposure to noncarcinogens in sediment that would result in a hazard index greater than 1.

- Prevent contaminant releases from sediment that result in groundwater, surface water or air contamination greater than allowable limits based on ARARs and protection of human health and the environment.

- Minimize impact of contaminated sediments adversely affecting terrestrial or aquatic species.

The excess cancer risks and hazard indices from incidental ingestion of and dermal contact with surface water and sediments for the only exposure scenario (on-site trespasser) evaluated in the BRA report are below or within the risk range of 10^{-4} to 10^{-6} (CDM, 1993). Disposal options for treated groundwater may include discharge to surface waters. Disposal actions must comply with applicable regulations as discussed in Section 2.3.2.

Although human health risks associated with creek sediments are low, some soils near or beneath the creek contain high concentrations of site contaminants (e.g., at seep locations). Remedial actions may address contaminated soils near or beneath the creek.

3.1.4 Equipment and Debris

The PRAOs for the equipment dismantled and stored on site and for contaminated debris on site are to:

- Prevent human exposure to contaminated equipment and debris.

- Prevent contaminant releases from these materials that result in soils, groundwater, surface water, or air contamination greater than allowable limits based on ARARs and protection of human health and the environment.

Wipe tests have been performed on some equipment. Concentrations of the contaminants vary with each piece of equipment tested. A risk assessment was not performed using the wipe test data and there are no specific requirements for disposal of equipment contaminated with wood-preserving wastewaters. The USEPA adopted debris treatment standards on August 18, 1992 for 20 of the RCRA newly listed wastes (57 FR 37196). Treatment standards for the FO32 and FO34 waste listings have not been proposed, and debris contaminated with FO32 or FO34 wastes is not covered by the August 18, 1992 rule.

3.1.5 Miscellaneous Oils and Sludges

The PRAOs for the miscellaneous oils and sludges stored on-site are to:

- Prevent human exposure to oils and sludges.
- Prevent releases of these materials, which would cause contamination in soils, groundwater or surface water greater than applicable regulations or human health-based levels.

A risk assessment was not performed for the oils and sludges stored on-site. The oil and sludge wastes are considered RCRA FO32 and FO34 listed wastes. There are no promulgated treatment standards for the FO32 and FO34 classifications.

3.2 PRELIMINARY REMEDIAL ACTION GOALS

The preliminary remedial action objectives discussed above were used to develop the preliminary remedial action goals (PRAGs). PRAGs are used to define cleanup levels, which are used to estimate the associated extent of cleanup. The PRAGs presented in this FS are only for those contaminants of concern considered most important for developing remedial alternatives.

Appropriate cleanup levels for all site contaminants of concern will be addressed in the site Record of Decision (ROD).

The risk-based PRAGs developed by DHES and presented in this section are based on a lifetime excess cancer risk of 1×10^{-6}. Preliminary remediation goals for carcinogens are set at 10^{-6} excess cancer risk as a point of departure, but may be revised to a different risk level within the acceptable risk range based on the consideration of appropriate site-specific factors. State and federal regulatory agencies have the flexibility to specify cleanup levels that are based on an excess cancer risk between 10^{-4} and 10^{-6}.

3.2.1 Preliminary Remedial Action Goals

PRAGs for site soils and sediments are presented in Table 3-1 for three potential land use scenarios: residential land use, industrial or commercial land use, and recreational or trespasser land use. The PRAGs were calculated by linearly adjusting the concentrations identified in the Baseline Risk Assessment report (CDM, 1993) for each land use scenario to correspond to an excess cancer risk of 1×10^{-6} except for dioxins. The PRAG for dioxins correspond to an excess cancer risk of 1×10^{-4}. For PCP, the dermal contact exposure scenario was used because it results in the highest risk of all the exposure scenarios. The PRAGs for dioxins/furans, carcinogenic PAHs, and arsenic were calculated using ingestion of contaminated soil as the exposure scenario. Carcinogenic PAHs are based on benzo(a)pyrene (BAP) equivalents using the toxicity equivalency factors (TEFs) as described in the Baseline Risk Assessment report (CDM, 1993). In 1988, the USEPA recommended a general approach for the disposition of PCP and PCB waste and contaminated soil. The recommended levels of dioxin in soils were 1 ppb TCDD equivalents for residential areas and 20 ppb TCCD equivalents for industrial or nonresidential sites (U.S. Congress, 1991). These values recommended by USEPA are more than two orders-of-magnitude less stringent than the risk-based PRAGs developed by DHES. The contaminant concentrations corresponding to 10^{-4}, 10^{-5}, and 10^{-6} risk are presented in Table 3-2. As stated above, although the PRAGs are based on a 10^{-6} risk, the regulatory agencies have the flexibility to specify cleanup levels that are based on an excess cancer risk between 10^{-4} and 10^{-6}.

PRAGs for site groundwater are presented in Table 3-3 and include both regulatory criteria (i.e., MCLs) and risk-based levels. The risk-based levels for groundwater were calculated similarly to the soil calculations above and correspond to an excess cancer risk of $1x10^{-6}$ based on data for the residential ingestion exposure pathway as presented in the Baseline Risk Assessment report (CDM, 1993).

PRAGs for site groundwater treated under certain remediation alternatives are based on the disposal option. If the groundwater is recharged into a clean portion of the aquifer, the concentrations of contaminants in the discharged water must meet regulatory criteria (i.e., MCLs). If the groundwater is recharged into a contaminated portion of the aquifer, the contaminant concentrations in the recharged water must meet nondegradation standards (i.e., be equal to or less than the average contaminant concentrations in the aquifer in the vicinity of the recharge system). However, to achieve long-term remedial action objectives, recharged groundwater concentrations should be significantly less than those existing in the aquifer. If the groundwater is discharged into Silver Bow Creek, the concentrations of contaminants must meet the regulatory criteria for a new discharge to surface water. PRAGs for surface water and discharge to surface water are presented in Table 3-4 and include health-based regulatory criteria and aquatic criteria. These PRAGs are based upon the Montana Water Quality Act I-Classification for Silver Bow Creek, the goal of which is to restore the creek to swimmable, fishable, and drinkable waters. MCLs and aquatic standards are discussed in Section 2.3.

Equipment and debris that are contaminated with a prohibited listed waste must meet the treatment standards for the listed waste. However, treatment standards for FO32 and FO34 wastes have not been promulgated by USEPA. Therefore, equipment and debris can either be disposed in a RCRA Subtitle C landfill, or, in a municipal landfill if the equipment and debris is adequately decontaminated.

The oil and sludge wastes stored on site are considered RCRA FO32 and FO34 listed wastes. There are no promulgated treatment standards for the FO32 and FO34 classification.

3.2.2 Volume Estimates

Site Soils

The volume of previously excavated soils stored on site and the volumes of in-place surface and subsurface contaminated soils that may require remediation at the MPTP site are shown on Table 3-5. Figures 3-1, 3-2, and 3-3 show the locations of these soils at the MPTP site. These volumes are estimated using PCP as an indicator compound, using the PCP PRAGs presented in Table 3-1, and using physical parameters (as discussed below) for determining the location and accessibility of these contaminated soils. Because soil contamination at the MPTP site is generally associated with contact with wood-treating chemical solutions, there is little difference between soil volume estimates based on the residential scenario PRAG of 3 mg/kg, the industrial scenario PRAG of 9 mg/kg, and the PCP trespasser land-use PRAG (34 mg/kg).

The volume of previously excavated soils presently stored on site is approximately 10,000 yd^3. The volume estimate of soils treated under the Alternative 3 remediation scenario evaluated in this FS includes the previously excavated soils, the soils near the creek that have been impacted by the seeps, and soils that would be excavated during construction of the groundwater extraction and treatment system. It is estimated that about 6,000 yd^3 of soils near the creek would require excavation and treatment. This volume calculation assumes all the soils north of the sheet piling installed by USEPA in September 1992 would be excavated to 4 feet bgs. The volume of soils estimated to be excavated during installation of the groundwater extraction system is approximately 7,000 yd^3.

Volume estimates of contaminated in-place site soils include surface soils and subsurface soils including soils impacted along the LNAPL plume. Areas where contamination was found above PRAGs (Table 3-1) in surface soils but not in subsurface soils are shown in Figure 3-1 and consist of "hot spot" areas in the east and west treated-wood storage yards and soils near the former process area. The volume of these soils is assumed to extend from the ground surface to 3 feet below ground surface and is estimated to be 10,000 yd^3. The actual depth of contamination in these areas will be determined during the remedial action.

Areas where contamination was found above PRAGs (Table 3-1) in both the surface and subsurface soils down to the groundwater table are shown in Figure 3-2 and include the former process area, the former waste water drainage ditch running from the process area to Silver Bow Creek and areas adjacent to the drainage ditch on the north side of the interstate. The volume of soils in these areas is estimated to be 82,000 yd^3. This volume assumes that contaminated subsurface soil concentrations above PRAGs extend to approximately 4 feet below the groundwater surface. This depth is based on the RI which determined that subsurface contamination above soil PRAGs extends approximately 4 feet below groundwater in these areas and other areas affected by the LNAPL plume. The volume of these soils located beneath the highway is estimated at 4,000 yd^3 and, for the purposes of this FS, is considered inaccessible.

In other areas of the site, subsurface soils have been impacted by the floating LNAPL layer. This area of LNAPL influence extends from the former process area to Silver Bow Creek and has been estimated based upon the inferred LNAPL plume shown in Figure 3-3. The extent of the inferred LNAPL plume is based on the presence of LNAPLs in a number of wells and borings on the site. Within this area, a "smear zone" where LNAPL has contacted subsurface soils near the groundwater table has been estimated to extend vertically 2 feet above and 4 feet below the groundwater surface. Because contaminated subsurface soils associated with the LNAPL plume in this area underlie uncontaminated soils, and these soils are excavated under one of the alternatives evaluated under this FS, volumes of the overlying soils in addition to the contaminated subsurface soils have been estimated and are presented on Table 3-4. In order to excavate contaminated soils associated with the LNAPL plume, the overlying soils would also require excavation. Separation of clean and contaminated soils during the remedial action would be important to minimize the volume of soils requiring treatment. Excavation of soils beneath the interstate highway is considered to be infeasible. Underlying contaminated soils beneath the highway would be left in place and may be remediated by other methods.

The volume of accessible contaminated subsurface soils associated with the LNAPL plume is estimated at 93,000 yd^3. This volume does not include the portion of the LNAPL plume accounted for in the surface/subsurface volume estimate cited above or the volume of soils beneath the inaccessible areas. The volume of contaminated subsurface soils associated with the LNAPL plume beneath the highway estimated at 37,000 yd^3. The volumes of uncontaminated soils overlying the LNAPL plume are estimated to be 28,000 yd^3 in the area north of the highway and 66,000 yd^3 in the area south of the highway.

Groundwater

The areal extent of contaminated groundwater above the PCP MCL of 1 μg/L is estimated to be 1.8 million square feet. Assuming an average aquifer thickness of 22 feet and a porosity of 30 percent, the total volume of contaminated alluvial groundwater was estimated to be approximately 90 million gallons. This volume represents the volume of contaminated groundwater in place. This value is substantially lower than the volume that would be treated by a pump-and-treat system.

Equipment and Debris

A rough estimate of the volume of equipment and debris on site was performed for this FS. As stated in Section 2.1, there is about 9,100 cubic yards of debris on site, consisting of wood, soil cuttings, concrete, steel, and brick. An extensive sampling program should be undertaken as part of remedial design to determine more accurately the volume of debris and extent of contamination.

Oils and Sludges

Approximately 6,300 gallons of untreated oily wastes from the oil/water separator process; 9,000 gallons of KPEG-treated oil; 2,200 gallons of KPEG-reagent sludge; and 3,000 gallons of miscellaneous oily wastes and sludge are estimated to be stored in drums and storage tanks at the MPTP site (ARCO, 1992a). Keystone (1991a) assumed that the total quantity of oily wastes and sludge requiring remediation was approximately 26,500 gallons. Additionally, it is estimated that between 3,000 and 6,000 gallons of oily wastes would be generated each year in the first few years of operation of the USEPA LNAPL Recovery System in operation at the MPTP site. The quantity of LNAPL recovered from the groundwater systems annually will decrease over time.

3.3 GENERAL RESPONSE ACTIONS

GRAs are those actions that will satisfy the remedial action objectives. The GRAs identified for each environmental media of concern are summarized in Table 3-6. The following paragraphs discuss each GRA and its applicability at the MPTP site.

3.3.1 Institutional Controls (Soil and Groundwater)

The GRAs for institutional controls include public or private measures that control land uses and limit access to contaminated media. Some institutional controls are currently in place at the site. For example, Butte-Silver Bow has adopted a well ban (Ordinance #431) that prevents the use of new wells within the community's central water service area for drinking water [Murray Lamont & Associates, Inc. (Murray Lamont), 1992]. The MPTP site is within the water service area. In addition, zoning laws, floodplain regulations, and building codes are in place that restrict residential development of the land and limit construction activities.

The current institutional controls can be strengthened, if necessary, and other institutional controls could be included in the remedial alternatives.

3.3.2 Containment Actions (Soil, Groundwater, and Oils and Sludges)

Containment actions for groundwater refers to preventing the spread of groundwater contamination through active or passive hydraulic gradient controls. Containment actions for contaminated soils refers to preventing the vertical and horizontal migration of the contaminants in the soil. Containment actions for both groundwater and soil are applicable to MPTP because both the soil and groundwater are contaminated and the contaminants in each media have the potential to spread. Containment actions for oils and sludges are potentially applicable because drums could potentially corrode and leak in the future.

3.3.3 Removal/Extraction Actions (Soil, Groundwater, and Equipment)

Extraction actions for groundwater may be applicable at the MPTP site because aquifer remediation may require that groundwater be extracted from the aquifer before treating it. Removal actions may be applicable for the soils at MPTP because certain soils may require excavation prior to treatment. Removal actions for the equipment on site may be applicable because the equipment may require demolition and excavation prior to treatment and/or disposal.

3.3.4 Treatment Actions (Soil, Groundwater, Equipment, and Oils and Sludges)

Treatment actions are applicable for all the environmental media of concern at the MPTP site. Treatment actions for soils and groundwater can be performed either aboveground or in situ. Aboveground treatment of the soils, equipment, and oils and sludges may be performed either on or off site.

3.3.5 Disposal Actions (Soil, Groundwater, Equipment, and Oils and Sludges)

Two types of disposal actions may need to be implemented as part of the remediation of the MPTP site:

- Disposal of treated groundwater, and
- Disposal of other waste such as excavated and treated soils, demolished equipment, debris, and treated oils and sludges.

Off-site and on-site disposal options are considered in this FS.

4.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Developing remedial alternatives involves identifying technologies and process options that can address the general response actions applicable for the contaminated media at the MPTP site. These contaminated media include soils, groundwater, LNAPL, oily wastes and sludges, stream sediments near seeps, and equipment and debris. The general response actions, presented in Section 3.2 for each type of contaminated media, include institutional controls, containment, removal/extraction, in situ and aboveground treatment, and disposal.

A preliminary screening of technologies based on effectiveness, implementability, and cost was performed by Keystone (1991a) for each contaminated media. After the screening report was prepared, several treatability studies were conducted to determine the effectiveness of a number of technologies in treating contaminated soils, oily wastes and sludge, and contaminated groundwater at the MPTP site (Calgon, 1991; GRC, 1991; Keystone, 1991a-e; 1992a-d). Further screening of the technologies was performed for this FS based on the initial screening performed by Keystone and results of the treatability studies.

Section 4.1 presents the institutional controls that are potentially applicable for soil and groundwater. Section 4.2 identifies and screens containment, removal, in situ and aboveground treatment, and disposal technologies for contaminated soil and sediment. Section 4.3 identifies and screens treatment and disposal technologies for oily wastes and sludges. Section 4.4 identifies and screens containment, extraction, in situ and aboveground treatment, and disposal technologies for contaminated groundwater. Section 4.5 presents and screens equipment and debris decontamination and disposal technologies. Section 4.6 summarizes the results of the technology screening and selects those technologies that are considered further in the development and screening of remedial alternatives presented in Section 5.0.

4.1 INSTITUTIONAL CONTROLS

Institutional controls for the MPTP site have been evaluated by Murray Lamont (1992). This section briefly summarizes their evaluation and screens the applicable institutional controls on the basis of effectiveness and implementability. The general categories of institutional controls analyzed in the Institutional Controls evaluation document are:

- Local government land use controls
- Private property rights
- Public groundwater controls
- Other federal, state, and/or local environmental, historic preservation, or other laws and programs
- Leases and contracts
- Dedicated development
- Financial programs
- Site management

The institutional controls evaluated in the "other federal, state, and/or local environmental, historic preservation, or other laws and programs" category (e.g., National Historic Preservation Act, Clean Water Act [CWA], Endangered Species Act, and Streambed Protection), with the exception of the CWA, are considered not applicable to the MPTP site. The site is less than 50 years old, no endangered species have been observed at the site, and limitations on the future location of Silver Bow Creek are not expected to affect remedial alternatives evaluations. The CWA protects wetlands and restricts or prohibits discharges to waters of the United States. These regulations, as they apply to the MPTP site, are discussed in Section 2.3. The institutional controls in the "other federal, state, and/or local environmental, historic preservation, or other laws and programs" category are eliminated from further consideration in this FS.

The "lease and contracts," "financial programs," and "site management" categories are also eliminated from further consideration in this FS. The institutional controls presented in these categories are considered as implementing measures for other controls discussed in this section. The remaining four categories are discussed below and summarized in Table 4-1.

4.1.1 Local Government Land Use Controls

Local government land use controls include zoning, floodplain regulations, subdivision regulations, and building codes. These regulations are already in effect in the Butte-Silver Bow area. It may be necessary to strengthen these controls to address specific conditions at the MPTP site. The applicability of each regulation is discussed along with potential modifications considered in developing remedial alternatives.

> Zoning. Designations in the current zoning code in Butte-Silver Bow limit the land uses allowed in the areas comprising land within the MPTP site. The portion north of the interstate highway is designated M-2: heavier industrial uses. The portion south of the highway is M-1: light industrial uses. M-1 zoning limits residential uses to owners or caretakers of businesses on the property.
>
> M-2 zoning allows the site to be used for kennels, stables, and stockyards. Depending upon the selected remedy for the site, the M-2 zoning codes for the MPTP site may need to be modified to disallow those uses.
>
> Floodplain Regulations. There are detailed floodplain regulations presently in effect in the county. A large portion of the site is located within the 100-year flood boundary. The county's flood regulations pose severe limits on building structures within the flood boundary. These discourage any future land uses other than industrial, for which the site is presently zoned. Because the county requires building permits, implementation of the floodplain regulations occurs at the local government level. No building permit should be issued when there would be a violation of the floodplain regulations.
>
> Subdivision Regulations. The subdivision regulations of the county are unlikely to be important land use controls at this site. The site itself is a subdivided portion of a larger site, and given the site's zoning and multiple property ownership, it is unlikely it would be subdivided in the future. This institutional control is eliminated from further consideration in this FS.
>
> Building Code. Butte-Silver Bow has adopted the Uniform Building Code (UBC) for regulation of the construction of buildings and structures. The code is enforced by

county staff through building permit requirements. To protect potential future workers at the site, the UBC model code could be modified to include a restriction on the construction depth for any type of structure built at the MPTP site to 0 to 2 feet below grade. Such provisions would decrease potential exposure to LNAPL and contaminated groundwater which are within 4 feet of the surface in some areas of the site. However, exposure to contaminated surface and near surface soils would not be prevented by this institutional control.

In summary, institutional controls presently exist at the MPTP site that restrict land uses primarily to industrial activities; residential uses are currently limited to owners or caretakers of businesses on the property. The restrictions are in the form of present zoning limitations (primarily industrial uses only), flood regulations (building restrictions for portions of the site in the 100 year floodway, and other portions in the flood storage area), and building regulations. These controls were enacted in the past by the Butte-Silver Bow government for reasons unrelated to the existence of contaminants at the site. These controls are enforceable and will likely remain in place. Although changes could occur through the local governmental authorities; proposed changes would require a formal process of public notice and public hearings.

Land use controls could be modified to strengthen their effectiveness in protecting human health and the environment against any continuing risks at the MPTP site. This would require action by the local governmental body in Butte-Silver Bow. For example, the zoning code could be amended to require special review of any proposed uses or activities at the MPTP location requiring a building permit. The local government could also enact and enforce regulations requiring excavation permits which also regulate the handling and disposal of soils. These modifications are considered in the development of remedial alternatives. Minimal costs would be incurred by the responsible parties to implement modifications to existing local land use regulations.

4.1.2 Private Property Rights

Fee ownership, deed restrictions, easements, conservation easements, grazing rights, and development rights are all various forms of private property rights that may be used to restrict or control access and/or to control certain types of land uses or development on particular lands. These types of private property rights are applicable as institutional controls at the MPTP site. Restrictions on access and future land uses on the site could be implemented for the areas where all risk to human health and the environment associated with residual contamination is not eliminated by the selected remedial action. Private property rights are considered further in this FS.

Private property controls can be implemented through negotiated agreement among the landowners at the site. The cost of restricting future uses to industrial and/or limiting access is likely to be minimal. DHES believes that enforcement would be difficult to ensure because it would be the responsibility of the property owners rather than local, state, or federal authorities.

4.1.3 Public Groundwater Controls

The Butte-Silver Bow local government has recently adopted an ordinance (#431) prohibiting the use of new wells for drinking water within the community's central water service area. The MPTP site is within the water service area. The prohibition applies only to wells to be used for drinking water, and does not affect existing wells used for that purpose prior to July 31, 1992. A private well is located on the MPTP site near the Oaas residence. This well is no longer being used as a potable water supply. There are no other wells in use at the site. This institutional control, if effectively enforced, will reduce potential future exposure to contaminated groundwater at the site.

4.1.4 Dedicated Development

Examples of dedicated developments include public parks, wildlife refuges, golf courses, wetlands, open space areas, and greenway trail systems along waterways.

Currently the site is an industrial area and is intersected by an interstate. There are several railroad tracks within the site and along the east boundary. However, remedial actions at the Lower Area One (LAO) site, which is adjacent to the northern portion of the MPTP site, may ultimately involve a park system and/or wildlife/wetlands areas. The location of such an adjacent park system may increase the likelihood of similar uses for portions of the MPTP site.

4.2 SOIL REMEDIAL TECHNOLOGIES

This section screens the potentially applicable technologies for treating previously removed soils, soils excavated during remediation activities, and other surface and subsurface soils that are currently in place at the MPTP site. Approximately 10,000 yd^3 of previously excavated, contaminated soils are stored in bags at the MPTP site. Additional soils currently in-place at the site may also require remedial action. Rationale for estimating the volumes of soil that may require remedial action is presented in Section 3.2. In the removed site soils, detected concentration levels range from 299,000 to 1,450,000 μg/kg for PCP; 16,560 to 441,600 μg/kg for PAHs; below detection limits ranging from 0.033 to 44.2 mg/kg to 23,600 mg/kg for TPH; and 2.12 to 9.45 μg/kg for 2,3,7,8-TCDD equivalent. In surface and subsurface soils, detected concentration levels range from approximately 5 to 1,510,000 μg/kg for PCP; 0 to 2,304,320 μg/kg for PAH where 0 represents varying detection limits from 18.4 to 350,000 μg/kg; 16.5 to 71,500 μg/kg for TPH; and from below detection limits to 16 μg/kg for 2,3,7,8-TCDD equivalent. Detection limits for 2,3,7,8-TCDD vary from 1.1 to 6.6 nanograms per kilogram (ng/kg). In the soils near the creek, detected concentration levels range from 147 to 1,820 μg/kg for PCP; 3.77 to 4,960 μg/kg for PAH; 0.032 to 161 mg/kg for TPH; 31 to 842 mg/kg for arsenic; 4.4 to 22 mg/kg for cadmium; 5.5 to 19 mg/kg for chromium; 656 to 5,210 mg/kg for copper; 362 to 714 mg/kg for lead; 1,360 to 6,220 mg/kg for zinc; and from 0.00303 to 0.019 μg/kg for 2,3,7,8-TCDD equivalent. PRAGs for soils are presented in Table 3-1.

Table 4-2 summarizes the screening of the remedial technologies and process options for contaminated soils based on effectiveness, implementability, and cost. Section 4.2.1 describes the applicable containment technologies. Section 4.2.2 screens the potentially applicable removal technologies for contaminated soils. Sections 4.2.3 and 4.2.4 screen the potentially applicable in situ and aboveground treatment technologies. Section 4.2.4 presents the potentially applicable disposal options for treated soils.

4.2.1 Containment Technologies for Soils

The objective of capping would be to prevent exposure to contaminated surface and subsurface soils and reduce contaminant migration via infiltration. Soil caps would be effective in preventing exposure to contaminated soils, and other capping methods such as clay caps, multimedia caps, or concrete/asphalt caps would also reduce or eliminate infiltration. Disadvantages of capping include limitations on future construction activities and uses of the site in the capped areas. Capping technologies are retained for further evaluation in this FS.

Other surface controls, such as grading, drainage control, and revegetation, can be applied to reduce infiltration. These controls, which would be used in conjunction with capping, are inexpensive and readily implementable, and are considered further in the development of remedial alternatives.

4.2.2 Removal Technologies for Soils

Conventional excavation is an effective means of removing impacted soil and can be implemented. Up to 292,000 yd^3 of soil may require excavation. Certain areas of the site (such as beneath the interstate highway) are inaccessible to excavation. Excavation is considered further in developing remedial alternatives in Section 5.0.

4.2.3 In Situ Treatment Technologies for Soils

In situ treatment technologies treat contaminated soil without prior excavation. Eight in situ technologies are evaluated and screened based on effectiveness, implementability, and cost. In situ bioremediation is retained for further consideration for site-wide application and is described later in this section. In situ soil flushing is retained for evaluation in areas of the site where excavation is not feasible (i.e., under the interstate highway).

The technologies eliminated from further consideration included vitrification, radio frequency heating, stabilization/solidification, vacuum extraction, and steam extraction. Vitrification and in situ stabilization/solidification were eliminated because they have not been proven effective for most organic wastes. In situ stabilization/solidification has been used primarily for treatment of inorganic wastes, and vitrification for radioactive wastes. Although radio frequency heating may be effective in removing some organic compounds, this technology is only in the development stage and would be difficult and costly to implement. Vacuum extraction of vadose soils is only effective in removing fairly volatile compounds (Henry's Law constant greater than $3x10^{-3}$ atm-m^3/mole). This technology is not effective in removing less volatile compounds, such as PCP or PAHs (Henry's Law constants of $3.0x10^{-6}$ and $6.0x10^{-7}$ atm-m^3/mole, respectively). Steam stripping is more effective than vacuum extraction in removing less volatile compounds; however, this process is only effective in soils that are permeable and fairly homogeneous so that control of the steam front may be maintained. Soil heterogeneity may lead to channeling of the steam front in the subsurface and nonuniform treatment. Steam channeling may also lead to the potential migration of contaminants into previously uncontaminated areas. Steam stripping is eliminated from further consideration because it is a relatively costly in situ treatment option and has not been implemented on a large-scale application.

Soil flushing may be effective in flushing a portion of the contaminants into the saturated zone for subsequent recovery, but it could also cause dispersion of the LNAPL plume. Potential effects of the soil flushing program would need to be addressed during the design of a groundwater/LNAPL recovery system. Soil flushing is not being retained for site-wide application, however, soil flushing is retained for application in areas of the site where excavation is not feasible such as beneath the interstate highway and active railway.

In situ bioremediation uses naturally occurring or introduced bacteria to biodegrade organic compounds. Increasing biological activity in the impacted subsurface requires the addition of oxygen and nutrients and in some cases bacteria. Oxygen, nutrient, and bacteria addition can be performed two ways (Figure 4-1): 1) extracted and treated groundwater can be enriched and reinjected into the aquifer at a sufficient rate to cause mounding, thereby distributing the oxygen and nutrients in the vadose zone and groundwater; or 2) the treated, extracted groundwater can be percolated through the vadose zone through the use of an infiltration gallery. Percolation of treated groundwater through the vadose zone in areas where LNAPL is found may cause vertical smearing of the LNAPL layer.

A treatability study using column tests was conducted to determine the effectiveness of aerobic and anaerobic processes in biodegrading PCP, TPH, and PAHs in contaminated soils (Keystone, 1992a). The general conclusion of this study is that in situ bioremediation is a viable technology for enhancing remediation of PCP and TPH (and to some extent PAHs) in soil and groundwater at the MPTP site. Biodegradation of dioxins was not evaluated in the treatability study; dioxins are not expected to be significantly biodegraded in situ (U.S. Congress, 1991). In situ bioremediation may not be effective on LNAPLs due to possible toxic effects of this highly concentrated waste material to microorganisms.

4.2.4 Aboveground Treatment Technologies for Soils

Twelve aboveground soil treatment technologies were evaluated and screened on the basis of effectiveness, implementability, and cost. Three organic contaminant treatment technologies were retained for further consideration: on-site incineration, biological land treatment, and soil washing. The aboveground soil treatment technologies that were eliminated from further consideration for organic contaminated soils on a site-wide basis include low temperature thermal desorption, off-site incineration, dechlorination, solvent extraction, supercritical extraction, stabilization/solidification, and biological slurry reactor. Biological slurry reactor technology was retained for treatment of soil washing residuals.

Although low temperature thermal desorption would probably be effective in removing organic contaminants from soils, it would be less effective than incineration and is not as cost effective as bioremediation; therefore, it was eliminated from further consideration. The costs for off-site incineration and dechlorination of contaminated soils are extremely high compared to other technologies of equal or better effectiveness; therefore, these process were eliminated from further consideration for site-wide applications. However, off-site incineration is considered for other site media such as oils and sludges and recovered LNAPL.

Supercritical extraction is effective in removing PCP, PAHs, and TPH from soils; however, it is more expensive than on-site incineration and soil washing processes which are considered equally or more effective. Stabilization/solidification was eliminated for site-wide application because it has not been proven effective for treating most organic compounds and has been used primarily for treatment of inorganic constituents. Stabilization/solidification may be appropriate as a post treatment process for stream sediments and near stream soils contaminated with inorganic and organic chemicals after removal or adequate reduction of organic chemicals. However, stabilization/solidification would likely be more costly than disposing of the inorganics-contaminated soils in a local waste repository. Therefore, for the purposes of this FS, it is assumed that soils contaminated with inorganic constituents will be addressed through off-site landfilling at the local mine-waste soil repository after removal or adequate reduction of organic chemicals. Bioslurry reactor technology was eliminated for site-wide application because land treatment is less costly and can be nearly as effective in achieving greater than 90 percent removal of organic compounds. However, bioslurry reactors typically treat organic compounds at a higher rate than land treatment units. Therefore, bioslurry reactors may be appropriate for treatment of soil washing residuals if soil washing is selected.

The following subsections discuss the aboveground soil treatment technologies retained for further evaluation under this feasibility study.

4.2.4.1 On-Site Incineration. Incineration is a combustion treatment process that has been proven effective in completely destroying the organic compounds of concern at the MPTP site, including dioxins. Incineration reactor types include rotary kiln, calcination kiln, fluidized bed, multiple hearths, liquid injection, and infrared incinerators. Although this process is more costly than some treatment options for soils, such as biological land treatment, it has been retained for further consideration because it provides the highest degree of treatment of all available technologies.

Incinerator facilities must be operated in accordance with strict combustion specifications and emissions standards. Drawbacks to the incineration process include community concerns, particularly with respect to on-site incineration. Selection and implementation of an on-site incineration program would require an extensive community relations and public education program within the public comment period.

4.2.4.2 Biological Land Treatment. Biological land treatment of soils uses naturally occurring or introduced microbes or fungi to biologically degrade organic wastes. Keystone evaluated two land treatment processes (bioremediation and composting) and one alternative organism (white rot fungus).

Bioremediation uses naturally occurring or introduced microbes or fungi to biologically degrade organic wastes. Mixing the soils by rototilling or windrowing provides aeration which enhances biological activity. Maintaining the proper microbial environment requires pH control and the addition of nutrients, water, and sometimes bacteria or fungi. In most cases, a liner be placed beneath the bioremediation area to prevent leaching of compounds into the ground. Bioremediation has been shown to be effective in degrading the types of organic contaminants found at the MPTP site, although the degree of treatment of some contaminants of concern like dioxins and furans may be limited by their generally slow degradation rates. Another factor that would potentially limit the implementability of bioremediation at the MPTP site is the cold climate (the normal frost-free period lasts only approximately 60 days) which may lengthen the time required for treatment.

Biodegradation can also be accomplished through composting or the construction of biopiles which may involve several steps including: 1) mixing contaminated soils with a bulking agent to facilitate oxygen transfer; 2) introducing air into the system; 3) allowing the mixture to cure until treatment goals have been achieved; and 4) separating the bulking agent (if used) from the treated soil for reuse. Composting and biopiles may have advantages over bioremediation due to the controlled and increased oxygen transfer and because excess heat is generated. These processes may effectively operate for a longer period of the year than a landfarm could be operated, thereby reducing the amount of time required to treat the wastes.

MPTP treatability test results showed degradation of PCP from 31.6 to 98.7 percent even with high initial concentrations (greater than 8,000,000 μg/kg) and degradation of PAH from 25.9 to 98.2 percent (Keystone, 1991c). From information gathered during Keystone's treatability studies, composting is expected to be similar to bioremediation in effectiveness. Dioxins and furans were not evaluated in the treatability tests, however, they are known to be degraded by the white rot fungus and may also photooxidize (U.S. Congress, 1991). Design studies would be required to determine more precisely the effectiveness of biological land treatment at the site.

Bioremediation at the Libby Groundwater NPL site in Libby, Montana, has been effective in reducing the concentration of PCP in the soils from approximately 130 mg/kg to below 30 mg/kg and in reducing the levels of carcinogenic PAHs from approximately 50 mg/kg to below 10 mg/kg (Woodward-Clyde, 1991). Contamination at Libby is similar to that found at the MPTP site.

A treatability study was conducted to determine the effectiveness of using white rot fungus to degrade PCP in soils in either a biological slurry reactor or using bioremediation (Keystone, 1991c). This strain of fungus, *phanerochaete chrysosporium*, produces extracellular enzymes that can degrade organic compounds like PAHs and some chlorinated compounds. The study concluded that white rot fungus and indigenous microorganisms are equally effective in degrading PCP and PAHs present in soils at the MPTP site in both bioslurry reactors and using bioremediation.

Treatability tests conducted by Keystone indicated that high initial concentrations of PCP in the bagged soils may have exerted toxic effects on the microorganisms resulting in lower PCP removal. Keystone suggested that mixing of the heavily contaminated soils with less impacted soils also requiring treatment may be required to achieve significant biodegradation of PCP in a reasonable period of time.

4.2.4.3 Soil Washing. Soil washing is a water-based process using intensive scrubbing to solubilize/remove organic compounds from soil into a water matrix with the use of aqueous surfactants, pH control, and temperature control. The process produces a cleaned soil matrix, contaminated water which requires further treatment, and a volume of residual fine-grain-sized material which may require further treatment. Although this technology has been shown to be effective for treating coarse soils contaminated with organic wood treating chemicals, it is less effective for treating fine-grained soils. Soil washing may not be cost effective for treating soils containing greater than approximately 25 percent clays and silts because this produces a large volume of residual fine-grain material, which may require a second, more costly, treatment. Soil washing at the MPTP site would require treatment for the process water and for any soil fractions not attaining the cleanup criteria.

A treatability study conducted by Keystone on bagged soils and in-place site soils found soil washing to be effective (greater than 95 percent removal of PCP) in removing organic contaminants from the soil fraction greater than #170 mesh size. Montana Pole site soils consist of thin, gravel-textured to thick, fine-grained alluvial soils. Along the creek, soils consist of a mixture of natural alluvial-derived soils and varying thicknesses of organic rich peat. However, due to mining-related activities in the area, the soils within the immediate vicinity of the creek channel are generally fine-grained, sandy-textured materials with higher metals and sulfide concentrations than the natural soils. Clay lenses are present at several locations at the site.

Soils used in the soil washing treatability studies were reportedly considered representative of MPTP site soil (Keystone 1991d). Treatability tests were conducted on previously removed soils stored in bags on site which were excavated from surface and subsurface areas of the site.

Treatability tests were also conducted on soils collected from backhoe pits on site which were to be representative of vadose soil conditions at the site. Using soil sieve analysis, Keystone found that 1.84 percent (by weight) of bagged soils were smaller than #170 mesh or 0.088 mm, and that 4.24 percent (by weight) of site soils were smaller than #170 mesh (Keystone, 1991d). Based on this information and for the purposes of this FS, it is assumed that the volume of fine-grained soils that would require further treatment after soil washing is 5 percent of the total volume. Design studies would be required to determine more precisely the effectiveness of soil washing at the site and the volumes of residual materials needing further treatment.

Results from recent bench-scale and pilot-scale soil washing studies conducted by the USEPA (1992) at a former wood-treating site in Florida showed that this technology was effective at reducing PCP concentrations in soils from 150 mg/kg to less than 1 mg/kg. This PCP concentration is below all MPTP PRAGs. Preliminary results indicate that dioxin and furan levels were also reduced more than 91 percent. This treatability study was performed using sandy soils that are ideal for the soil washing process.

According to a contractor (Weston) familiar with soil washing technology, soil washing of removed soils is expected to reduce the concentration of PCP in the soils to below 30 mg/kg and could potentially reduce the level to 5 mg/kg if the clay content of the soil is low (JMM telephone conversation with Weston, 1992). The treated soils would meet the PRAGs for PCP for the residential and industrial land use as specified on Table 3-1, if the levels could be reduced to 3 mg/kg. Soil washing would likely reduce the concentration of dioxins in the treated soils by less than 90 percent (JMM telephone conversation with Weston, 1992).

4.2.4.4 **Bioslurry Reactor.** The biological slurry process has been retained for further consideration in the FS for treatment of the residual, fine-grained soils (less than #170 mesh) that remain after soil washing. This process involves placing the impacted soils into a mixing tank, where nutrient-enriched water and, in some cases, microbes or surfactants are added. This process is typically conducted under aerobic conditions, which are generally maintained by sparging air or oxygen into the reactor.

4.2.5 Disposal Technologies for Soils

Two options for disposal of site soil resulting from site remediation activities were evaluated: off-site landfilling and backfilling. Off-site landfilling of site organic-contaminated soils is a costly disposal option which does not result in the treatment of wastes and is not considered further in the FS. Site soils treated for organic wastes that contain high concentrations of inorganic constituents (i.e., soils near Silver Bow Creek) could be addressed through off-site landfilling at a local waste repository. Backfilling soils treated for organic compounds that do not contain significant concentrations of inorganic materials will be considered further in the FS.

4.3 OILY WASTES AND SLUDGE REMEDIAL TECHNOLOGIES

This section screens the potentially applicable technologies for oily wastes and sludges that are currently in storage at the MPTP site or will be generated in the future as a result of soil, groundwater, and LNAPL remediation activities. Approximately 6,300 gallons of untreated oily wastes from the oil/water separator process; 9,000 gallons of KPEG-treated oil; 2,200 gallons of KPEG-reagent sludge; and 3,000 gallons of miscellaneous oily wastes and sludge are estimated to be stored in drums and storage tanks at the MPTP site (ARCO, 1992a). Keystone (1991a) assumed that the total quantity of oily wastes and sludge requiring remediation was approximately 26,500 gallons. Additionally, it is estimated that between 3,000 and 6,000 gallons of oily wastes would be generated each year by the USEPA LNAPL Recovery System currently in operation at the MPTP site. The quantity of LNAPL recovered from the groundwater systems annually will decrease over time.

PCP concentrations in the untreated oily wastes from the separator range between 1,900 to 2,700 mg/kg while concentrations in the KPEG treated oils and reagent sludge are consistently below the detection limit of 2.0 μg/l. PCP levels in the miscellaneous sludges and liquids range between 7,500 and 17,000 mg/kg and from below the detection limits of 320,000 μg/l to 160,000 μg/l, respectively. PAH concentrations in the untreated separator oils are approximately 5,800 mg/kg. On average, the KPEG-treated oils have slightly lower levels of

PAHs than non-KPEG-treated oils and sludges while in some cases the reagent sludges have somewhat higher levels. PAH levels in the miscellaneous sludges mixed with liquids range between 3,520 and 13,380 mg/kg for the sludge phase and between 2,800 and 6,220 μg/l for the liquid phase, respectively. Total 2,3,7,8-TCDD equivalent concentrations have been detected up to 280 μg/l in the miscellaneous liquids. Dioxin and furan concentrations measured on TCLP extract are below detection limits ranging from 0.5 to 7.8 ppt in both the KPEG-treated oils and the reagent sludges.

Table 4-3 summarizes the screening of the remedial technologies and process options for oily wastes and sludges based on effectiveness, implementability, and cost. Sections 4.3.1 and 4.3.2 screen the potentially applicable treatment and disposal options for oily wastes and sludges at the MPTP site.

4.3.1 Treatment Technologies for Oily Wastes and Sludges

Eleven treatment technologies for oily wastes and sludges were evaluated and screened. One technology, incineration, was retained for further consideration in the development of remedial alternatives. Biological treatment technologies and thermal desorption were eliminated from further consideration in the FS for treatment of oily wastes and sludges because these processes are not effective in treating high strength waste streams. Solidification/stabilization, wet air oxidation, and supercritical and solvent extraction without chemical degradation were also eliminated from further consideration. Solidification/stabilization has not been proven effective in treating oily, organic wastes and is typically used for treating inorganic constituents. Wet air oxidation and supercritical extraction have been proven effective in treating high strength aqueous waste streams containing organics, but have not been proven effective for high strength oily waste streams and sludges.

The dechlorination process uses a mixture of chemical reagents to dechlorinate compounds such as PCP and dioxins and furans. In the process, a waste sample is mixed with the reagents and heated to between 150 and 175 degrees centigrade (°C), which results in the detoxification of the oily wastes by dechlorination of the PCP and chlorinated dioxins and furans. The dechlorination process does not destroy PAHs or other nonchlorinated compounds. The dechlorination process was effectively used at the MPTP site for detoxifying separator waste oils (GRC, 1991).

However, based on conversations with vendors, the KPEG and APEG-PLUS™ dechlorination processes are no longer commercially available. A new process, referred to as base-catalyzed decomposition (BCD) is currently being developed. Because the BCD process is not expected to be commercially available for 2 to 5 years it is not considered further in this FS.

4.3.1.1 **Incineration.** Incineration is a combustion treatment process that has been proven effective in completely destroying the contaminants of concern at the MPTP site. Incineration reactor types include rotary kiln, calcination kiln, fluidized bed, multiple hearths, liquid injection, and infrared incinerators. On-site incineration is generally more costly than off-site incineration for small volumes of oily waste materials and generally less expensive than off-site incineration for large volumes of waste materials. Many off-site incinerators will not accept wastes containing dioxins.

Incinerator facilities must be operated in accordance with strict combustion specifications and emissions standards. Drawbacks to the incineration process include community concerns, particularly with respect to on-site incineration. Selection and implementation of an on-site incineration program would require an extensive community relations and public education program within the public comment period.

4.3.2 Disposal Technologies for Oily Wastes and Sludges

In addition to the treatment technologies evaluated in Section 4.3.1, three disposal technologies were evaluated: off-site landfill, on-site landfill, and reuse/recycling. Off-site and on-site landfilling of untreated oils and sludges would require prior solidification which would not be cost effective. Off-site and on-site landfilling of oily wastes and sludges were eliminated from further consideration.

Oily waste could be recycled by using it for incineration as a hazardous waste fuel. Recycling of waste oils in this manner refers to burning of hazardous wastes for energy recovery. Hazardous wastes may be burned for energy recovery in a boiler or industrial furnace in accordance with the requirements of 40 CFR Part 266, Subpart H. The regulations describe industrial furnaces to include cement kilns, lime kilns and aggregate kilns, among other things (40 CFR Part 260.10).

Under the Boiler and Industrial Furnaces (BIF) Rule, essentially any hazardous waste can be burned by a permitted facility, so long as the facility operator complies with the extensive requirements established by the BIF Rule. Section 266.100(a) states that the BIF regulations "apply to hazardous waste burned or processed in a boiler or industrial furnace...irrespective of the purpose of burning or processing...." Boilers and industrial furnaces that burn hazardous waste are considered RCRA treatment, storage, and disposal facilities (TSDs) and must comply with certain enumerated TSD requirements, including manifest system, recordkeeping, and reporting requirements (40 CFR § 266.102). Generators of hazardous waste that is burned in a BIF are subject to the manifesting, packaging, and recordkeeping requirements of 40 CFR Part 262; transporters are subject to Part 263; and storage facilities are subject to portions of Parts 264, 265, and 270 (40 CFR § 266.102).

Boilers and industrial furnaces burning hazardous wastes must be permitted (40 CFR § 266.102). The BIF Rule establishes the permitting requirements and procedures. The BIF Rule also provides for certain facilities to burn hazardous wastes under interim status prior to being permitted [40 CFR § 266.103(a)(ii)]. Once permitted, facilities can essentially accept any waste within the scope of the conditions described in their permit. However, the rule places some restrictions on the types of wastes that may be burned by interim status BIFs. F032 wastes are not included in the prohibition. Also, interim status facilities that have not yet received a certification of compliance cannot burn wastes that have a heating value of less than 5,000 BTU/lb, unless they did so before the BIF Rule took effect [40 CFR § 266.103 (a)(6)].

No facilities in Montana have been granted interim status. Furthermore, the Montana Administrative Rules governing BIFs expressly prohibit F032 wastes from being burned in a boiler or industrial furnace. Thus, should oily wastes generated at the MPTP site be identified as F032 listed wastes, options for recycling must be explored at facilities outside the State of Montana. Reuse/recycling of oily wastes is not considered further in this FS but should be considered during remedial design.

4.4 GROUNDWATER REMEDIAL TECHNOLOGIES

This section screens the potentially applicable technologies for addressing contaminated groundwater at the MPTP site. The average dissolved concentrations in the groundwater are 3,800 μg/l for PCP, 200 mg/l for TPH, 52,000 μg/l for PAHs, and 40 μg/l for BTEX. Some of the groundwater samples used to calculate dissolved concentration averages may have contained LNAPL which could inflate the overall average. It is not clear as to which samples contained LNAPL and which did not, therefore all analytical data was used to calculate dissolved concentration averages. The maximum 2,3,7,8-TCDD equivalent concentration detected in the groundwater samples is 0.0537 μg/l. LNAPL has been observed in eight of the 39 monitoring wells on the MPTP site. LNAPL thicknesses measured in the wells ranged from 0.01 feet to 2.2 feet. As stated in Section 2.1.4, the observed thickness in the well is typically much higher than the actual hydrocarbon thickness within the soil formation. The contaminant concentrations in LNAPL are similar to the untreated, separator oily wastes and are summarized in Section 4.3.

The remedial action objectives for groundwater presented in Section 3.0 include 1) containing the LNAPL and dissolved groundwater contaminant plumes from further migration; 2) limiting releases of LNAPL and dissolved phase contaminated groundwater to Silver Bow Creek sufficient to attain applicable standards for surface water; and 3) remediating the groundwater. Containment of the LNAPL and dissolved contaminant plumes is feasible with an appropriately designed system. However, because LNAPL is a continuing source of groundwater contamination and is difficult to completely remove, the cleanup levels that are attainable in the aquifer cannot be accurately determined at this time. Therefore, the selected groundwater remediation approach would be evaluated periodically to determine its effectiveness in removing LNAPL and dissolved contaminants and to define attainable cleanup levels in the future.

Clean-up criteria for the extracted groundwater will depend upon whether the water is to be discharged to Silver Bow Creek, recharged into a contaminated portion of the aquifer, or recharged upgradient of the contaminant plume. For discharge to the creek, extracted, treated groundwater would meet the Montana Water Quality Act I-Classification standards for new discharges. For recharge into the contaminated aquifer at the site, extracted groundwater would meet nondegradation criteria and be treated to levels appropriate with the overall goals of the selected groundwater remediation system. For recharge into an uncontaminated portion of the aquifer, extracted, treated groundwater would meet all promulgated MCLs and other health-based cleanup criteria.

Table 4-4 summarizes the screening of the potentially applicable remedial technologies and process options for contaminated groundwater and LNAPL based on effectiveness in meeting the remedial action objectives and PRAGs in extracted groundwater, implementability, and cost. Section 4.4.1 screens the applicable containment technologies. Section 4.4.2 screens the applicable extraction/collection technologies for contaminated groundwater and LNAPL. Sections 4.4.3 and 4.4.4 screen the potentially applicable in situ and aboveground treatment technologies. Section 4.4.5 presents the potentially applicable disposal options for treated groundwater. The applicable disposal options for oily wastes (i.e., LNAPL) are presented in Section 4.3.2.

4.4.1 Containment Technologies

Containment technologies that control groundwater contaminant migration include physical barriers, hydraulic methods, and a combination of the two. Physical barriers, such as slurry walls, grout curtains, and sheet piling, can be used to limit LNAPL and dissolved contaminant migration. At the MPTP site, these methods may not be completely effective in preventing dissolved contaminant migration because a competent bedrock zone needed to anchor the wall or trench was not found. Physical barriers, used in combination with hydraulic controls, may be designed to effectively control LNAPL migration.

Hydraulic containment of contaminated groundwater can be attained using gradient control wells or trenches. Gradient control is considered in the development of extraction options discussed in Section 4.4.2. During September 1992, as part of the USEPA emergency response action, sheet piling (Gundwall) was installed along Silver Bow Creek to control the migration of LNAPL and reduce seepage of free-product along the stream bank. The Gundwall extends approximately 15 feet below the ground surface. This sheet piling, in combination with gradient control, may provide effective containment of groundwater contamination at the MPTP site under current conditions.

4.4.2 Extraction/Collection Technologies

Groundwater extraction would inhibit the migration of and remove contamination from the aquifer. Groundwater extraction is generally used in combination with aboveground treatment and disposal or reinjection (i.e., pump-and-treat). Common methods for collecting groundwater include pumping wells and interceptor trenches.

Interceptor trenches are generally more effective in removing and containing groundwater contamination than pumping wells if the contamination is within 15 to 20 feet of the surface, particularly when the hydrogeology is varied and contains impermeable zones (e.g., clay lenses), as is the case at the MPTP site. The presence of LNAPL requires that groundwater extraction be performed with as little drawdown as possible so as to prevent the migration of contaminants to the deeper portions of the aquifer. Because contaminants have been detected in soil samples collected as deep as 25 feet below the water table, a combination of trenches and pumping wells should be evaluated as part of a system to effectively address the area of groundwater contamination. Actual determination of the most appropriate groundwater extraction approach will occur during design of the extraction system, with probable adjustments during implementation.

As part of the USEPA's removal action performed in 1985 and 1986, interceptor trenches were installed at the MPTP site to intercept the LNAPL layer and prevent seepage to the creek. The USEPA initiated another time-critical removal action in August 1992. Construction of two trenches, 800 feet long, were initially planned. However, flowing sand problems were encountered during excavation activities. The USEPA revised their decision and installed sheet piling and 12-inch-diameter recovery wells in lieu of trenches. Trenches may still be preferred over pumping wells at the MPTP, however, the problems encountered by the USEPA should be considered and addressed as part of any future trench design and installation at the site. Prior geotechnical characterization of proposed locations may help identify which areas are suitable or not suitable for trench construction.

An average aquifer permeability of 300 gpd/ft^2 is assumed in developing extraction option outlined in the FS. Assuming an average aquifer saturated thickness of 25 feet, the average transmissivity is approximately 7,500 gpd/ft. Additional pumping tests on the site would be required to produce more confident values.

With the understanding that porosity will always be somewhat higher than specific storage, a specific storage value of 0.2 is assumed in the analysis of the groundwater extraction option. This assumption is probably adequate for conceptual design purposes because gradient and discharge calculations, which approximate steady state relationships, are relatively insensitive to errors in specific storage; however, calculations of flow velocities and pore volumes are directly proportional to the porosity and specific storage values used and are therefore only approximated in this analysis.

To maintain the hydrologic balance across the site, the portion of the extracted groundwater equal to the natural flux through the site must ultimately be discharged to Silver Bow Creek.

A simple calculation of the flux through an aquifer with a cross section of 1,500 feet, under the influence of 0.004 gradient, with a permeability of 300 gpd/ft^2, and average thickness of 25 feet yields a value of approximately 30 gpm. Assuming an average annual rainfall of approximately 11 inches and applying a "rule of thumb" recharge factor of 10 percent, approximately 5 gpm would be added to the natural flux across the site. Therefore, approximately 35 gpm should be discharged to the creek to preserve the water balance across the MPTP site. If the gradient across the site is increased by additional recharge or reinjection, the flux across the site would be higher. In this case, a somewhat higher rate of discharge to the creek would be required to maintain the water balance.

Calculations presented here do not consider other potential local aquifer stresses such as the ones that will be created during dewatering activities at LAO. Numerical modeling that takes into account all potential future aquifer stresses should be performed during remedial design of the groundwater extraction system.

4.4.2.1 Assumed Groundwater and LNAPL System. A primary objective of the groundwater containment and extraction system is to contain the LNAPL and dissolved groundwater contaminant plumes and capture the contamination before it discharges into Silver Bow Creek. The specific design of the groundwater system will take place during the remedial design and remedial action phase of site cleanup. It is assumed that the system will utilize, to the extent practicable, the groundwater systems installed at the site during the USEPA's removal actions. The system described in the following paragraphs utilizes portions of the groundwater system installed by the USEPA during the 1985 removal action.

For the purposes of this FS it is assumed that an interception system, utilizing part of the existing North Recovery Trench, would be constructed so that it completely spans the impacted groundwater flow lines. This system, shown in Figure 4-2, would extend from approximately 200 feet east of the railroad embankment crossing of Silver Bow Creek to the vicinity of well BMW-1, 1,700 feet to the west. The existing South Recovery Trench would continue to be operated at its present rate of approximately 15 gpm.

To allow careful control of inflow gradients as well as discharge variation in response to aquifer heterogeneity, a segmented interception system in the vicinity of the North Recovery Trench would be installed with four segments, each 425 feet long and 10 feet deep, and each separated by a narrow groundwater flow barrier. These trenches would extract at a total flow rate of approximately 80 to 100 gpm. Based on site conditions as they existed during the RI, approximately 35 gpm of the treated groundwater would be discharged to Silver Bow Creek to maintain the water balance across the site. The other 60 to 80 gpm would be recharged in a series of three reinjection wells spaced approximately 300 feet apart along the south and southeast periphery of the contaminated groundwater plume. The alluvial aquifer is relatively thick along the south and southeast periphery of the site. Given the relative abundance of higher permeability materials with depth, this recharge option would allow the greatest recharge into the most permeable strata. Selective recharge into the deeper, more permeable strata would help preserve upward gradients across the site, which would inhibit the downward migration of contaminants.

The assumed groundwater containment and extraction system is expected to be effective in meeting the remedial action objectives of 1) limiting releases of LNAPL and dissolved phase contaminated groundwater to Silver Bow Creek; and 2) providing sufficient drawdown to contain the dissolved groundwater contaminant plume from further northward and northwestward migration. This extraction option would provide for a total estimated contaminated groundwater removal rate of approximately 95 to 115 gpm. Based on current activities at the site, it is estimated that at most approximately 3,000 gallons/year of LNAPL would be extracted during the first several years of operation; the LNAPL recovery rate is expected to decline in the ensuing years. Therefore, it is difficult to estimate the total quantity of LNAPL that would be recovered during the first 30 years of operation.

Based on site conditions as they existed during the RI, discharge of approximately 35 gpm of the extracted, treated groundwater to Silver Bow Creek is anticipated to be effective in maintaining the water balance across the site. Recharge of approximately 60 to 80 gpm in three reinjection wells along the south and southeast periphery of the site, based on site conditions as they existed during the RI, would help maintain vertical gradients to inhibit the downward migration of contaminants and would enhance the recovery of LNAPL and contaminated groundwater.

Approximately 1.4 million cubic yards of tailings will be removed from the Lower Area One (LAO) Operable Unit of the Butte/Silver Bow Creek NPL site. LAO is on the north side of the MPTP site and includes portions of Silver Bow Creek. To accomplish this removal, dewatering activities at LAO may be necessary. These dewatering activities may result in changes in groundwater gradients, flow directions and lowered water table conditions at the MPTP site. Such changes could influence the extent and rate of migration of contaminants at the MPTP site. Careful coordination of activities at the two sites will be necessary and mechanisms will have to be in place which allow appropriate adjustments to remedial action activities at both sites. The groundwater system at the MPTP site may need to be modified or adjusted depending upon specific LAO activities.

4.4.3 In Situ Treatment Technologies

One in situ technology, bioremediation, which treats both subsurface soil and groundwater was evaluated and retained for further consideration in the FS. A description of this process is included in Section 4.2.3.1.

4.4.4 Aboveground Treatment Technologies

Ten aboveground groundwater treatment technologies were evaluated and screened on the basis of effectiveness, implementability, and cost. Four technologies were retained for further consideration: biological treatment, carbon adsorption, UV/oxidation, and oil/water separation. The technologies that were eliminated from further consideration include air stripping, steam stripping, solvent extraction, and wet air oxidation. Air stripping is not effective in removing semivolatile organic compounds (SVOCs), such as PCP and PAHs; this process is typically used in removing more volatile organic compounds. Steam stripping is effective in removing SVOCs;

however, residuals treatment, such as off-site incineration, would be required and would add substantially to the overall cost of implementing this technology relative to other equally effective treatment options. Similarly, solvent extraction, although effective in removing PCP from contaminated aqueous streams, would require residuals treatment and would be more costly than other equally effective groundwater treatment options. Wet air oxidation would be effective in treating contaminated groundwater; however, this process is typically more costly than other equally effective treatment technologies.

Groundwater in the vicinity of Silver Bow Creek has been found to contain concentrations of metals which could preclude discharge of these waters into Silver Bow Creek after treatment for organic contamination. Depending on the concentrations of metals present in the organic treatment system discharge water, and the selected receiving water (e.g., Silver Bow Creek), additional treatment for reduction of metals may be necessary. Determination of the need for treatment of metals can be made during remedial design or the early stages of remedial action implementation.

4.4.4.1 Biological Treatment. Biological treatment using bioreactors has been retained for further consideration in the FS. Several types of bioreactor configurations are available and include rotating biological contractors, activated sludge, fixed film, and fluidized bed. The fluidized-bed reactor passes impacted groundwater through a suspended bed of material, such as activated carbon, sand, or anthracite coal. The particles making up the bed material are kept in suspension by the flow of water through the reactor and provide a contact site where a microbial film can develop. This active biomass degrades the adsorbable organics present in the groundwater. Results from treatability studies indicate that PCP was effectively treated and can be achieved at a moderate cost compared to other treatment technologies (Keystone, 1991e). Other types of bioreactors are also expected to be effective in achieving greater than 90 percent removal of contaminants. Further study would be required to determine the most effective reactor configuration.

4.4.4.2 Liquid-Phase Granular Activated Carbon (GAC) Adsorption. A liquid-phase GAC adsorption system consists of packed columns containing granular activated carbon media. Dissolved organic compounds adsorb onto the carbon surfaces until the carbon is saturated. At saturation, breakthrough of the least adsorbable compounds occurs first, with subsequent breakthrough of other compounds. The removal efficiency of the GAC system then decreases with time. Once the allowable effluent concentration of any of the compounds is exceeded, the GAC is exhausted and must be replaced. Carbon can be used once and disposed, or regenerated or reactivated on or off site for reuse.

GAC adsorption is a proven, effective separation process for removing nonpolar, hydrophobic organic compounds from aqueous streams. The adsorption capacity of the carbon media varies depending on the type of media used; the particle size; the nature of the compounds present; the TOC level (including naturally occurring organic matter) that compete for adsorption sites with the compounds of concern; and other water quality parameters such as pH, temperature, and TDS levels. This process favors compounds with low water solubility, high molecular weight, low polarity, and a low degree of ionization. In general, carbon is most economical with low concentration waste streams, or as a polishing step for final treatment prior to discharge. Adsorption would be costly if the carbon media were used once and disposed rather than regenerated or reactivated. Implementation of this process may be difficult because some reactivation facilities may not accept PCP- or dioxin-contaminated GAC media. On-site regeneration may be implementable; however, residuals would still require additional treatment.

An accelerated column test was conducted by Calgon Carbon Corporation (Calgon, 1991) using contaminated groundwater from the MPTP site. The results indicated a carbon usage rate of approximately 0.5 lb/1,000 gallons of groundwater treated. Keystone (1991), assuming a flow rate of 80 gpm and carbon usage rate of 2.5 lb/1,000 gallons, determined that compared to other treatment technologies (i.e., biological treatment) GAC adsorption was relatively high in cost. This assumption may overestimate the actual cost of treatment using this process option; however, sufficient information is not currently available to make a final determination of the relative cost-effectiveness of GAC adsorption. The removal action being implemented by

USEPA at the MPTP site includes treatment of extracted groundwater by GAC. Site-specific mass loading rates could be determined after the USEPA groundwater treatment system has been operational for many months. This technology is retained for further consideration in the FS.

4.4.4.3 Ultraviolet (UV) Oxidation. Liquid-phase UV oxidation systems consist of a reactor vessel that provides contact between the contaminated groundwater and the UV light source. Oxidation of compounds in UV systems can occur by two types of mechanisms: hydroxyl radical ($OH^{\bullet}$) attack and/or direct photolysis of the compound by absorption of the UV energy. Producing sufficient concentrations of $OH^{\bullet}$ in UV systems requires the addition of ozone or hydrogen peroxide.

Liquid-phase oxidation processes that use combinations of UV, ozone, and/or hydrogen peroxide are effective in treating groundwater with most chlorinated hydrocarbons. These processes have advantages over other groundwater treatment technologies in that many contaminants can be completely destroyed rather than just transferred from one phase to another. A disadvantage of these systems is that many chlorinated compounds may not be completely destroyed by these processes, and partial oxidation could result in the formation of oxidation by-products, which may require further treatment.

A treatability study was conducted to determine the effectiveness of UV oxidation with the addition of ozone or hydrogen peroxide in destroying PCP (Keystone, 1992c). Keystone's results indicated that high removal efficiencies can be obtained. In general, this process option is higher in cost relative to the bioreactor and activated carbon treatment options. Further studies may be required to determine the types of chemicals to be added and reaction by-products formed during oxidation.

4.4.4.4 Oil/Water Separation. Oil/water separation is generally achieved by allowing the oil to float under quiescent conditions, and then skimming the oil from the water surface while drawing the water off below. The flotation is sometimes enhanced by coagulating or coalescing the oil droplets using chemicals, filters, or mechanical devices, or by introducing air or gas bubbles into the water.

A treatability study was conducted to determine the most effective means of enhancing the separation of soluble and insoluble material from contaminated groundwater using physical and chemical pretreatment (Keystone, 1991b). The study considered gravity settling, pH adjustment, coagulation/flocculation, and dissolved air flotation (DAF). Gravity settling is effective in achieving significant removals of oil and grease and total suspended solids from groundwater with minimal sludge production. Gravity settling can then be followed by pH adjustment or coagulation/flocculation and then filtration. Coagulation/flocculation, which provided the best overall removal rates in Keystone's treatability study, is effective in removing residual oils and supernatant solids which are not captured by gravity settling. Visual observation indicated that coagulation/flocculation produced the clearest supernatant. Neither pH adjustment or DAF were as effective in removing residual oils or suspended solids.

Although not considered effective for the overall treatment of contaminated groundwater, oil/water separation can be used as a pretreatment method. All of the groundwater treatment technologies considered in developing alternatives will include pretreatment with gravity settling followed by coagulation/flocculation and filtration.

4.4.5 Groundwater Disposal

Following aboveground treatment, groundwater would require disposal. Four disposal options were evaluated. These options include recharge or reinjection into the aquifer; or discharge to a surface water, a POTW, or an industrial wastewater treatment facility. Treated groundwater discharged to Silver Bow Creek must meet Montana Water Quality Act I-Classification standards (including for inorganic constituents) for discharge. Discharging into the strata underlying the site is possible and can control off-site and downward migration of contaminants and possibly provide some bioremediation of impacted soils. Transporting impacted water to an industrial wastewater treatment facility depends on the characteristics of the water and the capacity of the facility. Currently, no industrial wastewater treatment facilities exist in the MPTP area; however, a water treatment facility for treatment of inorganic contamination may be constructed for the Lower Area One operable unit of the Butte/Silver Bow Creek NPL site. Discharge to the municipal wastewater treatment system also depends on wastewater characteristics and the capacity of the plant to accept the water. Pretreatment requirements would be set by the POTW and by applicable federal and state regulatory requirements. Pretreatment standards have not been identified for MPTP discharge water. Selection of the most appropriate discharge option will be made during the design phase of the remedial action. For the purpose of developing costs under this feasibility study, only recharge to the aquifer and discharge of excess water to Silver Bow Creek are retained for further consideration.

4.5 DECONTAMINATION TECHNOLOGIES

This section screens the potentially applicable technologies for decontaminating site buildings, former plant process equipment, and storage vessels that are currently stored at the MPTP site. The former pole treating building and office remain on site within the fenced former treatment area. South of the former treatment area, there are support buildings (sheds) and the remnants of a crane used for dipping poles. Four large storage tanks are located in the southern half of the site. Six buildings exist west of the former treatment area: five USEPA soil storage buildings and the old plant sawmill which houses some of the dismantled plant process equipment. The old plant sawmill building is surrounded by a chain-link fence.

Wipe test samples from the dismantled and stored equipment were analyzed for PCP, PAHs, dioxins, and furans. Detected concentrations ranged from 3.09 to 317 μg/wipe (a wipe encompasses an area of 100 cm^2) for PCP and 16.46 to 20.76 μg/wipe for PAHs; 2,3,7,8-TCDD equivalent concentrations for dioxins and furans ranged from 4×10^{-5} to 0.00719 μg/wipe.

Table 4-5 summarizes the screening of the decontamination technologies for the site buildings, dismantled plant process equipment, storage vessels, and debris based on effectiveness, implementability, and cost. Section 4.5.1 describes the applicable decontamination technologies for buildings. Section 4.5.2 and 4.5.3 screen the potentially applicable technologies for decontamination and disposal of former plant process equipment and storage vessels, respectively. Decontamination and disposal of the debris is discussed in Section 4.5.4.

4.5.1 Building Decontamination Technologies

Four methods of decontamination that apply to buildings include wet processes, wipe methods, HEPA vacuuming, and surface removal by scarification. Wet processes include high pressure cleaning of surfaces with water combined with surfactants and/or solvents, if necessary, to solubilize and remove contaminants. This process requires collection and treatment of the washwater prior to disposal to the POTW or the groundwater treatment facility. Wipe methods are effective if contaminants are close to the surface and can be easily removed with a cloth. High-efficiency particulate (HEPA) vacuuming is a suction process which physically pulls contaminants from the surface and filters the chemical-containing particles through HEPA filters. Both wipe cloths and HEPA filters reduce the volume of contaminated material and can be recycled and/or disposed of as a hazardous solid. Scarification processes include high-speed pneumatic needle-nose guns to remove predetermined layers of concrete, and planers to remove layers of contaminated wood from walls, floors, or ceiling surfaces. Scarification processes reduce the volume of contaminated waste which then must be treated and/or disposed. Each of these technologies removes contaminants on different types of surfaces. Wipe and vacuum methods reach surficial contamination while wet and scarification processes attack contaminants deep within the surface pores.

The building configuration, composition of the building materials, and type and level of chemicals present on the building surfaces dictate which method or combination of methods is appropriate for a particular building. Buildings with high ceilings, rafters, and/or ventilation systems usually require phased cleaning efforts to protect already decontaminated areas. Building materials that are more porous, such as brick, concrete, wood, and rusted or decomposed metals limit access of conventional cleaning techniques and may require scarifying the surfaces followed by resurfacing to reduce contaminated volume. Wet washing contaminated walls, floors, and ceilings is effective in decontaminating buildings and minimization of wash effluent reduces cleanup costs and controls the passing of contaminants from one media to another. Wipe methods and HEPA vacuuming may be effective in removing contaminants from building surfaces. All of these methods are considered further in the FS for the decontamination of buildings.

4.5.2 Plant Process Equipment Decontamination Technologies

The former plant process equipment and machinery may require decontamination prior to disposing it by either landfilling or salvaging. The same technologies for decontaminating buildings apply; however, wet washing is the most effective for this site. HEPA vacuuming and wipe methods are not effective for piping and hard to reach areas, which are common with MPTP process equipment. Scarification processes are not effective for metal or rubber surfaces, of which much of the plant process equipment is composed. The confined spaces within tanks, process lines, and pumps require special attachments for the high pressure washing equipment to reach. If disposal in a RCRA-permitted landfill is the method of choice, cutting or disassembling equipment to reduce volume is essential.

Wood poles remaining on-site are difficult to decontaminate using conventional methods because contaminants penetrate deep into the wood where they remain lodged and inaccessible. For large pieces of wood, planing the surface is effective. For small pieces of wood (less than 2 inches by 4 inches), volume reduction could be achieved by grinding the boards into chips. Combining the chips with a soil washing system or biological treatment mechanism may extract the contaminants.

4.5.3 Storage Vessel Decontamination Technologies

Decontaminating tanks and drums containing oils and sludges requires removing the contents and high-pressure washing the inner surfaces. As previously mentioned, surfactants and/or solvents may be necessary to scrub the contaminants from the surface. Cutting the decontaminated storage vessels prior to disposal reduces volume. Wipe methods, HEPA vacuuming, and scarification processes are not effective in decontaminating storage vessels. Excessive cloths and HEPA filters are required to remove remaining oily wastes and sludge from the surfaces of tanks and storage vats. Scarification processes are not effective for metal tanks and drums. Section 4.2 addresses treatment of the removed sludges and oils.

4.5.4 Debris Handling Methods

At the MPTP site, debris is found in several forms, including cut up pieces of metal tanks, automobile parts, wood scrap, pieces of equipment from processes, concrete, rebar, miscellaneous wood panels and chips, metal and plastic containers, railroad ties, oil boom, and other miscellaneous metal, rubber, and plastic.

In order to properly determine the most implementable and effective method for handling this wide variety of debris, a detailed inventory should be conducted as the first step. Included in this inventory is the determination of the type of debris, the size and/or volume of debris, and the concentration of chemical constituents present on the debris surface.

Once the inventory is completed, more detailed screening steps follow. These steps include evaluating the feasibility of physical separation or screening of debris pieces, determining if the debris is hazardous or nonhazardous, and evaluating decontamination technologies that may be applicable to the debris. During the inventory, a cost benefit analysis can also be prepared to determine the cost effectiveness of disposing some of the equipment and debris in a RCRA Subtitle C landfill without further treatment.

4.6 SUMMARY OF THE SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Several process options from each general response action category have been retained for further consideration in the FS in the development of remedial alternatives in Section 5.0. These general response action categories include no action, groundwater monitoring, institutional controls, containment, removal/extraction, in situ treatment, aboveground treatment, and disposal.

Groundwater monitoring would be included in all of the remedial alternatives developed in Section 5.0, except no action, to evaluate future contaminant migration and/or to assess the effectiveness of remedial action at the MPTP site. Institutional controls include those that currently are in place for the MPTP site (zoning limitations, flood regulations, subdivision regulations, and building codes); modifications to the existing controls; and additional institutional controls, such as private property rights.

Containment actions for soils include capping of contaminated surface and subsurface soils as well as other surface control measures, such as grading and revegetation. Removal actions for soils include excavation. In situ bioremediation has been retained for cleanup of subsurface soils and groundwater. In addition, other in situ technologies such as soil flushing could be considered for enhancing LNAPL recovery and soil cleanup in areas of the site where excavation is not feasible, particularly the area beneath the interstate highway and the active railway. Aboveground treatment process options for soils considered further in the FS include on-site incineration, biological land treatment, and soil washing. The bioslurry process option has been retained for possible use in soil washing residuals treatment.

One process option, off-site incineration, has been retained for treatment of oily wastes and sludges currently stored on the MPTP site and any other oily wastes generated as a result of remediation activities. On-site incineration would be used for treating stored, oily wastes and sludges, only if this process option is used for treating excavated soils. It is possible that oily wastes could be recycled as hazardous waste fuel.

Groundwater extraction options retained for further consideration in the FS include trenches and extraction wells. Although the USEPA has experienced some difficulty in trench installation at the site, trenches may still be feasible and a combination of trenches and extraction wells may provide the best overall approach to groundwater extraction. The objectives of the groundwater extraction and treatment system are: 1) to remove LNAPLs; 2) to control contaminant migration into Silver Bow Creek and currently uncontaminated areas; and 3) to provide for long-term remediation of the contaminated aquifer. An important aspect of a groundwater extraction system is limiting contaminant migration off site. This can be accomplished with hydraulic and physical barriers.

Groundwater treatment options that are feasible for the MPTP site include pretreatment with oil/water separation to separate the LNAPL and aqueous waste streams; UV oxidation followed by carbon polishing; carbon adsorption; and biological treatment. Selection of the most appropriate treatment process will occur during the remedial design. Extracted, treated groundwater would then be disposed. For the purposes of this FS, it is assumed that extracted, treated groundwater would be recharged to the aquifer or discharged to Silver Bow Creek.

Several methods have been retained for further consideration in the FS for decontaminating equipment and debris. These methods include wet washing, wipe methods, HEPA vacuuming, and scarification. Equipment and debris would be disposed of in an on-site landfill or in an appropriate off-site landfill. On-site landfilling may require previous decontamination of the material. Off-site landfilling may or may not require previous decontamination of the material, depending upon the type of landfill used.

5.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

Section 5.1 develops the remedial alternatives by combining the process options screened in Section 4.0. In Section 5.2, the alternatives developed in Section 5.1 are screened based on effectiveness, implementability, and cost. Section 5.3 summarizes the screened alternatives that are analyzed in detail in Section 6.0.

5.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The remedial alternatives are developed by selecting a process option or a combination of process options from each of the following general response action categories: no action, groundwater monitoring, institutional controls, containment, removal/extraction, in situ treatment, aboveground treatment, and disposal. A variety of technologies in each of these categories were evaluated and screened in Section 4.0. Technologies that were retained for further consideration are summarized in Section 4.6 and shown in Table 4-6.

For the purposes of this FS, where two or more process options have similar effectiveness, implementability, and cost, only one option is carried forward for development of remedial alternatives. This allows for flexibility in selection of a specific process option during design and implementation of the remedy without having to specifically evaluate these process options further in this feasibility study. The representative process options being carried forward include clay capping as representative of capping technology, trenching, wells as representative of groundwater extraction technology, oil/water separation/bioreactor/carbon polishing as representative of groundwater treatment technology, and off-site incineration as the representative treatment/disposal technology for oils and sludges. Three technologies are being carried forward for treating soil: incineration, on-site bioremediation, and soil washing with residuals treatment.

In addition, some process options are being carried forward on a limited basis or for application only under specific circumstances. In situ soil flushing is not considered applicable site wide, but may provide a method to enhance LNAPL and contaminant recovery in areas that cannot be excavated. Off-site landfilling, although not considered applicable to organically contaminated soils, is being retained to dispose of near-creek soils which may contain high levels of inorganic contaminants. After treatment for organics these soils may require treatment or disposal to address inorganics because these soils may not be suitable for backfill on site. On-site incineration of oils and sludges is being carried forward as a logical option if this process is selected for soils, although on-site incineration is not cost effective compared to off-site incineration for oils and sludges only. Some of the alternatives considered in this FS include soil washing as the primary soil treatment technology. Treatment of residuals generated in the soil washing process could occur by biological land treatment or by bioslurry reactor. For the purpose of evaluation under this FS, it is assumed that a bioslurry reactor will be used for residuals treatment.

Table 5-1 summarizes the five alternatives that have been developed by this procedure. These alternatives encompass the range of remediation activities from no further action to total removal of impacted soils to the extent practicable, with long-term management and treatment for groundwater.

Alternatives 1 and 2

Alternatives 1 (no action) and 2 (institutional controls) include maintaining the USEPA's actions currently being implemented on the MPTP site as well as existing institutional controls that are in place for the MPTP site. Alternative 2 also includes groundwater monitoring to assess future LNAPL and dissolved groundwater contaminant migration, and implementing additional institutional controls that would further restrict land development for the MPTP site. Neither of these alternatives include treatment or disposal of LNAPL or removed soils resulting from USEPA's removal actions.

Alternative 3

Under Alternative 3, no further excavation of contaminated site soils would be conducted except for 1) the soils removed during construction of the groundwater system (approximately 7,000 yd^3), 2) the soils near Silver Bow Creek impacted by the seeps (approximately 6,000 yd^3), and 3) the surface soil "hot spots" (approximately 6,000 yd^3). The hot spot soils would be excavated to a depth of 3 feet and consolidated in the former process area. The contaminated surface and subsurface soils in the former process area and along the historic drainage ditch would be contained by capping. The cap would be sloped from 1 to 3 percent and revegetated to limit erosion. In addition, a drainage channel would be constructed around the cap to divert surface run-off around the capped area. The extent and location of the cap is shown in Figure 5-1.

Alternative 3 is divided into three subalternatives, 3A, 3B, and 3C, which vary only with regard to the treatment technologies for removed soil. Alternative 3A includes on-site incineration; Alternative 3B includes on-site bioremediation; and Alternative 3C includes soil washing. Under Alternative 3C, residuals from soil washing would be treated in a bioslurry reactor and the process water would be treated by the groundwater treatment system. The estimated volume of soil treated under this alternative is 23,000 yd^3 which includes previously removed soils (10,000 yd^3).

The groundwater extraction design for Alternative 3 would entail an extensive network of extraction and containment mechanisms (trenches, extraction wells, physical/hydraulic barriers) designed to remove LNAPL, contain the plume, and remediate the contaminated aquifer. Aboveground groundwater treatment would occur to the degree required by the treated water disposal option. For the purposes of this FS, aboveground groundwater treatment is assumed to consist of oil/water separation, bioreactor treatment, and carbon polishing. In situ bioremediation would be utilized after all the LNAPLs that can be recovered have been removed, in an attempt to achieve long-term aquifer remediation.

Recovered LNAPL, oily wastes and sludges, equipment and debris, and groundwater would also be addressed in Alternative 3. Long-term monitoring of groundwater and institutional controls would also be implemented.

Alternative 4

In addition to the soils excavated under Alternative 3, Alternative 4 includes excavation of contaminated soils in areas where contamination extends from the surface to the groundwater table. Subsurface excavation would occur to a depth of approximately 4 feet below the groundwater table. The areas of the site that would be excavated under Alternative 4 are shown on Figure 5-2. The estimated volume of soil excavated under this alternative is 105,000 yd^3 which consists of soil categories 2, 3, 4, and 5 listed in Table 3-5. The estimated volume of soil treated under this alternative is 115,000 yd^3 which includes the bagged soils. Other soil actions that would be necessary under Alternative 4 include filling of excavated areas, surface grading, and revegetation.

Alternative 4 is divided into three subalternatives, 4A, 4B, and 4C, which vary only with regard to the treatment technologies for soil. Alternative 4A includes on-site incineration; Alternative 4B includes on-site bioremediation; and Alternative 4C includes soil washing. Under Alternative 4C, residuals from soil washing would be treated in a bioslurry reactor.

The remedial action objectives for groundwater are the same as for Alternative 3. Groundwater treatment would occur to the degree required by the treated water disposal option. For the purposes of this FS, aboveground groundwater treatment is assumed to consist of oil/water separation, bioreactor treatment, and carbon polishing. In situ bioremediation would be utilized in an attempt to achieve long-term aquifer remediation after all the LNAPLs that can be recovered have been removed.

Recovered LNAPL, oily wastes and sludges, equipment and debris, and groundwater would also be remediated under Alternative 4. Long-term monitoring of groundwater and institutional controls would be implemented.

Alternative 5

Under Alternative 5, excavation of contaminated soils would occur in the same areas as described for Alternative 4 in addition to areas where subsurface soils have been impacted by the presence of LNAPL. For the purposes of this FS, the soils impacted by the LNAPL, outside of the areas considered under Alternative 4, are assumed to extend from 2 feet above to 4 feet below the groundwater table. The lateral extent of this zone of excavation corresponds with the lateral extent of the LNAPL plume as shown on Figure 5-3. The estimated volume of soil excavated under this alternative is 292,000 yd^3 which consists of soil categories 2, 3, 4, 5, 6, and 7 listed in Table 3-5. This volume includes about 94,000 yd^3 of uncontaminated soil requiring excavation to access the LNAPL "smear zone" soils. These overlying soils would be separated from underlying contaminated soils during excavation and would not be treated. The estimated volume of soil requiring treatment is 208,000 yd^3 which includes soil categories 1, 2, 3, 4, 5, and 6 listed in Table 3-5. Other soil actions necessary under Alternative 5 include LNAPL removal (via extraction wells, water flushing, or other enhancement methods) and in situ bioremediation in areas inaccessible for excavation, replacement of clean soils, filling of excavated areas with either clean or treated soils, surface grading, and revegetation.

Alternative 5 is divided into three subalternatives, 5A, 5B, and 5C, which vary only with regard to the treatment technologies for soil. Alternative 5A includes on-site incineration; Alternative 5B includes on-site bioremediation; and Alternative 5C includes soil washing. Under Alternative 5C, residuals from soil washing would be treated in a bioslurry reactor and the process water would be treated by the groundwater treatment system.

The remedial action objectives for groundwater under Alternative 5 are the same as for Alternatives 3 and 4, but due to the difference in the soil excavation approach, the groundwater extraction design for Alternative 5 may entail a less extensive network of extraction and containment mechanisms (trenches, extraction wells, physical/hydraulic barriers) because excavation of all accessible areas containing LNAPL would be part of this alternative. Groundwater treatment would occur to the degree required by the treated water disposal option. For the purposes of this FS, aboveground groundwater treatment is assumed to consist of oil/water separation, bioreactor treatment, and carbon polishing. In situ bioremediation would be utilized once the LNAPL has been excavated in an attempt to achieve long-term aquifer remediation.

Under Alternative 5, recovered LNAPL, oily wastes and sludges, equipment and debris, and groundwater would also be remediated. Long-term monitoring of groundwater and institutional controls would be implemented.

5.2 SCREENING OF REMEDIAL ALTERNATIVES

This section screens the remedial alternatives developed in the previous section based on effectiveness, implementability, and cost as defined in the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988). A brief description of each criterion is included below.

In general, the effectiveness criterion focuses on the degree to which an alternative reduces toxicity, mobility, or volume through treatment; minimizes residual risks and affords long-term protection; complies with ARARs; minimizes short-term impacts; and how quickly it achieves protection. Specifically, the effectiveness criterion addresses whether the remedial alternative satisfies the preliminary remedial action objectives (PRAOs) and preliminary remedial action goals (PRAGs) identified for the MPTP site as presented in Section 3.1. The costs for the FS are presented as 30-year present-worth costs in accordance with guidance from the National Contingency Plan (40 CFR 300). Depending on the alternative selected and the effectiveness of that alternative in achieving remedial action goals, groundwater remediation activities and other long-term maintenance activities may continue for a period significantly longer than 30 years.

Given the nature and extent of groundwater contamination at the MPTP site and historical difficulties encountered with pump-and-treat technologies for remediating aquifers at other similar sites, remediating the MPTP aquifer to MCLs and non-zero MCLGs for all contaminants of concern will be difficult even with total removal of contaminated soil and LNAPL by excavation. As discussed in detail in Section 3.0, the USEPA is recommending that remedial actions that may not meet chemical-specific ARARs or other health-based action levels have contingency measures. These measures include engineered controls to contain the plume such as physical barriers and/or gradient control wells, institutional controls that restrict access, continued monitoring, and periodic reevaluation of remedial technologies and effectiveness of the selected remediation program.

The intent of groundwater remediation at the MPTP site includes long-term restoration of the aquifer, however, the above information will be considered throughout the groundwater remediation program.

The implementability criterion focuses on the technical feasibility and availability of the technologies and the administrative feasibility of implementing the alternative. Construction costs and any long-term costs to operate and maintain the alternatives are considered. Alternatives that provide similar effectiveness and implementability to other less costly alternatives can be eliminated based on cost.

5.2.1 Alternative 1 - No Action

In Alternative 1, no further action (other than the USEPA's actions currently being conducted at the MPTP site) would be undertaken at the site. Wastes such as separator oil and spent carbon would continue to be generated and stored on-site.

This alternative also includes the existing institutional controls currently in place for the MPTP site. These controls include zoning limitations (which restrict residential development), flood plain regulations (which restrict building in portions of the site in the 100-year floodplain), subdivision regulations (which control further subdivision of the site), building regulations, and the domestic well ban (which prevents future wells from being used as potable supply).

Because contamination would continue to exist on site above acceptable health-based risk levels, 5-year site reviews are included in this alternative in accordance with CERCLA regulations.

5.2.1.1 **Effectiveness.** The no-action alternative would not be effective in meeting the PRAOs for the site media presented in Section 3.0. Institutional controls currently in existence for the MPTP site would be effective in providing some protection to human health by restricting land uses to industrial activities and banning the use of groundwater as potable supply. This alternative does not address various wastes, such as oils and sludges and previously excavated soils currently stored on site as well as other wastes, that would be generated as a result of the USEPA's ongoing actions. Additionally, this alternative does not prevent exposure to contaminated surface and subsurface soils currently in-place on the MPTP site. However, the results of the baseline risk assessment indicate that the excess cancer risks to the trespasser, worker, and potential future resident from ingestion and dermal contact with contaminated soils are within the 10^{-4} to 10^{-6} risk range (CDM, 1993).

The no-action alternative is not effective in containing the dissolved groundwater contaminant plume from further migration and does not provide for treatment of contaminated groundwater. Actions are currently being conducted by the USEPA at the MPTP site to limit migration of LNAPL into Silver Bow Creek; however, these actions are not designed to contain the migration of the dissolved contaminant plume.

5.2.1.2 **Implementability.** Alternative 1 is technically implementable.

5.2.1.3 **Estimated Costs.** There are no capital costs for Alternative 1. The O&M costs include those costs for the USEPA's actions currently being implemented on the site and those costs for maintaining the existing institutional controls. The annual O&M costs and total present worth are summarized in Table 5-2. The estimated 30-year present worth for Alternative 1 is approximately $2.3 million.

5.2.2 Alternative 2 - Additional Institutional Controls and Groundwater Monitoring

In Alternative 2, additional institutional controls, beyond those currently in existence and described under Alternative 1, would be implemented to further restrict the development of land. These controls could include deed restrictions that prevent residential development and construction activities in contaminated areas and modifications to the zoning laws and building codes. The zoning laws could be modified to disallow certain uses for the land, such as kennels, stables, and stockyards. Building codes could be modified to restrict construction depths to less than the depth of the water table. The USEPA's actions currently being conducted at the MPTP site would continue. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions and proposes a Superfund district that would have additional restrictions. Wastes such as separator oil and spent carbon would continue to be generated and stored on site.

This alternative would include monitoring of downgradient and vertical migration of dissolved groundwater contamination and LNAPL. For the purposes of this FS it is assumed that long-term monitoring would include the installation of four additional wells, and semiannual sampling of 15 monitoring wells to evaluate the movement of the LNAPL and contaminated groundwater plumes. Because contamination would continue to exist on site above acceptable health-based risk levels, 5-year site reviews are included in this alternative in accordance with CERCLA regulations.

5.2.2.1 Effectiveness. Alternative 2 would not be effective in meeting the overall PRAOs for site media presented in Section 3.0. Existing institutional controls provide some protection to human health by restricting land uses to industrial activities and banning the use of groundwater as potable supply. Additional institutional controls would be effective in providing additional protection to human health by further restricting future land development at the site. Alternative 2 includes groundwater monitoring which is an effective means of monitoring the future migration of contamination. This alternative does not address various wastes, such as oils and sludges and previously excavated soils currently stored on site, as well other wastes that would be generated as a result of the USEPA's ongoing actions. Additionally, this alternative does not prevent exposure to contaminated surface and subsurface soils currently in place on the MPTP site. However, the results of the baseline risk assessment indicate that the excess cancer risks to the trespasser, worker, and resident from ingestion and dermal contact with contaminated soils are within the 10^{-4} to 10^{-6} risk range (CDM, 1993). A summary of the results of the baseline risk assessment is presented in Section 2.0.

This alternative is not effective in containing the dissolved groundwater contaminant plume from further migration and does not provide for treatment of contaminated groundwater. Actions are currently being conducted by the USEPA at the MPTP site to limit the migration of LNAPL into the Silver Bow Creek; however, these actions are not designed to contain the migration of the dissolved groundwater plume.

5.2.2.2 Implementability. Alternative 2 is technically implementable. However, institutional controls such as deed restrictions can prove difficult to enforce and maintain. Butte-Silver Bow county is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions.

5.2.2.3 Estimated Costs. The capital costs for Alternative 2 include the construction of four monitoring wells and costs for negotiating additional institutional controls. The O&M costs include the semiannual sampling of 15 monitoring wells, the costs for the actions being implemented by the USEPA at the site, and the costs for maintaining the existing institutional controls. The capital costs, annual O&M costs, and total present worth are summarized in Table

5-3. The estimated 30-year present worth for Alternative 2 ranges from $3.3 million to $4.4 million. Detailed costs are provided in Appendix B.

5.2.3 Alternative 3: Groundwater Monitoring; Capping; Treatment of Removed and Excavated Soils; Containment and Treatment of Groundwater and LNAPL; Treatment of Oily Wastes, Sludges, Equipment, and Debris

The technologies and process options included in Alternative 3 are listed on Table 5-1 and described below. Groundwater and LNAPL in and around the MPTP site would be monitored to evaluate the effectiveness of the associated recovery and treatment system. The same institutional controls would be implemented as those discussed under Alternative 2.

Alternative 3 includes the treatment of previously excavated soils, miscellaneous oils and sludges currently stored on-site, as well as any other contaminated soils that may be excavated as a result of the construction of remediation facilities (e.g., extraction trenches). Contaminated soils north of the Gundwall, where seepage of LNAPL has occurred, would be excavated and treated along with the previously removed soils. Contaminated surface soil hot spots (Figure 5-1) outside of the former process area and drainage ditch area would be consolidated with soils in the process area prior to capping. Capping the contaminated soils currently in-place on site would be included to prevent exposure and reduce infiltration. The cap would cover an area approximately 170,000 square feet (Figure 5-1) which includes the former process area and the drainage ditch.

The previously removed soils and the soils north of the Gundwall would be treated and backfilled on site. If the treated soils meet the cleanup level identified in the Record of Decision (ROD) they could be backfilled anywhere on site. If the treated soils do not meet the cleanup level, they would be backfilled in the area where the cap would be located. Alternative 3 is divided into three subalternatives which vary only with regards to their soil treatment technology. Alternative 3A includes on-site incineration of soils and oils and sludges. Alternative 3B includes on-site bioremediation of soils. Alternative 3C includes soil washing and residuals treatment by bioslurry reactor.

Oils and sludges currently in place at the MPTP site would be incinerated on-site along with soils under Alternative 3A. Under Alternative 3B and 3C it is assumed that these materials would be incinerated off-site. Disposition of LNAPL recovered through groundwater remediation after completion of the oils and sludges treatment program will be conducted in accordance with applicable regulations. For the purpose of estimating costs in this FS, it is assumed that LNAPLs would be incinerated off-site.

Equipment and debris can be either disposed of in a Subtitle C landfill without treatment, or, if adequately decontaminated, disposed in a Subtitle D landfill. Under Alternative 3 it is assumed that contaminated equipment and debris would be decontaminated and disposed of in an appropriate off-site landfill.

The primary objectives of the groundwater extraction system and treatment systems, which are summarized in Section 5.1 and detailed in Section 4.4, are to contain the dissolved contaminant and LNAPL plumes. The detailed design of the groundwater extraction and treatment systems at the MPTP site will be conducted during the design stages of the remedial action. The detailed design must consider the operating USEPA LNAPL Recovery System, the dewatering activities planned for the LAO site, and the varied hydrogeologic conditions around the site.

For the purpose of estimating costs in this FS, the following preliminary design assumptions were made. A segmented interception system in the vicinity of the North Recovery Trench would be installed with four segments, each 425 feet long and 10 feet deep, and each separated by a narrow groundwater flow barrier. These trenches would extract at a total flow rate of approximately 80 to 100 gpm. This system, shown in Figure 4-2, would extend from approximately 200 feet east of the railroad embankment crossing of Silver Bow Creek to the vicinity of well BMW-1, 1,700 feet to the west. An additional interception system would be constructed near the South Recovery Trench and would operate at an extraction rate of approximately 15 gpm. The USEPA LNAPL Recovery System would continue to operate under Alternative 3.

Extracted groundwater would be pretreated using enhanced oil/water separation (Section 4.4.3) for LNAPL recovery. For Alternative 3A, the oil phase from the separation process would be treated by on-site incineration during the first year of operation (while the incinerator is on site) and then by off-site incineration during the ensuing years. Alternatives 3B and 3C would utilize off-site incineration for all recovered LNAPLs. For the purposes of this FS, it is assumed that the aqueous phase would be treated by a bioreactor followed by carbon polishing to remove PCP and any other organic contaminants of concern. As stated previously, other treatment methods such as UV/oxidation or GAC may be utilized instead of a bioreactor. All the methods will be evaluated during detailed design. Additionally, if it is found that treatment for inorganic contaminants is necessary to meet discharge requirements, an appropriate process would be employed, possible in conjunction with treatment at the Silver Bow Creek/Butte Area NPL site. In situ bioremediation would be utilized to assist in long-term cleanup of groundwater and subsurface soils.

For the purposes of this FS, based on site conditions as they existed during the RI field investigation, it is assumed that approximately 35 gpm of the treated groundwater would be discharged to Silver Bow Creek to maintain the water balance across the site. The other 60 to 80 gpm would be recharged in a series of three reinjection wells spaced approximately 300 feet apart along the south and southeast periphery of the contaminated groundwater plume (Figure 4-2). After all recoverable LNAPLs have been collected, the system would be adjusted for addition of an in situ bioremediation process.

The stated preliminary design assumptions for the groundwater extraction and treatment system are based on site conditions as they existed during the RI field investigation. They do not take into account the USEPA LNAPL Recovery System or the affects on site hydrogeology from the dewatering activities schedule at LAO.

5.2.3.1 **Effectiveness.** Alternative 3 meets the PRAOs established for the MPTP site. Alternative 3 would be effective in eliminating potential human health and ecological risks caused by oils and sludges and contaminated surface soils at the site. Incineration of oils and sludges would be effective in reducing the mobility, toxicity, and volume of the contaminated oils and sludges.

Capping the former process area and the drainage ditch would be effective in preventing exposure (via incidental ingestion or dermal contact) to contaminated surface and subsurface soils currently in place on the MPTP site. Additionally, migration of contamination from vadose zone soils to the groundwater via infiltration would be reduced. Capping does not remove the major source (i.e., LNAPL) of groundwater contamination, and would not address migration of contaminants from LNAPL and soils to the saturated zone. However, contaminated groundwater and LNAPL would be contained by physical and hydraulic barriers, and releases would be effectively limited. A cap is subject to deterioration over time and requires long-term maintenance.

The effectiveness of removed soil treatment would vary depending upon the selection of Alternative 3A, 3B, or 3C. Alternative 3A, which consists of incineration of removed soils, would be effective in destroying at least 99 percent of the organic contaminants of concern in the soil matrix. The soil treated by incineration would meet all of the PRAGs listed on Table 3-1.

Alternative 3B, which consists of bioremediation of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Bioremediation would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and 10^{-6} for recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils. Design studies will be necessary to fully define treatment efficiency. Alternative 3B is not expected to be as effective as Alternative 3A.

Alternative 3C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet the 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

During soil washing COCs would be transferred to the process water or would remain in the fine fraction. For the purposes of this FS, it is assumed that the fraction of fines produced from the soil washing process would be about 5 percent (Keystone, 1991) and would require further treatment. Of the estimated 23,000 yd^3 of soils that would require treatment under this alternative, about 1,150 yd^3 of fines would require further treatment. Although this fine fraction may contain fairly high concentrations of PCP, PAH, dioxins, and furans, the biological slurry reactor is expected to be effective in reducing the levels of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. As with biological land treatment, design studies will be necessary to fully define treatment efficiency and process details. Alternative 3C is expected to be as effective as Alternative 3B but is not expected to be as effective as Alternative 3A.

The soils located near or beneath the creek may contain high concentrations of inorganic compounds that could preclude them from being backfilled on site. If these soils have high concentrations of inorganics, they would be treated for organic compounds separately and then transported to a local repository for disposal. Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

Under Alternative 3A, 3B, and 3C, contaminated groundwater and LNAPL would be contained by physical and hydraulic barriers. Assuming effective long-term operation and maintenance, releases would be limited sufficiently to attain PRAGs in Silver Bow Creek. Also, migration of contaminated groundwater and LNAPL would be effectively reduced or eliminated sufficiently to ensure PRAGs in adjacent uncontaminated aquifers.

During the RI, the area of groundwater in close proximity to Silver Bow Creek downstream of the site was shown to contain low levels of site-related contamination. It is expected that natural biodegradation and attenuation would effectively reduce the levels of organic contaminants in this area once site remediation has effectively contained the contaminated groundwater and LNAPL, and releases have been effectively reduced or eliminated. These natural mechanisms will be relied upon to address this low level contamination outside of the major plume boundary.

The groundwater treatment system would be effective in treating the organic compounds (and inorganic compounds if necessary) in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow Creek. A pilot-scale study may be required to determine the quantity of sludge produced requiring disposal and to determine the levels of dioxins in the sludge.

Aggressive LNAPL recovery, via trenches and extraction wells, would be expected to remove approximately 25 to 50 percent of the mass of LNAPL present in the subsurface. However, since a significant volume of LNAPL would not be recovered by these methods, and since this alternative does not include excavation of heavily contaminated soils and associated LNAPL, the long-term effectiveness of in situ bioremediation will be limited. Aquifer remediation to PRAGs is not expected within a 30 year remediation period.

This alternative also includes groundwater monitoring, which is effective for evaluating potential migration from the site and for determining the effectiveness of the remedial actions. Existing institutional controls provide some protection to human health by restricting land uses to industrial activities and banning the use of groundwater as potable supply. Additional institutional controls would be effective in providing additional protection of human health by further restricting future land development at the site. The institutional controls enacted for the site would be evaluated during the 5-year site reviews included in this alternative. Institutional controls require long-term enforcement and therefore do not offer the degree of permanence that a complete treatment option does.

Decontamination and/or disposal of contaminated equipment and debris in an appropriate off-site landfill would be effective in preventing future human exposure to these materials.

5.2.3.2 Implementability. Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

All treatment and or disposal methods associated with the soils and groundwater at the MPTP site are technically implementable. However, on-site incineration may not be acceptable to the local community. Approximately 23,000 yd^3 of soil would be excavated and treated under this alternative. It would take about 1 year to incinerate the soil, about 2 years to bioremediate the soil, and about 1 year to wash the soil.

The USEPA LNAPL Recovery System would be used to the extent possible in the overall groundwater remediation system. Additional wells and/or trenches would be required to contain the dissolved contamination. Construction of trenches may be difficult due to flowing sand conditions which have been encountered at the site. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would be required prior to designing the system to better define the extent of the plume, particularly in the northwest corner of the site.

To achieve effective containment of the contaminated groundwater and LNAPL, extensive monitoring and system adjustments would be required over the long term. The groundwater system would be expected to operate indefinitely.

Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable, however, a more detailed inventory would be required.

5.2.3.3 **Estimated Costs.** Tables 5-4 through 5-6 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; soil capping; excavation of some soils; groundwater extraction; soil, groundwater, and oily wastes treatment for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 3A ranges from $34.7 million to $60.1 million; Alternative 3B ranges from $21.0 million to $36.6 million; and Alternative 3C ranges from $27.7 million to $43.8 million. Thirty years duration for calculating present worth was chosen based on guidance from the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300). The groundwater treatment system is expected to operate for more than 30 years.

5.2.4 Alternative 4: Groundwater Monitoring; Excavation and Treatment of Contaminated Surface and Subsurface Soils; Treatment of Removed Soils; Containment and Treatment of Groundwater and LNAPL; Treatment of Oily Wastes, Sludges, Equipment and Debris

The technologies and process options included in Alternative 4 are listed on Table 5-1 and described below.

The remedial approach to site soils under Alternative 4 includes: treatment of previously excavated soils; excavation and treatment of contaminated soils from the former process area, the historic drainage ditch area, and surface soil hot spots; excavation and treatment of near-creek soils; and treatment of other contaminated soils that may be excavated as a result of the construction of remediation facilities.

Figure 5-2 shows the areas to be excavated under this alternative. The surface soil hot spots would be excavated to an approximate depth of 3 feet. The process area and the historic drainage ditch area would be excavated to approximately 4 feet below the groundwater table. These depths of excavation are based on the degree and vertical extent of contamination found at these locations during the RI. The soils excavated below the water table would require dewatering before being treated by incineration, may require some dewatering before bioremediation and are not expected to require dewatering before soil washing.

Enhanced LNAPL recovery may be possible during the excavation of soils from the former process area and the historic drainage ditch area. It is estimated that about 20 percent of the LNAPL would be collected by the excavation equipment and skimmer-type pumps that could be placed on ponded water within the excavated areas. After it is no longer advantageous to recover LNAPL from the excavated area, the area would be backfilled with treated soils. The soils that are put back into the plume area may become recontaminated.

Alternative 4A includes on-site incineration of soils. Alternative 4B includes on-site bioremediation of soils. Alternative 4C includes soil washing, and residuals treatment of bioslurry reactor. Treated soils would be backfilled on site.

Oils and sludges currently in place at the MPTP site would be incinerated on site along with soils under Alternative 4A. Under Alternatives 4B and 4C it is assumed that these materials would be incinerated off-site. Disposition of LNAPL recovered through groundwater remediation after completion of the oils and sludges treatment program will be conducted in accordance with applicable regulations. For the purposes of estimating costs in this FS, it is assumed that the LNAPLs would be incinerated off site but other options should be explored during remedial design.

Equipment and debris can be either disposed of in a Subtitle C landfill without treatment, or, if adequately decontaminated, disposed in a Subtitle D landfill. Under Alternative 4 it is assumed that contaminated equipment and debris would be decontaminated and disposed of in an appropriate off-site landfill.

The primary objectives of the groundwater extraction and treatment systems, which are summarized in Section 5.1 and detailed in Section 4.4, are to contain the dissolved contaminated groundwater and LNAPL plumes and remediate the aquifer to the extent practicable. The detailed design of the groundwater extraction and treatment systems at the MPTP site will be conducted during the design stages of the remedial action. The detailed design must consider the operating USEPA LNAPL Recovery System, the dewatering activities planned for the LAO site, and the varied hydrogeologic and geologic conditions around the site.

For the purpose of estimating costs for this FS, the following preliminary design assumptions are made. A segmented interception system in the vicinity of the North Recovery Trench would be installed with four segments, each 425 feet long and 10 feet deep, and each separated by a narrow groundwater flow barrier. These trenches would extract groundwater at a total flow rate of approximately 80 to 100 gpm. This system, shown in figure 4-2, would extend from approximately 200 feet east of the railroad embankment crossing of Silver Bow Creek to the vicinity of well BMW-1, 1,700 feet to the west. An additional interception system would be constructed near the South Recovery Trench and would operate at an extraction rate of approximately 15 gpm. The USEPA LNAPL Recovery System would continue to operate under Alternative 4 although the system may be modified because two of the wells are located near the area that would be excavated. It may be necessary to abandon those wells.

Extracted groundwater would be pretreated using enhanced oil/water separation (Section 4.4.3) for LNAPL recovery. For Alternative 4A, the oil phase from the separation process would be treated by on-site incineration during the first 3 years of operation (while the incinerator is on-site) and then by off-site incineration during the ensuing years. Alternatives 4B and 4C would utilize off-site incineration for all recovered LNAPLs. For the purposes of this FS, it is assumed that the aqueous phase would be treated by a bioreactor followed by carbon polishing to remove PCP and any other organic contaminants of concern. If it is found that treatment for inorganic contaminants is necessary to meet discharge requirements, an appropriate treatment process such as ion exchange would be employed. In situ bioremediation would be utilized to assist in long-term cleanup of groundwater and subsurface soils.

For the purposes of estimating costs for this FS, it is assumed that inorganics treatment is not required and that approximately 35 gpm of the treated groundwater would be discharged to Silver Bow Creek to maintain the water balance across the site. The other 60 to 80 gpm would be recharged in a series of three reinjection wells spaced approximately 300 feet apart along the south and southeast periphery of the contaminated groundwater plume (Figure 4-2). After all recoverable LNAPLs have been collected, the extraction and injection systems would be modified to operate in a mode that would enhance in situ bioremediation.

The stated preliminary design assumptions for the groundwater extraction and treatment system are based on site conditions presented in the RI. They do not take into account the USEPA LNAPL Recovery System or the affects on site hydrogeology from the dewatering activities scheduled at LAO.

5.2.4.1 Effectiveness. Alternative 4 would meet the PRAOs established for the MPTP site and would remove and treat about 60 to 70 percent of the in place LNAPL (under best conditions) and 44 percent of the contaminated soils. The estimate of the volume of LNAPL that may be removed under this alternative was based on the assumption that approximately 25 to 50 percent of the LNAPL could be removed by extraction. The remaining 10 to 20 percent would be removed during excavation. The volume of LNAPL removed during excavation was estimated based on the ratio of the volume of soil excavated to the volume of soil impacted by the LNAPL plume.

Alternative 4 would be effective in eliminating potential human health and ecological risks caused by oils and sludges at the site. On-site or off-site incineration of oils and sludges would be effective in reducing the mobility, toxicity, and volume of the contaminated oils and sludges.

Excavation and treatment of surface soil "hot spots," and surface and subsurface soils in the former process area and the drainage ditch would be effective in reducing potential exposure to contaminated surface soils currently in place at the MPTP site. The effectiveness of soil treatment would vary depending upon the selection of Alternative 4A, 4B, or 4C. Alternative 4A, which consists of incineration of soils, would be effective in destroying approximately 99 percent of the organic contaminants of concern in the soil matrix. The soil treated by incineration would be expected to meet all of the PRAGs listed on Table 3-1. Alternative 4B, which consists of bioremediation of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Bioremediation would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and 10^{-6} for recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils. Design studies will be necessary to fully define treatment efficiency. Alternative 4B is not expected to be as effective as Alternative 4A.

Alternative 4C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet the 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

During soil washing, COCs would be transferred to the process water or would remain in the fine fraction. For the purposes of this FS, it is assumed that the fraction of fines produced from the soil washing process would be about 5 percent (Keystone, 1991) and would require further treatment. Of the estimated 115,000 yd^3 of soils that would require treatment under this alternative, about 5,750 yd^3 of fines would require further treatment. Although this fine fraction may contain fairly high concentrations of PCP, PAH, dioxins, and furans, the biological slurry reactor is expected to be effective in reducing the levels of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. As with biological land treatment, design studies will be necessary to fully define treatment efficiency and process detail. Alternative 4C is expected to be as effective as Alternative 4B but is not expected to be as effective as Alternative 4A.

The soils located near or beneath the creek may contain high concentrations of inorganic compounds that could preclude them from being backfilled on site. If these soils have high concentrations of inorganics, they would be treated for organic compounds separately and then transported to a local repository for disposal. Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

Under Alternatives 4A, 4B, and 4C, contaminated groundwater and remaining LNAPL would be contained by physical and hydraulic barriers. Assuming effective long-term operation and maintenance, releases would be limited sufficiently to attain PRAGs in Silver Bow Creek. Also, migration of contaminated groundwater and LNAPL would be effectively reduced or eliminated sufficiently to ensure PRAGs in adjacent uncontaminated aquifers.

During the RI, the area of groundwater in close proximity to Silver Bow Creek downstream of the site was shown to contain low levels of site-related contamination. It is expected that natural biodegradation and attenuation would effectively reduce the levels of organic contaminants in this area once site remediation has effectively contained the contaminated groundwater and LNAPL, and releases have been effectively reduced or eliminated. These natural mechanisms will be relied upon to address this low level contamination outside of the major plume boundary.

The groundwater treatment system would be effective in treating the organic compounds in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow

Creek. A pilot-scale study may be required to determine the quantity of sludge produced requiring disposal and to determine the levels of dioxins in the sludge.

Excavation is expected to remove approximately 20 percent of the mass of LNAPL present in the subsurface. Aggressive LNAPL recovery via trenches and extraction wells would be expected to remove between 25 and 50 percent of the remaining mass. Therefore the total mass of LNAPL expected to be removed under this alternative is expected to be between 40 and 60 percent. In addition, approximately 44 percent of in-place contaminated soils would also be removed. LNAPL that would remain in place under this alternative would be addressed by long-term pump-and-treat/in situ bioremediation. Aquifer remediation to PRAGs may not be achieved within a 30 year remediation period.

Disposal of decontaminated equipment and debris in an appropriate off-site landfill would be an effective disposal method.

5.2.4.2 Implementability. Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

Alternative 4 requires excavation of approximately 105,000 cubic yards of contaminated soils above and below the water table. Excavation depths range from approximately 22 feet bgl in the southern portion of the site to approximately 6 feet bgl in the northern portion of the site. It is likely that the excavation would be implemented in stages starting in the southern part of the site and moving downgradient towards the creek. Soils would be excavated, stockpiled, treated, and then placed back on site. Lag time would exist between excavation and backfill of the soils producing "ponded water" on site because the soils would be excavated to approximately 4 feet below the water table. It is likely that LNAPL would be present on the ponded water. Skimmer pumps would be used to remove the LNAPL to the extent possible. It is likely that sheen of PCP/diesel would still be present when the site is backfilled.

Excavating below the water table is more difficult than excavating above the water table because it is difficult to visualize the bottom surface of the hole that is being dug, and the material that is being excavated behaves more like a suspension than soil. The soils excavated below the water table would require dewatering before being treated by incineration, may require some dewatering before bioremediation, and are not expected to require dewatering before soil washing. Flowing sand conditions were encountered during excavation of the USEPA LNAPL Recovery System and would likely be encountered during implementation of this alternative. Shoring, sheet piling, and/or well point dewatering would be required to reduce the impact of the geotechnical instability that would likely be encountered. Shoring and sheet piling will be required during excavation around the interstate. The potential for spreading contamination during excavation will need to be addressed during excavation design and implementation. It is possible that excavation below the water table will emulsify the LNAPL into the groundwater.

All soil treatment methods associated with this alternative are technically implementable. However, on-site incineration may not be acceptable to the local community. It would take about 2 to 4 years to incinerate approximately 115,000 cubic yards of soil, about 5 to 10 years to bioremediate the soil, and about 2 to 4 years to wash the soil.

The USEPA LNAPL Recovery System would be included to the extent possible in the overall groundwater remediation system. Additional wells and/or trenches would be required to contain the dissolved contamination. Construction of trenches may be difficult due to flowing sand conditions which have been encountered at the site. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would also be required prior to designing the system to better define the extent of the plume, particularly in the northwest corner of the site.

Extensive monitoring and system adjustments would be required over the long term to achieve effective containment of the contaminated groundwater and LNAPL. Groundwater extraction and treatment may continue longer than 30 years.

Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable, however, a more detailed inventory would be required.

5.2.4.3 Estimated Costs. Tables 5-7 through 5-9 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; excavation of some soils; groundwater extraction; soil, groundwater, and oily wastes treatment for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 4A ranges from $77.9 million to $110.8 million; Alternative 4B ranges from $24.8 million to $47.6 million; and Alternative 4C ranges from $35.5 million to $52.7 million.

5.2.5 Alternative 5: Excavation and Treatment of All Contaminated Soils; Treatment of Removed Soils; Containment and Treatment of Groundwater and LNAPL; Treatment of Oily Wastes, Sludges, Equipment, and Debris

The technologies and process options included in Alternative 5 are listed on Table 5-1 and described below.

The remedial approach to site soils under Alternative 5 includes: the treatment of previously excavated soils; excavation and treatment of contaminated soils from the former process area, the historic drainage ditch area, surface soil hot spots, and areas impacted by the LNAPL plume; excavation and treatment of contaminated soils north of the Gundwall; and treatment of other contaminated soils that may be excavated as a result of the construction of remediation facilities.

Figure 5-3 shows the areas to be excavated under this alternative. The surface soil hot spots would be excavated to an approximate depth of 3 feet. The process area and the historic drainage ditch area would be excavated to approximately 4 feet below the groundwater table. Additional areas of the site impacted by the LNAPL plume would be excavated to a depth of 4 feet below the groundwater table. It is estimated that vertical extent of subsurface contamination is 2 feet above the groundwater table to 4 feet below the groundwater table in the areas impacted by the LNAPL plume. These areas would be excavated so that clean overlying soils would be segregated from contaminated soils. Contaminated soils would be treated and clean soils would be used for fill material or site grading purposes. Excavation would not be conducted beneath the interstate highway.

Removal of the heavily contaminated soils from the MPTP site would permanently address the surface soils human exposure pathway, and would eliminate the major sources of groundwater contamination.

The objective of excavating below the water table is to remove LNAPL within the soil matrix. The area directly beneath the highway cannot be excavated, so other methods would be used to extract LNAPL from this area. It may be possible to flush LNAPLs from beneath the highway for subsequent recovery using soil flushing or gradient control technologies. Alternative 5 includes the use of gradient control beneath the highway for this purpose. The excavated areas of the site would be filled with clean soils or treated soils. Backfilled soils may become recontaminated due to LNAPL reentry into the excavated area.

Alternative 5A includes on-site incineration of soils. Alternative 5B includes on-site bioremediation of soils. Alternative 5C includes soil washing and residuals treatment by bioslurry reactor. Treated soils would be backfilled on site.

Oils and sludges currently in place at the MPTP site and LNAPL recovered during the remedial action would be incinerated on-site along with soils under Alternative 5A. Under Alternatives 5B and 5C it is assumed that these materials would be incinerated off site.

Equipment and debris can be disposed of in a Subtitle C landfill or, if appropriately decontaminated, in an off-site municipal landfill or in an on-site landfill. Under Alternative 5 it is assumed that contaminated equipment and debris would be decontaminated and/or disposed of at an appropriate off-site landfill.

The primary objective of the groundwater extraction system and treatment system under Alternative 5 is to contain contamination and to restore the aquifer. The detailed design of the groundwater extraction and treatment systems at the MPTP site under Alternative 5 will be conducted during the design stages of the remedial action. For the purpose of evaluation under this FS the following assumptions are made. An interception system would be constructed so that it completely spans the impacted groundwater flow lines. This system, shown in Figure 4-2, would extend from approximately 200 feet east of the railroad embankment crossing of Silver Bow Creek to the vicinity of well BMW-1, 1,700 feet to the west. An extraction trench located near the South Recovery Trench would also be constructed and would operate at a flow rate of 5 gpm.

Extracted groundwater would be pretreated using enhanced oil/water separation (Section 4.4.3) for recovery of any residual LNAPL not recovered during the excavation. For Alternative 5A, any oil phase from the separation process would be treated by on-site incineration during the first 5 years of operation (while the incinerator is on site) and then off-site incineration during the ensuing years. Alternatives 5B and 5C would utilize off-site incineration for all recovered LNAPLs. For the purposes of this FS, it is assumed that the aqueous phase would be treated by a bioreactor followed by carbon polishing to remove PCP and any other organic contaminants of concern. Other treatment methods such as UV/oxidation or GAC may be utilized instead of a bioreactor. All three methods will be considered during detailed design. Additionally, if it is found that treatment for inorganics contaminants is necessary to meet discharge requirements, an appropriate process would be employed, possibly in conjunction with treatment at the Silver Bow Creek/Butte Area NPL site. In situ bioremediation would be utilized in an effort to restore the aquifer.

For the purposes of this FS it is assumed that approximately 35 gpm of the treated groundwater would be discharged to Silver Bow Creek to maintain the water balance across the site. The other 60 to 80 gpm would be amended with nutrients and oxygen then recharged back into the contaminated groundwater plume (Figure 4-2). The recharge system would be designed to enhance in situ bioremediation of subsurface soils in addition to bioremediation of groundwater.

The stated preliminary design assumptions for the groundwater extraction and treatment system are based on site conditions as they existed during the RI field investigation. They do not take into account the USEPA LNAPL recovery system or the affects on site hydrogeology from the dewatering activities schedule at LAO.

5.2.5.1 Effectiveness. Alternative 5 would meet the PRAOs established for the site and would remove and treat about 87 percent of the in place LNAPL (under best conditions) and approximately 83 percent of the contaminated soils. The estimate of the volume of LNAPL that may be removed under this alternative was based on the ratio of the volume of soil excavated to the volume of soil impacted by the LNAPL plume. The inaccessible areas account for about 13 to 20 percent of the volume of soil impacted by the LNAPL plume. It may be possible to recover some of the LNAPL trapped in the soil matrix in the inaccessible areas by soil flushing or gradient control during excavation.

Alternative 5 would be effective in eliminating potential human health and ecological risks caused by oils and sludges. On-site or off-site incineration of oils and sludges would be effective in reducing the mobility, toxicity, and volume of the contaminated oils and sludges.

The effectiveness of soil treatment would vary depending upon the selection of Alternative 5A, 5B, or 5C. Alternative 5A, which consists of incineration of soils, would be effective in destroying approximately 99 percent of the organic contaminants of concern in the soil matrix. The soil treated by incineration would be expected to meet all of the PRAGs listed on Table 3-1.

Alternative 5B, which consists of on-site bioremediation of excavated soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Bioremediation would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and 10^{-6} for recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils. Design studies will be necessary to fully define treatment efficiency. Alternative 5B is not expected to be as effective as Alternative 5A.

Alternative 5C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet the 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

During soil washing, COCs would be transferred to the process water or would remain in the fine fraction. For the purpose of this FS, it is assumed that the fraction of fines produced from the soil washing process would be about 5 percent (Keystone, 1991) and would require further treatment. Of the estimated 208,000 yd^3 of soils that would require treatment, about 10,400 yd^3 of fines would require further treatment. Although this fine fraction may contain fairly high concentrations of PCP, PAH, dioxins, and furans, the biological slurry reactor is expected to be effective in reducing the levels of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. As with biological land treatment, design studies will be necessary to fully define treatment efficiency and process design. Alternative 5C is expected to be as effective as Alternative 5B but is not expected to be as effective as Alternative 5A.

The soils located near the creek may contain high concentrations of inorganic compounds that could preclude them from being backfilled on site. If these soils have high concentrations of inorganics, they would be treated for organic compounds separately and then transported to a local repository for disposal. Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or engineering control methods may be necessary to minimize releases.

Under Alternative 5A, 5B, and 5C, contaminated groundwater and residual LNAPL would be contained by physical and hydraulic barriers. Assuming effective operation and maintenance, releases would be limited sufficiently to attain PRAGs in Silver Bow Creek. Also, migration of contaminated groundwater and LNAPL would be effectively reduced or eliminated sufficiently to ensure PRAGs in adjacent uncontaminated aquifers.

During the RI, the area of groundwater in close proximity to Silver Bow Creek downstream of the site was shown to contain low levels of site-related contamination. It is expected that natural biodegradation and attenuation would effectively reduce the levels of organic contaminants in this area once site remediation has effectively contained the contaminated groundwater and LNAPL, and releases have been effectively reduced or eliminated. These natural mechanisms will be relied upon to address this low level contamination outside of the major plume boundary.

The groundwater treatment system would be effective in treating the organic compounds (and inorganic compounds if necessary) in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow Creek. A pilot-scale study may be required to determine the quantity of sludge produced requiring disposal and to determine the levels of dioxins in the sludge.

Excavation is expected to remove approximately 80 to 90 percent of the mass of LNAPL present in the subsurface. Aggressive LNAPL recovery via trenches and extraction wells would be expected to remove between 25 and 50 percent of the remaining mass. Therefore the total mass of LNAPL expected to be removed under this alternative is expected to be between 84 and 95 percent. In addition, approximately 83 percent of in-place contaminated soils would also be removed.

Aquifer remediation is the primary goal of this alternative and it may occur within a 30- to 50-year remediation period. However, the presence of some residual LNAPL beneath the interstate and other factors such as currently undefined in situ biodegradation efficiencies, make it difficult to predict how long it will take to remediate the aquifer.

This alternative also includes groundwater monitoring, which is effective for evaluating potential migration from the site and for determining the effectiveness of the remedial actions. Existing institutional controls provide some protection to human health by restricting land uses to industrial activities and banning the use of groundwater as potable supply. Additional institutional controls would be effective in providing additional protection of human health by further restricting future land development at the site. Upon cleanup of the site, institutional controls could be lifted.

Disposal of decontaminated equipment and debris at an appropriate off-site landfill would be an effective disposal method.

5.2.5.2 **Implementability.** Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

Alternative 5 requires excavation of approximately 292,000 $yards^3$ of contaminated soils above and below the water table. Excavation depths range from approximately 22 feet bgl in the southern portion of the site to approximately 6 feet bgl in the northern portion of the site. It is likely that the excavation would be implemented in stages starting in the southern part of the site and moving downgradient towards the creek. Soils would be excavated, stockpiled, treated, and then placed back on site. Lag time would exist between excavation and backfill of the soils producing "ponded water" on site because the soils would be excavated to approximately 4 feet below the water table. It is likely that LNAPL would be present on the ponded water. Skimmer pumps would be used to remove the LNAPL to the extent possible. It is likely that a sheen of PCP/diesel would still be present when the site is backfilled.

Excavating below the water table is more difficult than excavating above the water table because it is difficult to visualize the bottom surface of the hole that is being dug, and the material that is being excavated behaves more like a suspension than soil. The soils excavated below the water table would require dewatering before being treated by incineration, may require some dewater before bioremediation and are not expected to require dewatering before soil washing. Flowing sand conditions were encountered during excavation of the USEPA LNAPL Recovery System and would likely be encountered during implementation of this alternative. Shoring, sheet piling, and/or well point dewatering would be required to reduce the impact of the geotechnical instability that would likely be encountered. Shoring and sheet piling will be required during excavation around the interstate and the USEPA groundwater treatment plant. The potential for spreading contamination during excavation will need to be addressed during excavation design and implementation. It is possible that excavation below the water table will emulsify the LNAPL into the groundwater.

All soil treatment methods associated with this alternative are technically implementable. However, on-site incineration may not be acceptable to the local community. Approximately 292,000 yd^3 of soil would be excavated and approximately 208,000 yd^3 of soil would be treated under this alternative. It would take about 7 years to incinerate the soils, about 10 to 15 years to bioremediate the soils, and about 4 to 6 years to soil wash and treat the residuals.

The USEPA LNAPL Recovery System could be utilized during implementation of this alternative up until excavation occurred in those areas where recovery system features are located. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would be required prior to designing the system to better define the extent of the plume, particularly in the northwest corner of the site. Extraction and treatment of the dissolved groundwater contamination may continue longer than 30 years. Extensive monitoring and system adjustments would be required over the long term to achieve effective containment of the contaminated groundwater.

Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept the dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable, however, a more detailed inventory would be required.

5.2.5.3 Estimated Costs. Tables 5-10 through 5-12 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; excavating soils; groundwater extraction; soil, groundwater, and oily wastes treatment for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 5A ranges from $99.9 million to $156.2 million, Alternative 5B ranges from $27.5 million to $55.2 million, and Alternative 5C ranges from $48.1 million to $78.2 million.

5.3 SUMMARY OF SCREENING OF REMEDIAL ALTERNATIVES

This section presents the summary of the screening of remedial alternatives presented in Section 5.2. Table 5-13 summarizes the results of the screening process. Alternative 1 (no action) and Alternative 2 would not be effective in meeting the overall PRAOs. Alternative 1 is required by the CERCLA process to provide a baseline for comparing the other alternatives included in the detailed evaluation against the nine criteria in Section 6.0. Alternative 2 is eliminated from further consideration in the FS because it is not effective in meeting the overall site objectives. Alternatives 3, 4, and 5 are retained for further evaluation because they provide a varying degree of mass removal.

6.0 DETAILED ANALYSIS OF SELECTED REMEDIAL ALTERNATIVES

The detailed analysis is the last step in the feasibility study process. The purpose of the detailed analysis is to present the relevant information needed to choose a site remedy. During the detailed analysis, each alternative is assessed against criteria developed by the USEPA. The results of this assessment are arranged to compare the alternatives and identify their key advantages and disadvantages. This approach to analyzing alternatives is designed to provide sufficient information to select an appropriate site remedy and satisfy other CERCLA remedy selection requirements in the decision documents.

Nine evaluation criteria have been developed by the USEPA to address the CERCLA requirements and additional technical and policy considerations important for selecting among the remedial alternatives. The detailed analysis of remedial alternatives presented in this section will address seven of these criteria. State and community acceptance will be addressed following public comment on the FS report. The nine evaluation criteria are defined as follows (USEPA, 1988):

> <u>Overall Protection of Human Health and Environment</u>: The analysis with respect to overall protection of human health and the environment provides a summary evaluation of how the alternative reduces the risk from potential exposure pathways through treatment, engineering, and/or institutional controls. An examination of whether alternatives pose any unacceptable short-term or cross-media impacts is also included in this analysis.
>
> <u>Compliance with ARARs</u>: The ability of each alternative to meet all of the federal and state requirements that are potentially applicable or relevant and appropriate, or the need to justify a waiver, is noted for each alternative.
>
> <u>Long-term Effectiveness and Permanence</u>: Long-term effectiveness and permanence are evaluated with respect to the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste over the long term.
>
> <u>Reduction of Mobility, Toxicity, or Volume Through Treatment</u>: The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies included in the remedial alternative.

Short-term Effectiveness: The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until the response objectives have been met.

Implementability: The analysis of implementability evaluates the technical and administrative feasibility of the alternative and the availability of the goods and services needed to implement it.

Cost: The cost estimates for the FS are order-of-magnitude-level estimates. The assessment against this criterion evaluates the capital, indirect, and operation and maintenance (O&M) costs of each alternative on a present-worth basis. The present worth has been determined for a 30-year period at a 10 percent discount rate (40 CFR 300).

State Acceptance: This criterion reflects the state's apparent preferences among or concerns about each alternative.

Community Acceptance: This criterion reflects the community's apparent preferences among or concerns about each alternative.

This section presents the detailed analysis of each of the four remedial alternatives that passed the initial screening process

6.1 ALTERNATIVE 1: NO ACTION

In Alternative 1, no further action (other than the USEPA's actions currently being conducted at the MPTP site) would be undertaken to remediate the site. Actions would continue indefinitely. Wastes such as separator oil and spent carbon would continue to be generated and stored on site.

This alternative also includes the existing institutional controls currently in place for the MPTP site. These controls include zoning limitations (which limit residential development), floodplain regulations (which restrict building in portions of the site in the 100-year floodplain), subdivision regulations (which control further subdivision of the site), building codes, and the domestic well ~~ban (which prevents future wells from being used as potable supply).~~

Because contamination would continue to exist on site above the health-based risk levels, 5-year site reviews are included in this alternative in accordance with CERCLA regulations.

6.1.1 Overall Protection of Human Health and the Environment

The no-action alternative would not be effective in meeting the PRAOs for the MPTP site. Institutional controls currently in existence for the MPTP site are effective in providing some protection to human health by limiting residential development and banning the use of groundwater as potable supply. This alternative does not address various wastes, such as oils and sludges and previously excavated soils currently stored on site. These wastes, as well other wastes that would be generated as a result of the USEPA's ongoing actions, would continue to pose risk of human exposure. Additionally, this alternative does not prevent exposure to contaminated surface and subsurface soils currently in place on the MPTP site. However, the results of the baseline risk assessment indicate that the excess cancer risks to the trespasser, worker, and potential future resident from ingestion and dermal contact with contaminated soils are within the 10^{-4} to 10^{-6} risk range (CDM, 1993).

The no-action alternative is not effective in containing the dissolved groundwater contaminant plume from further migration and does not provide for treatment of contaminated groundwater. Actions are currently being conducted at the MPTP site to limit migration of LNAPL into Silver Bow Creek; however, these actions are not adequate to contain the migration of the dissolved contaminant plume.

6.1.2 Compliance with ARARs

Chemical-specific ARARs identified for the MPTP site include the state and federal MCLs and MCLGs for groundwater. There are no chemical-specific ARARs for soils. Concentrations of benzene and PCP were detected in groundwater samples above their MCLs. This alternative does not actively reduce the concentration of benzene and PCP in the groundwater and therefore is not expected to meet the chemical-specific ARARs. An ARARs waiver would be required for the no-action alternative.

The location-specific ARARs identified by DHES for the site include protecting fish and wildlife resources, avoiding adverse impacts associated with development of a floodplain, avoiding destruction of wetlands, and not jeopardizing the existence of any threatened or endangered species (DHES, 1992). The no-action alternative meets these location-specific ARARs.

The Montana Surface Water Quality Standards are considered action-specific ARARs for this alternative because the USEPA actions currently being implemented will involve the discharge of treated water to Silver Bow Creek. It is unknown whether the actions currently being implemented by the USEPA will attain the appropriate ARARs.

6.1.3 Long-Term Effectiveness and Permanence

The no-action alternative provides no long-term effectiveness or permanence for reducing risks to human health and the environment beyond those currently in existence at the site.

6.1.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

The no-action alternative reduces the volume of LNAPL in the groundwater and treats the water phase before discharging it to Silver Bow Creek. This alternative does not reduce the mobility, toxicity, or volume of the contaminants dissolved in the groundwater or of the various wastes currently on site, including miscellaneous oils and sludges, bagged soils, on-site soils, and miscellaneous equipment and debris. In addition, the no-action alternative continues to generate wastes such as excavated soils, oil recovered from the oil/water separator, and spent carbon.

6.1.5 Short-Term Effectiveness

There is potential for workers and site visitors to be exposed to hazardous chemicals during implementation of the time-critical removal action being performed by USEPA at the MPTP site. The exposure pathway includes ingestion of and dermal contact with contaminated soil and groundwater. The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels.

6.1.6 Implementability

The no-action alternative can be readily implemented.

6.1.7 Cost

There are no capital costs for Alternative 1. Annual O&M costs are included for maintaining the institutional controls, 5-year site reviews, and for the current remediation actions being implemented. The annual O&M costs and total present worth are summarized in Table 5-2. The estimated 30-year present worth for Alternative 1 is about $2.3 million. Thirty years duration for calculating present worth was chosen based on guidance from the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300). The USEPA LNAPL Recovery System would be expected to operate longer than 30 years.

6.1.8 State and Community Acceptance

The acceptability of this alternative will be addressed after the state and community have reviewed and commented on the FS report.

6.2 ALTERNATIVE 3: GROUNDWATER MONITORING; CAPPING; TREATMENT OF REMOVED AND EXCAVATED SOILS; CONTAINMENT AND TREATMENT OF GROUNDWATER AND LNAPL; TREATMENT OF OILY WASTES, SLUDGES, EQUIPMENT, AND DEBRIS

The technologies and process options included in Alternative 3 are listed on Table 5-1 and described in detail in Section 5.2.3. In summary, this alternative includes the following:

1. Groundwater monitoring;

2. Existing and additional institutional controls;

3. On-site incineration (Alternative 3A), on-site bioremediation (Alternative 3B), or soil washing (Alternative 3C) of soils (including bagged soils, near-creek soils, and soil generated from construction of remediation facilities);

4. On-site and off-site incineration of oils and sludges (Alternative 3A) or off-site incineration of oils and sludges (Alternatives 3B and 3C) and treatment of soil washing residuals by bioslurry reactor (Alternative 3C);

5. Clay capping of contaminated surface soils currently in place on the site;

6. Groundwater extraction and containment;

7. Extracted groundwater treatment using enhanced oil/water separation followed by a) biological treatment with carbon polishing of the aqueous phase and, b) on-site and off-site incineration of the oil phase;

8. Treated groundwater would be recharged to the aquifer (approximately 60 to 80 gpm) and discharged to Silver Bow Creek (approximately 35 gpm); and

9. In-situ bioremediation of subsurface soils and groundwater after recoverable LNAPLs have been collected; and

10. Decontamination, if required, followed by off-site disposal of miscellaneous equipment and debris.

6.2.1 Overall Protection of Human Health and the Environment

Alternative 3 meets the PRAOs for the MPTP site. Alternative 3 includes groundwater monitoring, which is effective for evaluating the effectiveness of remedial action. Institutional controls currently in existence for the MPTP site are effective in providing some protection to human health by limiting residential development and banning the use of groundwater as potable supply. Enhancing institutional controls or implementing additional controls would provide more protection to human health by further restricting land uses.

Under Alternative 3A, on-site incineration would be effective in eliminating the risk of human exposure to previously excavated contaminated soils, additional soils and sediments excavated under this alternative, and miscellaneous oils and sludges stored or generated on site. On-site incineration would permanently destroy contaminants thereby effectively eliminating the toxicity of these contaminated media. Incinerated soils would be expected to meet all PRAGs identified for soils at the MPTP site (Table 3-1).

Alternative 3B, which consists of bioremediation of removed soils, would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for industrial and residential land use scenarios and 10^{-6} for the recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils.

Alternative 3C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet the 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

Miscellaneous oils and sludges stored or generated on-site would be incinerated off-site. Off-site incineration of oils and sludges would effectively eliminate risks to human health and the environment posed by these materials.

Alternative 3 includes consolidation of surface soil hot spots with soils in the former process area and historic drainage ditch. These surface soils and soils in the process area and drainage ditch would be capped to limit infiltration and prevent exposure via incidental ingestion or dermal contact (Figure 5-1). The cap would be approximately 170,000 square feet. Direct exposure to these contaminated media would be effectively eliminated by capping. The contaminated soils left in place may continue to act as a source of groundwater contamination although these contaminants of concern are relatively immobile. Effective long-term enforcement of institutional controls will be required to prevent future site activities that may result in adverse human exposure.

A properly designed groundwater extraction and treatment system would be effective in containing contaminated groundwater and LNAPL thereby limiting releases to Silver Bow Creek. Extracted groundwater that would be discharged to Silver Bow Creek and the aquifer would first be treated to appropriate cleanup criteria. After removal of all recoverable LNAPLs, extracted and treated groundwater which would be recharged to the aquifer would be amended with nutrients and oxygen to promote in situ biodegradation of remaining contamination. This groundwater remediation approach, in conjunction with the institutional controls at the site (specifically the well ban), would effectively limit the potential for adverse risk from exposure to contaminated groundwater and surface water at the site. Effective long-term enforcement of the well ban would be required to prevent future human exposure to contaminated groundwater.

Proper off-site disposal of decontaminated equipment and debris would be protective of human health and the environment.

6.2.2 Compliance with ARARs

The chemical-specific ARARs identified by DHES for the MPTP site include the state and federal MCLs and non-zero MCLGs for groundwater. There are no chemical-specific ARARs for soils. Concentrations of benzene and PCP were detected in groundwater samples above their MCLs. This alternative reduces the quantity of contaminants in groundwater via groundwater and LNAPL extraction and treatment. However, chemical-specific ARARs (MCLs) within the aquifer are not expected to be met under Alternative 3 because contaminated soils and LNAPL will remain and will continue to act as sources of groundwater contamination. Under this alternative, significant groundwater contamination may still be present after a remediation period of 30 years.

The location-specific ARARs identified by DHES for the site include protecting fish and wildlife resources, avoiding adverse impacts associated with development of a floodplain, avoiding destruction of wetlands, and not jeopardizing the existence of any threatened or endangered species (DHES, 1992). The northern portion of the site is currently in a 100-year flood plain. However, plans for remediating LAO include relocating Silver Bow Creek. The cap at the MPTP site would be outside the 100-year floodplain following completion of work at LAO. At that time, Alternative 3 would meet the location-specific ARARs.

The action-specific ARARs for this alternative include the Montana Surface Water Quality Standards (for extracted treated water discharged to Silver Bow Creek), MCLs and non-zero MCLGs (for extracted treated water recharged upgradient of the contamination plume). In addition, certain RCRA action-specific requirements would apply to various aspects of these alternatives, for example, the substantive requirements for the operation of incinerators (40 CFR 264.340-351 and 40 CFR 265, Subpart O), for land treatment units (40 CFR 264, Subpart M), and for waste piles (40 CFR 264, Subpart L). All of the technologies included in Alternative 3 are capable of meeting the action-specific ARARs. Careful design and operation of the remedial action systems should ensure compliance with all action-specific ARARs.

6.2.3 Long-Term Effectiveness and Permanence

The oils and sludges that are currently stored on site and LNAPLs generated during the remedial action are permanently addressed through on-site incineration or off-site incineration.

Alternative 3A, incineration of soils, would effectively and permanently remove the organic contaminants of concern from the soil matrix. The soil treated by incineration would be expected to meet all of the PRAGs listed on Table 3-1.

Bioremediation (Alternative 3B) and soil washing (Alternative 3C) are expected to effectively and permanently reduce the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Further actions such as capping or institutional controls may be necessary after land treatment or soil washing if the treated soils do not meet the cleanup criteria established in the ROD. Design studies will be necessary to fully define treatment efficiency. Alternatives 3B and 3C do not provide the degree of contaminant concentration reduction nor are they expected to be as effective as Alternative 3A.

With appropriate maintenance, capping of the former process area and the drainage ditch (Figure 5-1) would be effective in preventing exposure (via incidental ingestion or dermal contact) to contaminated surface and subsurface soils currently in place on the MPTP site. Additionally, migration of contamination from vadose zone soils to the groundwater via infiltration would be reduced. However, capping does not remove a potential source (i.e., subsurface soils) of groundwater contamination. Additionally, since the cap is subject to deterioration over time and requires long-term maintenance, this alternative does not provide the degree of permanence that an alternative which includes excavation and treatment of contaminated soils would.

Contaminated groundwater and LNAPL would be contained by physical and hydraulic barriers, and impacts to Silver Bow Creek would be limited. This alternative would be effective in treating the organic compounds (and inorganic compounds if necessary) in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow Creek.

Because this alternative does not include excavation of heavily contaminated soils and associated LNAPL, the long-term effectiveness of in-situ bioremediation would be expected to be limited. Aquifer remediation is not likely to be achieved within a 30-year remediation period. The groundwater extraction and treatment system would be expected to be operated and maintained indefinitely.

Existing institutional controls provide some protection to human health by restricting land uses and banning the use of groundwater as potable supply. Additional institutional controls and enhancements to existing controls would be effective in providing additional protection of human health by further restricting future development at the site. The institutional controls enacted for the site would be evaluated during the 5-year site reviews included in this alternative. Institutional controls require long term enforcement.

6.2.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

Alternative 3 reduces the toxicity and volume of LNAPL and dissolved contaminants in the groundwater. Approximately 5 percent of the in-place contaminated soils would be excavated and treated. Approximately 25 to 50 percent of the LNAPL would be extracted from the subsurface and incinerated either on or off site. The dissolved contaminants in the extracted groundwater would be degraded in the bioreactor or removed by carbon adsorption. Further degradation of contaminants in the groundwater and soils would occur through enhanced in-situ biodegradation.

The toxicity and volume of contaminants in the excavated soils are effectively reduced by treatment. Incineration, which typically achieves 99 percent destruction efficiencies for organic compounds, would be more effective than bioremediation and soil washing. Bioremediation and soil washing with residuals treatment are expected to remove about 80 to 95 percent of the PCP and about 75 to 85 percent of the PAHs.

The cap reduces the mobility of contaminants in the subsurface by limiting infiltration through the vadose zone. Migration of soil or groundwater contaminants in the saturated zone would be controlled by the groundwater extraction system.

The toxicity of the equipment and debris is reduced by decontamination and subsequent treatment of the residual wash water and other decontamination materials.

6.2.5 Short-Term Effectiveness

There is potential for workers, site visitors, and nearby residents to be exposed to hazardous substances during implementation of Alternative 3. The exposure pathways for the workers and site visitors includes ingestion of and dermal contact with contaminated soil and groundwater and inhalation of contaminated dust and vapors and emissions from on-site incineration. The exposure pathway for the nearby resident would include inhalation of contaminated dust and vapors and emissions from on-site incineration.

The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels. Dust and vapor release control activities can be implemented to limit this exposure potential and the incinerator can be designed to limit emissions to acceptable standards. Given the short duration that the incinerator would be on site under Alternative 3A and the emission standards that would be met, health risks to nearby residents would be low. The health risks described above which are related to on-site incineration are only related to Alternative 3A. On-site incineration is not included in Alternatives 3B and 3C.

Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

6.2.6 Implementability

Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

All treatment and disposal methods associated with this alternative are technically implementable. However, on-site incineration may not be acceptable to the local community. Additionally, off-site incineration of the oily wastes and sludges may be difficult to implement given the limited availability of permitted facilities which can accept dioxin-containing wastes.

The USEPA LNAPL Recovery System would be included to the extent possible in the overall groundwater remediation system. Additional wells and/or trenches would be required to contain the dissolved contamination. Construction of trenches may be difficult due to flowing sand conditions. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would be required prior to design to better define the extent of the plume, particularly in the northwest corner of the site. The groundwater system would be expected to operate indefinitely.

The technologies for soil and groundwater treatment are implementable. Numerous bench- and pilot-scale studies have been performed, however, very few full-scale demonstrations of these technologies for the types of contamination at MPTP site have been performed. Prior to full scale implementation of any of these treatment technologies at the MPTP site, design optimization studies may be appropriate.

On-site incineration of soils and oily wastes and sludges may not be acceptable to the local community. Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable, however, a more detailed inventory would be required. Groundwater extraction and treatment and maintenance of the clay cap would continue indefinitely.

6.2.7 Cost

Tables 5-4 through 5-6 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; soil capping; excavation of some soils; groundwater extraction; treatment of soil, groundwater, and oily wastes for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 3A ranges from $34.7 million to $60.1 million; Alternative 3B ranges from $21.0 million to $36.6 million; and Alternative 3C ranges from $27.7 million to $43.8 million. Thirty years duration for calculating present worth was chosen based on guidance from the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300). The groundwater treatment system is expected to operate for more than 30 years.

6.2.8 State and Community Acceptance

The acceptability of this alternative will be addressed after the state and community have had a chance to comment on the FS report.

6.3 ALTERNATIVE 4: GROUNDWATER MONITORING; EXCAVATION AND TREATMENT OF CONTAMINATED SURFACE AND SUBSURFACE SOILS; TREATMENT OF REMOVED SOILS; CONTAINMENT AND TREATMENT OF GROUNDWATER AND LNAPL; TREATMENT OF OILY WASTES, SLUDGES, EQUIPMENT AND DEBRIS

The technologies and process options included in Alternative 4 are listed on Table 5-1 and described in detail in Section 5.2.4. In summary, this alternative includes the following:

1. Groundwater monitoring;

2. Existing and additional institutional controls;

3. On-site incineration (Alternative 4A), on-site bioremediation (Alternative 4B), or soil washing (Alternative 4C) (including bagged soils, near-creek soils, soil generated from construction of remediation facilities, and soils from the former process area, the historic drainage ditch area, and surface soil hot spots);

4. On-site and off-site incineration of oils and sludges (Alternative 4A) and off-site incineration oils and sludges (Alternatives 4B and 4C), and treatment of soil washing residuals by bioslurry reactor (Alternative 4C),

5. Groundwater extraction and containment;

6. Extracted groundwater treatment using enhanced oil/water separation followed by a) biological treatment with carbon polishing of the aqueous phase and, b) on-site and off-site incineration of the oil phase;

7. Treated groundwater would be recharged to the aquifer (approximately 60 to 80 gpm) and discharged to Silver Bow Creek (approximately 35 gpm);

8. In-situ bioremediation of subsurface soils and groundwater after recoverable LNAPLs have been collected; and

9. Decontamination, if required, followed by off-site disposal of miscellaneous equipment and debris.

6.3.1 Overall Protection of Human Health and the Environment

Alternative 4 would meet the PRAOs for the MPTP site and would remove and treat about 60 to 70 percent of the LNAPL in place (under best conditions) and about 44 percent of the contaminated soils. The LNAPL and subsurface soils currently act as sources of groundwater contamination. Under Alternative 4 not all contaminated soils would be excavated. Contaminated soils beneath the highway and soils near the groundwater table that have been impacted by the spread of the LNAPL plume would be left in place and addressed over the long term via groundwater extraction/treatment and in-situ bioremediation.

Under Alternative 4A, on-site incineration would be effective in eliminating the risk of human exposure to previously excavated contaminated soils, additional soils excavated under this alternative, and miscellaneous oils and sludges stored or generated on-site. On-site incineration would permanently destroy contaminants, thereby effectively eliminating the toxicity of these contaminated media. Incinerated soils would be expected to meet all PRAGs identified for soils at the MPTP site (Table 3-1).

Alternative 4B, which consists of bioremediation of removed soils, would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for industrial and residential land use scenarios and 10^{-6} for the recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils.

Alternative 4C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

Miscellaneous oils and sludges stored or generated on-site would be incinerated off-site which would effectively eliminate risks to human health and the environment posed by these materials.

Under Alternative 4, surface soil "hot spots" and soils in the former process area and historic drainage ditch would be excavated and treated thus effectively reducing the health risks from potential human exposure via incidental ingestion or dermal contact.

A groundwater extraction and treatment system (Figure 4-2) for this alternative could be designed to be effective in containing contaminated groundwater and LNAPL thereby limiting releases to Silver Bow Creek. Extracted groundwater that would be discharged to Silver Bow Creek and the aquifer would first be treated to appropriate cleanup criteria. After removal of all recoverable LNAPLs, the extracted and treated groundwater that would be recharged to the aquifer would be amended with nutrients and oxygen to promote in situ biodegradation of remaining contamination. This groundwater remediation approach, in conjunction with the institutional controls at the site (specifically the well ban), would effectively limit the potential for human exposure to contaminated groundwater and surface water at the site.

Appropriate treatment, if necessary, and off-site disposal of decontaminated equipment and debris would be protective of human health and the environment.

6.3.2 Compliance with ARARs

The chemical-specific ARARs identified by DHES for the MPTP site include the state and federal MCLs and non-zero MCLGs for groundwater. There are no chemical-specific ARARs for soils. Concentrations of benzene and PCP were detected in groundwater samples above their MCLs. This alternative reduces the quantity of contaminants in groundwater via excavation of contaminated soils and associated LNAPL in the saturated zone and groundwater extraction and treatment.

The overall groundwater remediation goal of Alternative 4 is long-term restoration of the aquifer. However, chemical-specific ARARs (i.e., MCLs) for groundwater may not be met within a remediation period of 30 years under Alternative 4 because some contaminated soils and associated LNAPL will remain and will continue to act as sources of groundwater contamination. Under this alternative, groundwater contamination would still be present after a remediation period of 30 years.

The location-specific ARARs identified by DHES for the site include protecting fish and wildlife resources, avoiding adverse impacts associated with development of a floodplain, avoiding destruction of wetlands, and not jeopardizing the existence of any threatened or endangered species (DHES, 1992). This alternative meets the location-specific ARARs.

The action-specific ARARs for this alternative include the Montana Surface Water Quality Standards (for extracted, treated water discharged to Silver Bow Creek), MCLs, and non-zero MCLGs (for extracted, treated water recharged upgradient of the contamination plume). In addition, certain RCRA action-specific requirements would apply to various aspects of these alternatives, for example, the substantive requirements for the operation of incinerators (40 CFR 264.340-351 and 40 CFR 265, Subpart O), for land treatment units (40 CFR 264, Subpart M), and for waste piles (40 CFR 264, Subpart L). All of the technologies included in Alternative 4 are capable of meeting the action-specific ARARs. Careful design and operation of the remedial action systems should ensure compliance with all action-specific ARARs.

6.3.3 Long-Term Effectiveness and Permanence

The oils and sludges that are currently stored on site and LNAPLs generated during the remedial action are permanently addressed through on-site and off-site incineration.

Alternative 4A, which consists of incineration of soils, would effectively and permanently remove the organic contaminants of concern from the soil matrix. The soil treated by incineration would be expected to met all of the PRAGs listed on Table 3-1.

Bioremediation (Alternative 4B) and soil washing (Alternative 4C) are expected to effectively and permanently reduce the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Further actions such as capping or institutional controls may be necessary after bioremediation or soil washing. Design studies will be necessary to fully define treatment efficiency. Alternatives 4B and 4C do not provide the degree of contaminant concentration reduction nor are they expected to be as effective as Alternative 4A.

The groundwater treatment system would be designed to contain the contaminated groundwater and LNAPL by physical and hydraulic barriers; impacts to Silver Bow Creek would be effectively eliminated. This alternative would be effective in treating the organic compounds (and inorganic compounds if necessary) in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow Creek.

This alternative also includes groundwater monitoring, which is effective for evaluating potential migration from the site and for determining the effectiveness of the remedial actions. Existing institutional controls provide some protection to human health by restricting land uses and banning the use of groundwater as potable supply. Additional institutional controls and enhancements to existing controls would be effective in providing additional protection of human health by further restricting land uses at the site. The institutional controls enacted for the site would be evaluated during the 5-year site reviews included in this alternative. Institutional controls require long-term enforcement.

6.3.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

Alternative 4 reduces the volume of LNAPL in the subsurface by about 60 percent through excavation and extraction. The LNAPL that is extracted from the groundwater by pumping would be incinerated. The dissolved contaminants in the extracted groundwater are degraded in the bioreactor and removed by carbon adsorption. Further degradation of contaminants in the groundwater and soils would occur through enhanced in situ biodegradation.

About 50 percent of the contaminated soils are removed and treated. The toxicity of the excavated contaminated soils is effectively eliminated by incineration under Alternative 4A. Under Alternatives 4B and 4C the toxicity of the excavated soils is reduced by about 75 to 95 percent through treatment.

The toxicity of the equipment and debris is reduced by decontamination and subsequent treatment of the residual wash water and other decontamination materials.

6.3.5 Short-Term Effectiveness

There is potential for workers, site visitors, and nearby residents to be exposed to hazardous substances during implementation of Alternative 4. The exposure pathways for the workers and site visitors includes ingestion of and dermal contact with contaminated soil and groundwater and inhalation of contaminated dust and emissions from on-site incineration. The exposure pathway for the nearby resident would include inhalation of contaminated dust and emissions from on-site incineration. The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels. Dust control activities can be implemented to limit this exposure potential and the incinerator can be designed to limit emissions to acceptable standards. Given the short duration that the incinerator would be on-site, health risks to nearby residents are expected to be low.

The health risks described above that are related to on-site incineration only apply to Alternative 4A. Incineration is not included in Alternatives 4B and 4C.

Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

6.3.6 Implementability

Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

Alternative 4 requires excavation of approximately 105,000 cubic yards of contaminated soils above and below the water table. Excavation depths range from approximately 22 feet bgl in the southern portion of the site to approximately 6 feet bgl in the northern portion of the site. It is likely that the excavation would be implemented in stages starting in the southern part of the site and moving down gradient towards the creek. Soils would be excavated, stockpiled, treated, and then placed back on site. Lag time would exist between excavation and backfill of the soils producing "ponded water" on site because the soils would be excavated to approximately 4 feet below the water table. It is likely that LNAPL would be present on the ponded water. Skimmer pumps would be used to remove the LNAPL to the extent possible. It is likely that a sheen of PCP/diesel would still be present when the site is backfilled.

Excavating below the water table is more difficult than excavating above the water table because it is difficult to visualize the bottom surface of the hole that is being dug and the material that is being excavated behaves more like a suspension than soil. The soils excavated below the water table would require dewatering before being treated by incineration, may require some dewatering before bioremediation and are not expected to require dewatering before soil washing. Flowing sand conditions were encountered during excavation of the USEPA LNAPL Recovery System and would likely be encountered during implementation of this alternative.

Shoring, sheet piling, and/or well point dewatering would be required to reduce the impact of the geotechnical instability that would likely be encountered. The potential for spreading contamination during excavation will need to be addressed during excavation design and implementation. It is possible that excavation below the water table will emulsify the LNAPL into the groundwater.

All soil treatment methods associated with this alternative are technically implementable. Numerous bench- and pilot-scale studies have been performed, however, very few full-scale demonstrations of these technologies for the types of contamination at the MPTP site have been performed. Prior to full scale implementation of any of these treatment technologies at the MPTP site, design optimization studies may be appropriate. On-site incineration may not be acceptable to the local community. It would take approximately 4 years to incinerate 115,000 cubic yards of soil, about 5 to 10 years to bioremediate the soil, and about 2 to 4 years to wash the soil.

Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept the dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable; however, a more detailed inventory would be required.

The USEPA LNAPL Recovery System would be used to the extent possible in the overall groundwater remediation system. Additional wells and/or trenches would be required to contain the dissolved groundwater contamination. Construction of the trenches may be difficult due to floating sand conditions. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would also be required prior to design to better define the extent of the plume, particularly in the northwest corner of the site. Extraction and treatment of the dissolved groundwater contamination may continue longer than 30 years.

6.3.7 Cost

Tables 5-7 through 5-9 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; excavation of some soils; groundwater extraction; treating soil, groundwater, and oily wastes for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 4A ranges from \$77.9 million to \$110.8 million; Alternative 4B ranges from \$24.8 million to \$47.6 million; and Alternative 4C ranges from \$35.5 million to \$52.7 million.

6.3.8 State and Community Acceptance

The acceptability of this alternative will be addressed after the state and community have had a chance to comment on the FS report.

6.4 ALTERNATIVE 5: EXCAVATION AND TREATMENT OF ALL CONTAMINATED SOILS; TREATMENT OF REMOVED SOILS; CONTAINMENT AND TREATMENT OF GROUNDWATER AND LNAPL; TREATMENT OF OILY WASTES, SLUDGES, EQUIPMENT, AND DEBRIS

The technologies and process options included in Alternative 5 are listed on Table 5-1 and described in detail in Section 5.2.5. In summary, this alternative includes the following:

1. Groundwater monitoring;
2. Existing and additional institutional controls;
3. On-site incineration (Alternative 5A), on-site bioremediation (Alternative 5B), or soil washing (Alternative 5C) (including bagged soils, near-creek soils, soil generated from construction of remediation facilities, soils from the former

process area, the historic drainage ditch area soils, soils in areas impacted by the LNAPL plume, and surface soil hot spots);

4. On-site incineration (Alternative 5A) or off-site incineration (Alternatives 5B and 5C) of oils and sludges and treatment of soil washing residuals by bioslurry reactor (Alternative 5C)

5. Groundwater extraction and containment;

6. Extracted groundwater treatment using enhanced oil/water separation followed by a) biological treatment with carbon polishing of the aqueous phase and, b) on-site incineration or off-site incineration of the oil phase;

7. Treated groundwater would be recharged to the aquifer (approximately 60 to 80 gpm) and discharged to Silver Bow Creek (approximately 35 gpm);

8. In-situ bioremediation of groundwater and any remaining subsurface soil contamination, after LNAPL recovery via soil excavation; and

9. Decontamination, if required, followed by off-site disposal of miscellaneous equipment and debris.

6.4.1 Overall Protection of Human Health and the Environment

Alternative 5 would meet the PRAOs for the MPTP site and would remove and treat about 87 percent of the LNAPL (under best conditions) and about 83 percent of the contaminated soils. Under Alternative 5, all contaminated soils and associated LNAPLs at the site would be excavated and treated with the exception of inaccessible soils beneath the interstate highway and the USEPA groundwater treatment plant. LNAPL is the major source of groundwater contamination. Removal of a large percentage of the LNAPL may allow for more effective groundwater restoration than that provided under Alternatives 3 or 4. Contaminated soils beneath the highway which have been impacted by the spread of the LNAPL plume would remain and would be addressed via soil flushing, groundwater extraction/treatment, and in situ bioremediation.

Under Alternative 5A, on-site incineration would be effective in eliminating the risk of human exposure to contaminated soils and miscellaneous oils and sludges stored or generated on-site.

On-site incineration would permanently destroy contaminants thereby effectively eliminating the toxicity of these contaminated media. Incinerated soils would be expected to meet all PRAGs identified for soils at the MPTP site (Table 3-1).

Alternative 5B, which consists of bioremediation of removed soils, would likely achieve cleanup levels that correspond to an excess cancer risk of 10^{-5} for industrial and residential land use scenarios and 10^{-6} for the recreational land use for PCP. Bioremediation may not significantly reduce the levels of dioxins in the soils.

Alternative 5C, which consists of soil washing of removed soils, is expected to be effective in reducing the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Soil washing would likely achieve PCP levels in the treated soils that correspond to an excess cancer risk of 10^{-5} for the industrial and residential land use scenarios and may meet the 10^{-6} risk level for all land use scenarios for PCP. Soil washing could potentially reduce the concentration of dioxins in the treated soils by about 90 percent but the dioxins would be transferred to the process water.

Miscellaneous oils and sludges stored or generated on-site would be incinerated off-site which would effectively eliminate risks to human health and the environment posed by these materials.

Under Alternative 5, surface soil "hot spots," soils in the former process area and historic drainage ditch, and soils impacted by the LNAPL plume would be excavated and treated thus effectively reducing the health risks from potential human exposure via incidental ingestion or dermal contact.

A groundwater extraction and treatment system (Figure 4-2) for this alternative could be designed to be effective in containing contaminated groundwater and LNAPL thereby limiting releases to Silver Bow Creek. Extracted groundwater that would be discharged to Silver Bow Creek and the aquifer would first be treated to appropriate cleanup criteria. After removal of all recoverable LNAPLs, the extracted and treated groundwater that would be recharged to the aquifer would be amended with nutrients and oxygen to promote in situ biodegradation of remaining contamination. This groundwater remediation approach, in conjunction with the institutional controls at the site (specifically the well ban), would effectively limit the potential for human exposure to contaminated groundwater and surface water at the site.

Appropriate treatment, if necessary, and off-site disposal of decontaminated equipment and debris would be protective of human health and the environment.

6.4.2 Compliance with ARARs

The chemical-specific ARARs identified by DHES for the MPTP site include the state and federal MCLs and non-zero MCLGs for groundwater. There are no chemical-specific ARARs for soils. Concentrations of benzene and PCP were detected in groundwater samples above their MCLs. This alternative reduces the quantity of contaminants in groundwater via excavation of contaminated soils and associated LNAPL in the saturated zone and groundwater extraction and treatment.

The overall groundwater remediation goal of Alternative 5 is restoration of the aquifer as rapidly and completely as possible. Chemical-specific ARARs (i.e., MCLs) for groundwater may be met under Alternative 5 because the accessible contaminated soils and associated LNAPL will be removed and treated thereby significantly reducing the major source of groundwater contamination.

The location-specific ARARs identified by DHES for the site include protecting fish and wildlife resources, avoiding adverse impacts associated with development of a floodplain, avoiding destruction of wetlands, and not jeopardizing the existence of any threatened or endangered species (DHES, 1992). This alternative meets the location-specific ARARs.

The action-specific ARARs for this alternative include the Montana Surface Water Quality Standards (for extracted, treated water discharged to Silver Bow Creek), MCLs and MCLGs (for extracted, treated water recharged upgradient of the contamination plume). In addition, certain RCRA action-specific requirements would apply to various aspects of these alternatives, for example, the substantive requirements for the operation of incinerators (40 CFR 264.340-351 and 40 CFR 265, Subpart O), for land treatment units (40 CFR 264, Subpart M), and for waste piles (40 CFR 264, Subpart L). All of the technologies included in Alternative 5 are capable of meeting the action-specific ARARs. Careful design and operation of the remedial action systems should ensure compliance with all action-specific ARARs.

6.4.3 Long-Term Effectiveness and Permanence

The oils and sludges that are currently stored on site and LNAPLs generated during the remedial action are permanently addressed through on-site or off-site incineration.

Alternative 5A, which consists of incineration of soils, would effectively and permanently remove the organic contaminants of concern from the soil matrix. The soil treated by incineration would be expected to meet all of the PRAGs listed on Table 3-1.

Bioremediation (Alternative 5B) and soil washing (Alternative 5C) are expected to effectively and permanently reduce the concentration of organic contaminants of concern to within the 10^{-4} to 10^{-6} health risk range. Further actions such as capping or institutional controls may be necessary after bioremediation or soil washing. Design studies will be necessary to fully define treatment efficiency. Alternatives 4B and 4C do not provide the degree of contaminant concentration reduction nor are they expected to be as effective as Alternative 4A.

Contaminated groundwater and any remaining LNAPL would be contained by physical and hydraulic barriers; impacts to Silver Bow Creek would be limited. LNAPL would be recovered and dissolved contamination would be permanently reduced by biological treatment. In situ bioremediation may be effective in reducing the groundwater contamination after the recoverable LNAPL has been removed from the subsurface. Because this alternative includes excavation of all accessible contaminated soils and LNAPL, it may be possible to remediate the aquifer within 30 to 50 years.

Existing institutional controls provide some protection to human health by restricting land uses and banning the use of groundwater as a potable supply. Additional institutional controls and enhanced existing controls would be effective in providing additional protection of human health by further restricting land uses at the site. The institutional controls would be evaluated during 5-year site reviews to determine their continued importance.

6.4.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

Excavating the soils shown in Figure 5-3 to a depth of 4 feet below the water table is expected to remove approximately 80 to 90 percent of the LNAPL. Flushing beneath the highway and USEPA groundwater treatment plant may remove an additional 5 percent. The remaining LNAPL beneath the interstate and USEPA groundwater treatment plant (5 to 15 percent) would be trapped in the soil matrix and would be essentially immobile. The toxicity of the LNAPL that is removed would be effectively eliminated by incineration. The dissolved contaminants in the extracted groundwater would be degraded in the bioreactor and removed by carbon adsorption. Further degradation of contaminants in the groundwater and soils would occur through enhanced in situ biodegradation.

About 83 percent of in-place contaminated soils are removed and treated. The toxicity and volume of contaminants in the excavated soils would be effectively reduced by treatment. Incineration, which typically achieves 99 percent destruction efficiencies for organic compounds, would be more effective than bioremediation and soil washing. Bioremediation and soil washing with residuals treatment are expected to remove about 80 to 95 percent of the PCP and about 75 to 85 percent of the PAHs.

The toxicity of the equipment and debris would be reduced by decontamination and subsequent treatment of the residual wash water and other decontamination materials.

6.4.5 Short-Term Effectiveness

There is potential for workers, site visitors, and nearby residents to be exposed to hazardous substances during implementation of Alternative 5. The exposure pathways for the workers and site visitors includes ingestion of and dermal contact with contaminated soil and groundwater and inhalation of contaminated dust and emissions from on-site incineration. The exposure pathway for the nearby resident would include inhalation of contaminated dust and emissions from on-site incineration. The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels. Dust control activities can be implemented to limit this exposure potential and the incinerator can be designed to limit emissions to acceptable standards. Given the short duration that the incinerator would be on-site, health risks to nearby residents are expected to be low.

The health risks described above that are related to on-site incineration only apply to Alternative 5A. Incineration is not included in Alternatives 5B and 5C.

Excavation near Silver Bow Creek may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

6.4.6 Implementability

Institutional controls, such as private property rights can ordinarily be negotiated amongst land owners. However in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

Alternative 5 requires excavation of approximately 292,000 cubic yards of contaminated soils above and below the water table. Excavation depths range from approximately 22 feet bgl in the southern portion of the site to approximately 6 feet bgl in the northern portion of the site. It is likely that the excavation would be implemented in stages starting in the southern part of the site and moving down gradient towards the creek. Soils would be excavated, stockpiled, treated, and then placed back on site. Lag time would exist between excavation and backfill of the soils producing "ponded water" on site because the soils would be excavated to approximately 4 feet below the water table. It is likely that LNAPL would be present on the ponded water. Skimmer pumps would be used to remove the LNAPL to the extent possible. Some residual PCP/diesel may still be present when the site is backfilled.

Excavating below the water table is more difficult than excavating above the water table because it is difficult to visualize the bottom surface of the hole that is being dug and the material that is being excavated behaves more like a suspension than soil. The soils excavated below the water table would require dewatering before being treated by incineration, may require some dewatering before bioremediation and are not expected to require dewatering before soil washing. Flowing sand conditions were encountered during excavation of the USEPA LNAPL Recovery System and would likely be encountered during implementation of this alternative. Shoring, sheet piling, and/or well point dewatering would be required to reduce the impact of the geotechnical instability that would likely be encountered. Shoring and sheet piling will be required during excavation around the interstate and the USEPA groundwater treatment plant. The potential for spreading contamination during excavation will need to be addressed during excavation design and implementation. It is possible that excavation below the water table will emulsify the LNAPL into the groundwater.

All soil treatment methods associated with this alternative are technically implementable. Numerous bench- and pilot-scale studies have been performed, however, very few full-scale demonstrations of these technologies for the types of contamination at the MPTP site have been performed. Prior to full scale implementation of any of these treatment technologies at the MPTP site, design optimization studies may be appropriate. On-site incineration may not be acceptable to the local community. It would take approximately 7 years to incinerate 208,000 cubic yards of soil, about 10 to 15 years to bioremediate the soil, and about 4 to 6 years to wash the soil.

Off-site incineration of the oily wastes and sludges may be difficult to implement because of the limited availability of permitted facilities which may accept the dioxin-containing wastes. Decontamination of the equipment and debris is easily implementable, however, a more detailed inventory would be required.

Wells and/or trenches would be required to contain the dissolved groundwater contamination. Construction of the trenches may be difficult due to floating sand conditions. The design of the overall groundwater remediation system should include hydraulic modeling which must take into account dewatering activities planned for the LAO site as well as the varied hydrogeologic and geologic conditions around the site. Additional groundwater sampling would also be required prior to design to better define the extent of the plume, particularly in the northwest corner of the site.

The USEPA LNAPL Recovery System could be utilized during implementation of this alternative up until excavation occurred in those areas where recovery system features are located.

6.4.7 Cost

Tables 5-10 through 5-12 summarize the capital costs, annual O&M costs, and total present worth. These costs include negotiating additional institutional controls; maintaining existing institutional controls; groundwater monitoring; excavating soils; groundwater extraction; soil, groundwater, and oily wastes treatment for organic compounds; decontamination of equipment and debris; and disposal. The costs also include transporting the near-creek soils to a local mine-waste repository after they have been treated to reduce the concentration of organic compounds. Detailed costs are provided in Appendix B. Assuming a discount rate of 7 percent, the 30-year present worth for Alternative 5A ranges from $99.9 million to $156.2 million, Alternative 5B ranges from $27.5 million to $55.2 million, and Alternative 5C ranges from $48.1 million to $78.2 million.

6.4.8 State and Community Acceptance

The acceptability of this alternative will be addressed after the state and community have had a chance to comment on the FS report.

6.5 COMPARATIVE ANALYSIS

In this section, a comparative analysis of the remedial alternatives against the nine evaluation criteria is presented to identify the relative advantages and disadvantages of each alternative.

6.5.1 Overall Protection of Human Health and the Environment

The no-action alternative would not be effective in meeting the overall PRAOs for the MPTP site. The no-action alternative does not prevent exposure to contaminated surface and subsurface soils or oils and sludges currently stored and in-place on the MPTP site. Migration of contaminated groundwater to Silver Bow Creek is not prevented, and human exposure to contaminated groundwater is reduced solely by institutional controls and limited groundwater actions presently being undertaken by USEPA. The USEPA groundwater actions are not designed to cleanup site groundwater and institutional controls do not eliminate the potential for exposure and require long term maintenance and enforcement. The no-action alternative is the least protective of the alternatives considered in this FS.

Alternatives 3, 4, and 5 meet the PRAOs for the MPTP site and are equally as protective of human health and the environment providing long-term maintenance of the cap is maintained in Alternative 3. These three alternatives reduce the risks to human health and the environment posed by oils, sludges, equipment, and debris on the site through proper treatment and disposal.

The groundwater extraction and treatment system included in Alternatives 3, 4, and 5 could be designed to effectively contain contaminated groundwater and LNAPL thereby limiting releases to Silver Bow Creek. In conjunction with the institutional controls at the site (specifically groundwater use restrictions) all of the alternatives would limit the potential for human exposure to contaminated groundwater and surface water at the site. Effective long term enforcement of groundwater use restrictions would be required to prevent future human exposure to contaminated groundwater.

Under Alternative 3, previously removed soils, near-creek soils, and soils excavated during construction of the groundwater extraction and treatment systems, would be treated using one of three treatment technologies: Alternative 3A - on-site incineration; Alternative 3B - biological land treatment; and Alternative 3C - soil washing. On-site incineration would be effective in eliminating the risk of human exposure to these soils. On-site incineration would permanently destroy contaminants thereby effectively eliminating the toxicity of these contaminated media. Biological land treatment and soil washing would be effective in reducing the risk from human exposure to these soils to within 10^{-4} to 10^{-6} health risk range.

Alternative 3 reduces the potential for exposure to contaminated surface and subsurface soils, which would remain in place at the site, by capping. However the contaminated soils left in place may continue to act as a source of groundwater contamination, and effective long-term enforcement of institutional controls will be required to prevent site activities which may result in human exposure.

Alternative 4 differs from Alternative 3 in that surface soil hot spots and a large quantity of contaminated soils and associated LNAPL located in the process area and along the drainage ditch to Silver Bow Creek would be removed and treated. The same three soil treatment alternatives as described above for Alternative 3 would be considered. A large portion of the site's contaminated soils would be removed and treated under Alternative 4 which may allow less restrictive used of the land. Groundwater quality improvement is expected to occur to a greater extent and over a shorter time frame than under Alternative 3. Due to the more extensive cleanup associated with this alternative compared to Alternative 3, the period of time that enforcement of institutional controls is critical should be shorter.

Alternative 5 differs from Alternative 4 in that all accessible contaminated soils and associated LNAPLs at the site would be excavated and treated. Soils beneath the interstate highway are considered inaccessible. All accessible contaminated soils and associated LNAPLs will be removed and treated under Alternative 5 which would allow significantly less restrictive uses of the land. Groundwater quality improvement will occur to a greater extent and over a shorter time frame than under Alternatives 3 or 4. Since the goal of this alternative is to permanently reduce site risks related to soils and groundwater as rapidly and completely as possible, the period of time that institutional controls are relied upon for risk management should be shorter than under Alternative 4.

Alternatives 3, 4 and 5 are protective of human health and the environment providing that the mechanisms each alternative uses to prevent exposure and contaminant migration are effective over the long term.

6.5.2 Compliance with ARARs

The no-action alternative does not meet the chemical-specific ARARs for groundwater or surface water.

Under Alternative 3, chemical-specific ARARs for groundwater are not expected to be met, but chemical-specific surface water ARARs would be met via groundwater containment, and location-specific and action-specific ARARs would also be met.

Under Alternative 4, attaining chemical-specific ARARs for groundwater is uncertain within a 30 year remediation period but compliance may be possible in the long term. Chemical-specific surface water ARARs would be met via groundwater containment in the short term and possibly by aquifer remediation in the long term. Alternative 4 would meet location-specific and action-specific ARARs.

The overall groundwater remediation goal of Alternative 5 is remediation of the aquifer as rapidly and completely as possible. Chemical-specific ARARs for groundwater would likely be met under Alternative 5 since all accessible contaminated soils and associated LNAPL will be removed and treated thereby eliminating the major sources of groundwater contamination. Under this alternative, groundwater cleanup would occur more rapidly than under Alternatives 3 or 4 and discontinuation of groundwater treatment may be possible within a 30 to 50 year remediation period. Chemical-specific surface water ARARs would be met via groundwater containment in the short term and aquifer remediation in the long term. Alternative 5 would meet location-specific and action-specific ARARs.

6.5.3 Long-Term Effectiveness and Permanence

The no-action alternative provides no long term effectiveness or permanence for reducing risks to human health and the environment beyond those currently in existence at the site.

Under Alternatives 3, 4, and 5 the oils and sludges that are currently stored on site and LNAPLs generated during the remedial action are permanently addressed through on-site or off-site incineration.

Excavated soils would be permanently addressed under Alternatives 3A, 4A, and 5A by on-site incineration. Under Alternatives 3B, 4B, 5B, 3C, 4C, and 5C the levels of contamination in the excavated soils are permanently reduced. However, the degree of treatment provided by bioremediation and soil washing is expected to be less than that provided by incineration.

Under Alternative 3, capping of the former process area and the drainage ditch would be effective in preventing exposure (via incidental ingestion or dermal contact) to contaminated surface and subsurface soils currently in-place on the MPTP site. Additionally, migration of contamination from vadose zone soils to the groundwater via infiltration would be reduced. Capping does not remove the major source of groundwater contamination (i.e., LNAPL), is subject to deterioration over time, and requires long term maintenance. Alternative 3 does not provide the degree of mass removal that an alternative which includes excavation and treatment of contaminated soils would. Additionally, since the cap is subject to deterioration over time and requires long term maintenance, this alternative does not provide the degree of permanence that an alternative which includes excavation and treatment of contaminated soils would.

The groundwater treatment systems in Alternatives 3, 4, and 5 could be designed to effectively contain the contaminated groundwater and LNAPL by physical and hydraulic barriers; impacts to Silver Bow Creek would be limited. Alternatives 3, 4, and 5 would be effective in treating the organic compounds (and inorganic compounds if necessary) in the extracted groundwater to meet PRAGs for recharge to the aquifer or discharge to Silver Bow Creek. In-situ bioremediation would be utilized in Alternatives 3, 4, and 5. Under Alternative 3, the long term effectiveness of in-situ bioremediation will be limited since this alternative does not include excavation of heavily contaminated soils and associated LNAPL. The groundwater extraction and treatment system would be operated indefinitely under Alternative 3.

Alternatives 3, 4, and 5 also includes groundwater monitoring, which is effective for evaluating potential migration from the site and for determining the effectiveness of the remedial actions. Existing institutional controls provide some protection to human health by restricting land uses and banning the use of groundwater as potable supply. Additional institutional controls would be effective in providing additional protection of human health by further restricting future land development at the site. The institutional controls enacted for the site would be evaluated during the 5-year site reviews included in this alternative.

Alternative 4 differs from Alternative 3 in that surface soil hot spots and the large quantity of contaminated soils and associated LNAPL located in the process area and along the drainage ditch to Silver Bow Creek would be removed and treated. Since this alternative includes excavation of heavily contaminated soils and associated LNAPL, the long-term effectiveness of the soil remedial action and groundwater treatment under this alternative is expected to be greater than under Alternative 3. Under Alternative 4, overall groundwater quality achieved for the aquifer would be expected to be higher than under Alternative 3 for a 30 year remediation period. Discontinuation of the groundwater extraction and treatment system within or after the 30 year remediation period. Discontinuation of the groundwater extraction and treatment system within or after the 30 year remediation period may be possible under Alternative 4. The period of time that enforcement of institutional controls is critical should be shorter than under Alternative 3.

Alternative 5 differs from Alternative 4 in that all accessible contaminated soils and associated LNAPLs at the site would be excavated and treated. Soils beneath the interstate highway are considered inaccessible and would be addressed in situ. Since this alternative includes excavation of all accessible contaminated soils and associated LNAPL, the long term effectiveness of the soil remedial action and groundwater treatment under this alternative would be greater than under Alternatives 3 or 4. Groundwater cleanup would be expected to occur more rapidly than under Alternatives 3 or 4 and discontinuation of groundwater treatment may be possible within a 30 to 50 year remediation period. Since the goal of this alternative is to permanently reduce site risks related to soils and groundwater as rapidly and completely as possible, the period of time that institutional controls are relied upon for risk management would be expected to be shorter than under Alternatives 3 or 4.

6.5.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

The no-action alternative provides no reduction of mobility, toxicity, or volume through treatment beyond that provided by the actions currently in place at the site.

Alternative 3 reduces the toxicity and volume of LNAPL and dissolved contaminants in the groundwater. Approximately 25 to 50 percent of the LNAPL would be extracted from the subsurface and incinerated either on or off site. The dissolved contaminants in the extracted groundwater would be degraded in the bioreactor and removed by carbon adsorption. Further degradation of contaminants in the groundwater and saturated soils would occur through enhanced in situ biodegradation. The toxicity and volume of contaminants in the excavated soils would be effectively reduced by treatment. Incineration (Alternative 3A), which typically achieves 99 percent destruction efficiencies for organic compounds, would be more effective than bioremediation and soil washing. Bioremediation (Alternative 3B) and soil washing with residuals treatment (Alternative 3C) are expected to remove about 80 to 95 percent of the PCP and about 75 to 85 percent of the PAHs. The cap utilized in Alternative 3 reduces the mobility of contaminants in the subsurface by limiting infiltration through the vadose zone. Migration of soil or groundwater contaminants in the saturated zone would be controlled by the groundwater extraction system.

Alternative 4 reduces the volume of LNAPL in the subsurface by about 60 percent through excavation and extraction. The LNAPL that is extracted from the groundwater by pumping would be incinerated. The dissolved contaminants in the extracted groundwater are degraded in the bioreactor and removed by carbon adsorption. Further degradation of contaminants in the groundwater and soils would occur through enhanced in situ biodegradation. About 50 percent of the contaminated soils are removed and treated in Alternative 4. The toxicity of the excavated contaminated soils is effectively eliminated by incineration under Alternative 4A. Under Alternatives 4B and 4C the toxicity of the excavated soils is reduced by about 75 to 95 percent through treatment.

Approximately 80 to 90 percent of the LNAPL would be removed under Alternative 5. Flushing beneath the highway and USEPA groundwater treatment plant may remove an additional 5 percent. The remaining LNAPL beneath the interstate and USEPA groundwater treatment plant (5 to 15 percent) would be trapped in the soil matrix and would be essentially immobile. The toxicity of the LNAPL that is removed would be effectively eliminated by incineration. The dissolved contaminants in the extracted groundwater would be degraded in the bioreactor and removed by carbon adsorption. Further degradation of contaminants in the groundwater and soils would occur through enhanced in situ biodegradation. The toxicity and volume of contaminants in the excavated soils would be effectively reduced by treatment. Incineration (Alternative 5A), which typically achieves 99 percent destruction efficiencies for organic compounds, would be more effective than bioremediation and soil washing. Bioremediation (Alternative 5B) and soil washing with residuals treatment (Alternative 5C) are expected to remove about 80 to 95 percent of the PCP and about 75 to 85 percent of the PAHs.

The toxicity of the equipment and debris is reduced by decontamination and subsequent treatment of the residual wash water and other decontamination materials in Alternatives 3, 4, and 5.

6.5.5 Short-Term Effectiveness

Under the no-action alternative, there is potential for workers and site visitors to be exposed to hazardous substances during implementation of the time critical removal actions being performed by USEPA at the MPTP site. The exposure pathway includes ingestion of and dermal contact with contaminated soil and groundwater. The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels.

During implementation of Alternatives 3, 4 and 5 there is potential for workers, site visitors, and nearby residents to be exposed to hazardous chemicals. The exposure pathways for the workers and site visitors includes ingestion of and dermal contact with contaminated soil and groundwater and inhalation of contaminated dust and vapors and emissions from on-site incineration. The exposure pathway for the nearby resident would include inhalation of contaminated dust and vapors and emissions from on-site incineration. The health risk to the site visitor is expected to be minimal because of the short duration of the activity. Adhering to safe work practices and using health and safety equipment should limit the exposure to workers to within acceptable levels. Dust and vapor release control activities can be implemented to limit this exposure potential and the incinerator can be designed to limit emissions to acceptable standards. Given the short duration that the incinerator would be on-site and the emission standards that would be met, health risks to nearby residents would be low. The health risks described above which are related to on-site incineration are only related to Alternatives 3A, 4A and 5A. On-site incineration is not included in any of the other alternatives.

Excavation near Silver Bow Creek in Alternatives 3, 4, and 5 may impact short-term effectiveness by posing a threat of additional releases to Silver Bow Creek. Sheet piling or other engineering control methods may be necessary to minimize releases.

6.5.6 Implementability

The no-action alternative can be readily implemented.

Under Alternatives 3, 4, and 5, institutional controls, such as private property rights may possibly be negotiated amongst land owners. However, in this case the record owner of a significant portion of the site is a dissolved corporation and this may make these institutional controls difficult to implement and control. Changes to zoning laws and building codes are generally performed by local legislative bodies and can be difficult to control. Butte-Silver Bow County is currently developing a plan for implementing and enforcing institutional controls at sites throughout the county. The plan addresses well head treatment programs, cap maintenance, building restrictions, and proposes a Superfund district that would have additional restrictions. The 5-year site reviews included with this alternative could be used to evaluate the effectiveness of the institutional controls.

Groundwater flow and solute transport modeling is recommended before designing the extraction and recharge systems in Alternatives 3, 4, and 5. Modeling would be used along with additional LNAPL and groundwater sampling data to optimize the trench and extraction well locations.

The technologies for soil and groundwater treatment are readily implementable. Prior to full-scale implementation of any of these treatment technologies at the MPTP site, design optimization studies may be appropriate. On-site incineration may not be acceptable to the local community, and off-site incineration of the oily wastes and sludges may be difficult to implement because off-site incinerator operators are reluctant to accept dioxin containing wastes.

Groundwater extraction, containment and treatment, and maintenance of a clay cap would be required indefinitely under Alternative 3. Implementing operations and maintenance activities indefinitely is difficult to ensure.

Alternatives 4 and 5 differ from alternative 3 in that implementation of a clay cap maintenance program will not be necessary and operation of the groundwater extraction and treatment systems is not expected to continue indefinitely. Alternatives 4 and 5 may be more difficult to implement than Alternative 3 because excavation below the water table is more difficult than above the water table, dewatering of saturated soils may be necessary before treatment and the potential for spreading contamination during excavation would need to be addressed. Sheet piling, skimmer pumps, and careful attention to maintaining hydraulic control would be required.

6.5.7 Cost

Alternative 1 is the least costly to implement. Alternative 5A is the most costly to implement. Alternative 5B is relatively inexpensive but takes about 10 to 15 years to implement. The 30-year present worth of Alternative 3 ranges from $21.0 million to $60.1 million; Alternative 4 ranges from $24.8 million to $110.8 million; and Alternative 5 ranges from $27.5 million to $156.2 million.

6.5.8 State and Community Acceptance

A comparative analysis of the acceptability of each alternative will be addressed after the state and community have reviewed and commented on the FS report.

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APPENDIX A

SCREENING AND DESCRIPTION OF POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

MONTANA POLE NPL SITE
BUTTE, MONTANA

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MDHES
April 28, 1992

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LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency of Toxic Substances and Disease Registry
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BPCTCA	Best Practicable Control Technology Currently Available
BPJ	Best Professional Judgment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DNRC	Department of Natural Resources and Conservation (Montana)
DSL	Department of State Lands (Montana)
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HWM	Hazardous Waste Management
LNAPL	Light Non-aqueous Phase Liquid
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDHES	Montana Department of Health and Environmental Sciences
MGWPCS	Montana Groundwater Pollution Control System
MPDES	Montana Pollutant Discharge Elimination System
NCP	National Contingency Plan
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NPL	National Priorities List
NPDES	National Pollutant Discharge Elimination System
PAH	Polynuclear Aromatic Hydrocarbon
PCP	Pentachlorophenol
POHC	Principal Organic Hazardous Constituents
POTW	Public Owned Treatment Works
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SHPO	State Historic Preservation Officer (Montana)
SIP	State Implementation Plan
TBC	To Be Considered
TU	Turbidity Unit
UIC	Underground Injection Control

1.0 INTRODUCTION

1.1 OBJECTIVE AND SCOPE OF THIS DOCUMENT

The purpose of this document is to screen and describe in detail potential applicable or relevant and appropriate requirements (ARARs) for the Montana Pole National Priorities List (NPL) site. This detailed analysis of ARARs will provide the basis for assessing the extent to which the various alternatives being considered in the feasibility study comply with ARARs. Such an assessment is required by the NCP, 40 CFR 300.430(e)(9)(iii)(B).

1.2 THE SITE

The Montana Pole and Treating Plant is a defunct wood treating facility located in Butte, Montana. The site occupies approximately thirty acres bordering Silver Bow Creek and is located adjacent to another Butte Superfund site which contains primarily mineral mining and smelting wastes. Portions of the Montana Pole site lie within the floodplain of Silver Bow Creek, a tributary of the Clark Fork River.

Construction of the plant began in 1946, and the plant operated from 1947 until 1984 using pressure and butt treating processes to preserve poles, posts and bridge timbers. With the exception of coal tar creosote, used for a short time in 1969, the preservative solution used to treat timber products consisted of a 5 percent pentachlorophenol (PCP) and 95 percent petroleum mixture.

In 1983 the site was investigated by the State of Montana and the United States Environmental Protection Agency (EPA) after an oily sheen was reported on nearby Silver Bow Creek. EPA began emergency removal action at the site in 1985, removing contaminated soils and equipment and placing these in storage sheds on site. EPA also installed a groundwater interception and oil recovery system as part of the removal action. Currently the State of Montana, as lead agency with EPA support, is overseeing a Remedial Investigation and Feasibility Study being conducted by the Atlantic Richfield Company (ARCO) under an Administrative Order on Consent. Site soils and groundwater and Silver Bow Creek surface water and sediments are contaminated primarily with PCP, polynuclear aromatic hydrocarbons (PAHs), diesel oil and metals.

2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

2.1 ARARS FOR REMEDIAL ACTIONS

Section 121(d)(2) of CERCLA, 42 U.S.C. § 9621(d)(2), requires that cleanup actions conducted under CERCLA achieve a level or standard of control which at least attains "any standard, requirement, criteria or limitation under any Federal environmental law ... or any [more stringent] promulgated standard, requirement, criteria or limitation under a State environmental or facility siting law ... [which] is legally applicable to the hazardous substance concerned or is relevant and appropriate under the circumstances of the release of such hazardous substance or pollutant, or contaminant ..." The standards, requirements, criteria or limitations identified pursuant to this section are commonly referred to as "applicable or relevant and appropriate requirements," or ARARs.

Two general types of cleanup actions are recognized under CERCLA: removal actions and remedial actions. A removal action is an action to abate, prevent, minimize, stabilize, mitigate or eliminate a release or threat of release and is often an interim action taken to alleviate the most acute threats or to prevent further spread of contamination until more comprehensive action can be taken. A remedial action is a thorough investigation, evaluation of alternatives, and determination and implementation of a comprehensive and fully protective remedy for the site.

The cleanup of the Montana Pole NPL site being planned through the ongoing RI/FS process is a remedial action. Such an action must comply with or attain all ARARs unless specific ARAR waivers are invoked. See CERCLA § 121(d)(4), 42 U.S.C. § 9621(d)(4), and the NCP, 40 CFR 300.430(f)(1)(ii)(C). ARARs must be observed both during the conduct of on site clean up activities and at the conclusion of the cleanup activity, unless specifically exempted.[1]

2.2 REQUIREMENTS FOR ARARS

ARARs may be either "applicable" requirements or "relevant and appropriate" requirements. Compliance with both is equally mandatory under CERCLA.[2]

Applicable requirements are those standards, requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

Relevant and appropriate requirements are those standards, standards, requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Factors which may be considered in making this determination, when the factors are pertinent, are presented in 40 CFR § 300.400(g)(2). They include, among other considerations, examination of: the purpose of the requirement and the purpose of the CERCLA action; the medium and substances regulated by the requirement and the medium and substances at the CERCLA site; the actions or activities regulated by the requirement and the remedial action contemplated at the site; and the potential use of resources affected by the requirement and the use or potential use of the affected resource at the CERCLA site.

ARARs are divided into contaminant-specific, location-specific and action-specific requirements. Contaminant-specific requirements govern the release to the environment of materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Contaminant-specific ARARs generally set human or environmental risk-based criteria and protocol which, when applied to site-specific conditions, result in the establishment of numerical action values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

Location-specific ARARs relate to the geographic or physical position of the site, rather than to the nature of site contaminants. These ARARs place restrictions

[1] 40 CFR § 300.435(b)(2); Preamble to the Proposed NCP, 53 Fed. Reg. 51440 (December 21, 1988); Preamble to the Final NCP, 55 Fed. Reg. 8755-8757 (March 8, 1990).

[2] See CERCLA § 121(d)(2)(A), 42 U.S.C. § 9621(d)(2)(A).

on the concentration of hazardous substances or the conduct of cleanup activities due to their location in the environment.

Action-specific ARARs are usually technology- or activity-based requirements, or are limitations on actions taken with respect to hazardous substances. A particular remedial activity will trigger an action-specific ARAR. Unlike chemical-specific and location-specific ARARs, action-specific ARARs do not, in themselves, determine the remedial alternative. Rather, action-specific ARARs indicate how the selected remedy must be achieved.

Only the substantive portions of the requirements are ARARs.[3] Administrative requirements are not ARARs and thus do not apply to actions conducted entirely on-site. Administrative requirements are those which involve consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement. The CERCLA program has its own set of administrative procedures which assure proper implementation of CERCLA. The application of additional or conflicting administrative requirements could result in delay or confusion.[4] Provisions of statutes or regulations which contain general goals that merely express legislative intent about desired outcomes or conditions but are non-binding are not ARARs.[5]

Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be applicable or relevant and appropriate. To be an ARAR, a state standard must be "promulgated," which means that the standards are of general applicability and are legally enforceable.[6]

Additional documents may be identified as To Be Considered (TBCs). The TBC category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. These may be considered as appropriate in selecting and developing cleanup actions.[7]

Laws which are not environmental laws or state facility siting laws are not ARARS, but, if applicable, must be observed and complied with in any action at the site. CERCLA § 121 exempts any action conducted entirely on-site from any local, state or federal permit requirement, including any permit requirements of these other laws. However, all other applicable requirements of these other laws, including the administrative as well as the substantive requirements, apply to actions conducted at the site.

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3 40 CFR § 300.5 (Definitions of "Applicable requirements" and "Relevant and appropriate requirements.) See also Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8, 1990).

4 Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8, 1990); Compliance with Other Laws Manual, Vol. I, pp. 1-11 through 1-12.

5 Preamble to the Final NCP, 55 Fed. Reg. 8746 (March 8, 1990).

6 40 C.F.R. § 300.400(g)(4).

7 40 C.F.R. § 300.400(g)(3); 40 C.F.R. § 300.415(i); Preamble to the Final NCP, 55 Fed. Reg. 8744-8746 (March 8, 1990).

2.3 ARARS APPLICABLE TO THE MONTANA POLE NPL SITE

This document constitutes MDHES' and EPA's detailed description of potential ARARs for use in the feasibility study for the Montana Pole NPL site and resulting remedial action decisions. A final version of this document will be included in the feasibility study report, along with an evaluation of the compliance of the various alternatives with ARARs. However, the final determination of ARARs that will ultimately apply to the site and the final determination of compliance with ARARs or applicability of ARAR waivers will be presented in the record of decision (ROD).

The description of federal and state ARARs which follows includes summaries of the legal requirements which, in many cases attempt to set out the requirement in a concise fashion that is useful in evaluating compliance with the requirement. These descriptions are provided to allow the user a reasonable understanding of the requirements without having to refer constantly back to the statute or regulation itself. However, in the event of any inconsistency between the law itself and the summaries provided in this document, the applicable or relevant and appropriate requirement is ultimately the requirement as set out in the law, rather than any paraphrase of the law provided here.

The ARARs analysis is based on § 121(d) of CERCLA, 42 U.S.C. § 9621(d); "CERCLA Compliance with Other Laws Manual, Volume I," OSWER Dir. 9234.1-01 (August 8, 1988); "CERCLA Compliance with Other Laws Manual, Volume II," OSWER Dir. 9234.1-02 (August, 1989); the Preamble to the Proposed National Contingency Plan, 53 Fed. Reg. 51394, et. seq. (December 21, 1988); the Preamble to the Final National Contingency Plan, 55 Fed. Reg. 8666-8813 (March 8, 1990); and the Final National Contingency Plan, 40 CFR Part 300 (55 Fed. Reg. 8813-8865, March 8, 1990) (hereinafter referred to as the NCP). All references to 40 CFR Part 300 contained in this document refer to the final NCP, unless noted.

3.0 FEDERAL ARARS

Potential Federal applicable or relevant and appropriate requirements for the Montana Pole NPL site are discussed below.

3.1 FEDERAL CONTAMINANT-SPECIFIC ARARS

3.1.1 Safe Drinking Water Act (Relevant and Appropriate)[8]

The National Primary and Secondary Drinking Water Standards (40 CFR Parts 141, 143), better known as "maximum contaminant levels" (MCLs), are not applicable to remedial activities at the site because the aquifer underlying the site is not a public water supply. Currently there is no known public use of groundwater underlying, or coming into contact with, contaminants from the Montana Pole site. These standards may be applicable in the future should the EPA detect an exceedance at a public water outlet.

These drinking water standards are, however, relevant and appropriate because groundwater in the area is a potential source of drinking water, and because the aquifer feeds Silver Bow Creek, which is designated as a potential drinking water source.

The determination that the drinking water standards are relevant and appropriate at the site is fully supported by EPA regulations and guidance. The Preamble to the National Contingency Plan (NCP) clearly states the MCLs are relevant and appropriate for groundwater that is a current or potential source of drinking water, 55 Fed. Reg. 8750 (March 8, 1990), and this determination is further supported by requirements in the RI/FS section of the NCP, 40 CFR § 300.430(e)(2)(i)(B). EPA's Guidance on Remedial Action For Contaminated Groundwater at Superfund Sites states that "MCLs developed under the Safe Drinking Water Act generally are ARARs for current or potential drinking water sources".

The MCLs are relevant and appropriate for remedial actions that will be considered for this site. In addition, the non-zero maximum contaminant level goals (MCLGs) are relevant and appropriate (55 Fed. Reg. 8750-8752 (March 8, 1990)). The MCLs and the MCLGs are:

Chemical	MCLG (mg/l)	MCL (mg/l)
Inorganics:		
Arsenic	N/A	.05[9]
Cadmium	.005[10]	.005[11]

[8] EPA has granted to the State of Montana primacy in enforcement of the Safe Drinking Water Act. Thus the law commonly enforced in Montana is the state law, rather than the federal law. The state regulations under the state Public Water Supply Act, §§ 75-6-101 et seq., MCA, substantially parallel the federal law. The MCLs are currently identical, see ARM 16.20.203, and will remain so until certain federal rule changes become effective on July 1, 1992, and January 1, 1993. The state requirements are not separately identified, since they are not more stringent. This note is provided only to clarify the primacy issue, i.e., which law is commonly enforced in Montana.

[9] 40 CFR § 141.11 (1991). See also ARM 16.20.203.

[10] This MCLG for cadmium will be effective July 30, 1992. See 56 Fed. Reg. 3593 (January 30, 1991).

Chromium	.1[12]	.1[13]
Copper	1.3[14]	1.3[15]
Lead	N/A[16]	.015[17]
Organics:[18]		
Benzene	N/A[19]	0.005[20]
Dichlorobenzene (para)	0.075[21]	0.075[22]
Dichlorobenzene (ortho)	0.6	0.6
Ethylbenzene	0.7	0.7
Monochlorobenzene	0.1	0.1
Toluene	1.	1.

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[11] 40 CFR § 141.11. Effective July 30, 1992, the cadmium MCL specified in 40 CFR § 141.11 will expire and the same MCL will become effective under 40 CFR § 141.51. See 56 Fed. Reg. 3593 (January 30, 1991). The current state MCL is 0.010 mg/l. See ARM 16.20.203.

[12] The chromium MCLG will become effective July 30 ,1992. See 40 CFR § 141.51(Effective Date Note 1).

[13] This chromium MCL will become effective July 30 ,1992. See 40 CFR § 141.62(Effective Date Note 1). Until that date the MCL is effectively 0.05 mg/l. See 40 CFR § 141.11(Effective Date Note 1).

[14] This level is established as an MCLG for copper through July 30, 1992. See 40 CFR § 141.51.

[15] Effective November 9, 1992, this level will become effective as an "action level" similar to the lead level described in the footnote discussing the lead MCL. See 40 CFR Subpart I. In addition, a secondary MCL of 1.0 mg/l is identified for copper at 40 CFR § 143.3. However, the secondary MCLs are not enforceable as federal standards and are provided only as guidelines for the states. These standards are not generally considered ARARs unless the state adopts them as enforceable standards. See CERCLA Compliance With Other Laws Manual, Volume 1 (August 1988), p. 4-8. Montana has not adopted the secondary MCLs as enforceable standards.

[16] Lead is among the acutely toxic substances for which the MCLG is zero. However, the zero MCLGs are not generally considered "appropriate" requirements for CERCLA cleanups, primarily for reasons of practicability. See 40 CFR § 300.430(e)(2)(i)(C); see also Preamble to the Final NCP, 55 Fed. Reg. 8750-8753 (March 8, 1990).

[17] The level specified is not an MCL, but rather an "action level." The standard is normally measured at the taps of users of the water to account for additional lead contamination resulting from corrosion in the water supply lines. See 40 CFR Subpart I, (40 CFR §§ 141.80-141.91). The action level will become effective November 9, 1992. 40 CFR § 141.80(a)(2). Until December 7, 1992, an MCL for lead is specified at 0.05 mg/l. See 40 CFR § 141.11(Effective Date Note 1).

[18] Except as noted in the footnotes below, the MCLGs and MCLs for the following organic compounds will become effective July 30, 1992. See 40 CFR § 141.50(Effective Date Note 1), for the MCLGs specified, and 40 CFR § 141.61(Effective Date Note 1), for the MCLs specified.

[19] The MCLG for benzene is zero. See 40 CFR § 141.50.

[20] See 40 CFR § 141.61.

[21] See 40 CFR § 141.50.

[22] See 40 CFR § 141.61.

Xylenes (total)	10.	10.
Pentachlorophenol	N/A[23]	0.001[24]

In addition, new <u>proposed</u> MCLs for certain PAHs detected at the site and for certain dioxins are identified in the To Be Considered (TBC) section of the federal ARARs, below.

3.1.2 Clean Water Act (Relevant and Appropriate)

3.1.2.1 <u>Categorical Industrial Pretreatment Standards for the Wood Preserving Steam Subcategory</u> (Relevant and Appropriate)

Under 40 CFR §§ 429.85 and 429.86,[25] pretreatment standards are set for discharges from existing and new sources to publicly owned treatment works (POTWs). These standards are legally applicable to discharges of "process wastewater" into a publicly owned treatment works and may be relevant and appropriate to discharges of contaminated treatment water from remedial actions to a POTW. Because discharge to a POTW is considered an "off-site" activity, compliance with both the administrative and substantive requirements of these regulations is required.

3.1.3 Resource Conservation and Recovery Act (RCRA)

3.1.3.1 <u>Groundwater Protection Standards (Applicable)</u>

Under 40 CFR Part 264, Subpart F[26], concentration limits are set for hazardous constituents in groundwater. These standards are applicable to remedial actions at the site. The limits specified for groundwater protection are the same as or less stringent than the MCLs or MCLGs identified above for those substances.[27]

3.1.3.2 Hazardous Waste Management (Relevant and Appropriate)

The Resource Conservation and Recovery Act of 1980, 42 U.S.C. § 6901, <u>et seq.</u>, and accompanying regulations set forth the standards for hazardous waste.

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[23] Effective January 1, 1993, pentachlorophenol will be included in the group of toxic chemicals for which the MCLG is zero. <u>See</u> 56 Fed. Reg. 30280 (July 1, 1991), to be codified at 40 CFR § 141.50(a).

[24] An EPA rulemaking establishing an MCL for pentachlorophenol at 0.001 mg/l has been finalized. The new MCL will be effective January 1, 1993. <u>See</u> 56 Fed. Reg. 30280 (July 1, 1991), to be codified at 40 CFR § 141.61. This MCL should be considered a relevant and appropriate requirement for this action. Moreover, the final determination of ARARs is to be made in the ROD for the site. The anticipated date for issuance of the ROD for this site is subsequent to the effective date of the new MCL, January 1, 1993. Therefore, the penta MCL will be specified as an applicable, rather than relevant and appropriate, requirement in the ROD.

[25] The pretreatment requirements for the Wood Preserving - Boulton Subcategory, also a process used at the site, are the same as for the Steam Subcategory. <u>See</u> 40 CFR §§ 429.95 and 429.96.

[26] The State of Montana implements an authorized RCRA program which includes the groundwater protection standards of 40 CFR Part 264, Subpart F, (1990) as incorporated by reference in ARM 16.44.702.

[27] The maximum groundwater concentrations specified are (1) for arsenic and lead: the same as the MCL, .05 mg/l; (2) for cadmium: the same as the old MCL, .010 mg/l, but not as stringent as the new MCL or the MCLG, .005 mg/l. No solid waste groundwater standard is specified for copper.

The EPA has stated that the test for determining whether such standards are applicable to cleanups at superfund sites is:

> RCRA Subtitle C requirements for the treatment, storage, or disposal of hazardous waste will be applicable if a combination of the following requirements are met: a) the waste is listed or characteristic waste under RCRA; and b) either (1) the waste was treated, stored, or disposed of after the effective date of the RCRA requirements (November 8, 1980); or (2) the activity at the CERCLA site constitutes treatment, storage or disposal as defined under RCRA. (42 U.S.C. § 6901, et seq.)

Because of the location of the Montana Pole site, and the historical mining activities which took place in this area, contaminated soil materials being addressed at the site may include material derived during the extraction and beneficiation processes. Wastes from ore extraction and benefication are specifically excluded from Subtitle C under the mining waste (Bevill) exclusion, (RCRA Section 3001(b)(3)(A)(ii)). Therefore, RCRA is not applicable to mine waste found at the site.

Despite this situation, the EPA has determined that certain RCRA standards, and their state counterparts, are relevant and appropriate to potential remedial actions planned. The EPA's determination is based on the current definition of "relevant and appropriate" found in the most recent version of the NCP at 40 CFR § 300.5. For mining waste, certain provisions of RCRA can be relevant and appropriate if they meet the definition of "relevant and appropriate" found in the NCP; if the activities contemplated at the Montana Pole site will result in discrete areas of mining waste which resemble traditional RCRA management units; and if the mining wastes are located in areas where exposure is likely to occur, are toxic, are close to groundwater, or are otherwise distinguishable from EPA's generic determination of low toxicity/high volume for RCRA-excluded mining waste. See Preamble to Final NCP, 55 Fed. Reg. 8763-8764 (March 8, 1990); CERCLA Compliance With Other Laws Manual, Volume II (August 1989)(OSWER Dir. No. 9234.1-02) p.6-4; Preamble to Proposed NCP, 53 Fed. Reg. 51447 (Dec. 21, 1988); and guidance entitled "Consideration of RCRA Requirements in Performing CERCLA Responses at Mining Wastes Sites," August 19, 1986 (OSWER).

At Montana Pole, if mining wastes are controlled in place as discrete units, or are actively collected and managed as discrete units, the following RCRA standards will be ARARs:

> 40 CFR § 264.18(a) and (b), which impose siting restrictions and conditions on the treatment, storage, or disposal of wastes;
>
> certain provisions of 40 CFR Part 263, which govern the transportation of wastes;
>
> 40 CFR §§ 264.116 and 264.119, regarding notification and filing requirements;
>
> 40 CFR § 264.228(a)(2)(i), addressing dewatering of wastes;
>
> 40 CFR § 264.228(a)(2)(iii)(B),(C), and (D), and 40 CFR § 264.251(c),(d), and (f), regarding run-on and run-off controls; and

40 CFR §§ 257.3-1(a), 257,3-2, 257.3-3, and 257.3-4, which impose general requirements on waste handling, storage, and disposal.

Land disposal restrictions, discussed below with respect to organic substances at the site, are not identified as relevant and appropriate for these mining wastes, in accordance with current EPA guidance.

3.1.3.3 Land Disposal Restrictions

In December 1990, EPA listed new hazardous wastes consisting of waste waters, process residuals, preservative drippage, and spent formulations of wood preserving processes generated at plants using chlorophenolic and creosote formulations for wood preserving waste nos. F032 and F034. 55 Fed. Reg. 50,450; 50,482, to be codified at 40 CFR § 261.31(a). Because the site is a wood treating site that used pentachlorophenol and creosote, these newly-listed wastes are found in various locations throughout the site. Land disposal restrictions (LDRs) may be relevant and appropriate to site soils contaminated with FO32 and FO34 waste if placement of those soils occurs.

LDRs typically set concentration levels or treatment standards that hazardous wastes must meet before they can be land disposed. These treatment standards represent best demonstrated available treatment technology (BDAT) for these wastes. In some cases, however, hazardous wastes and appropriate treatment levels may differ significantly even within the same class of hazardous waste. See 40 CFR § 268.44. Consequently, a variance from an LDR treatment standard may be appropriate when a waste "differs significantly from waste analyzed in developing the treatment standard." 40 CFR §§ 268.44(a) and (h). The NCP states that "because contaminated soil and debris are significantly different from the wastes evaluated in establishing the BDAT standards, it cannot be treated in accordance with those standards, and thus qualifies for a treatability variance from those standards ..." 54 Fed. Reg. 8760 (October 10, 1989). Accordingly, the site's contaminated soil may obtain a treatability variance under 40 CFR § 268.44. See Superfund LDR Guidance No. 6A, "Obtaining a Soil and Debris Treatability Variance for Remedial Actions," EPA OSWER Directive, 9347.3-06FSW, July 1989.

3.1.4 Clean Air Act (Applicable)

Section 109 of the Clean Air Act, 42 U.S.C. § 7409, and implementing regulations found at 40 CFR Part 50 set national primary and secondary ambient air quality standards.[28] National primary ambient air quality standards define levels of air quality which are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which are necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. The ambient air quality standards and other standards set out below are applicable for releases into the

[28] The ambient air quality standards established as part of Montana's approved State Implementation Plan in many cases provide more stringent or additional standards. Moreover, the federal regulations apply the standards only to "major sources;" the state regulations are fully applicable throughout the state and are not limited to "major sources." See ARM 16.8.808 and 16.8.811 - 821. As part of an EPA-approved State Implementation Plan, the state standards are also federally enforceable. Thus, the state standards are noted in this section together with the federal standards.

air resulting from remedial action.[29] These standards must be met both during the design and implementation phases of the remedial action.

3.1.4.1 Particulate Matter

The ambient air quality standard for particulate matter of less than or equal to 10 micrometers in diameter (PM-10) is 150 micrograms per cubic meter, 24 hour average concentration; 50 micrograms per cubic meter, annual arithmetic mean. 40 CFR § 50.6[30] (Applicable).

In addition, state law provides an ambient air quality standard for settled particulate matter. Particulate matter concentrations in the ambient air shall not exceed the following 30-day average: 10 grams per square meter. ARM § 16.8.818 (Applicable).

The Butte area has been designated by EPA as non-attainment for total suspended particulates. 40 CFR § 81.327. ARM 16.8.1401 (Applicable) requires that any new source of airborne particulate matter that has the potential to emit less than 100 tons per year of particulates shall apply best available control technology (BACT); any new source of airborne particulate matter that has the potential to emit more than 100 tons per year of particulates shall apply lowest achievable emission rate (LAER). The BACT and LAER standards are defined in ARM 16.8.1401.

3.1.4.2 Lead

ARM § 16.8.815 (Applicable). Lead concentrations in the ambient air shall not exceed the following 90-day average (annual arithmetic mean): 1.5 micrograms Pb per cubic meter of air. 40 CFR § 50.12[31] (Applicable).

3.1.4.3 Asbestos

The National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61) designate certain air pollutants that cause serious adverse health effects. Subpart M (§§ 61.141-157) specifies control requirements for asbestos. 40 CFR §§ 61.145 and 61.150 (Applicable) cover demolition and waste disposal for demolition operations and would be applicable if asbestos is encountered during implementation of the remedy.

3.1.5 Federal Insecticide, Fungicide, and Rodenticide Act (Applicable)

This statute (7 U.S.C. § 136 et seq.) regulates the sale, distribution and use of all pesticide products in the United States and is applicable to any alternative involving the recycling and reuse of pentachlorophenol and other wood-treating pesticides. Under FIFRA, use of a registered pesticide product in a manner inconsistent with its labeling is a violation of the Act (7 U.S.C. § 136j).

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29 Ambient air quality standards are also provided for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, and ozone. If emissions of these compounds were to occur at the site in connection with any remedial action, these standards would also be applicable. See ARM 16.8.811 - 820.

30 The state air quality regulations provide an equivalent standard, see ARM 16.8.821, which is enforceable in Montana as part of the State Implementation Plan.

31 The state air quality regulations provide an equivalent standard, see ARM 16.8.815, which is enforceable in Montana as part of the State Implementation Plan.

Recovered pesticides may be reused provided they meet new product labelling specifications, which include concentration limits for pesticides in solution.

3.2 FEDERAL LOCATION-SPECIFIC ARARS

3.2.1 Fish and Wildlife Coordination Act (Applicable)

This standard (16 USC §§ 1531-1566, 40 CFR § 6.302(g)) requires that federal agencies or federally funded projects ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provide for adequate protection of fish and wildlife resources. Compliance with this ARAR requires EPA to consult with the U.S. Fish and Wildlife Service and the Wildlife Resources Agency of the affected State. Further consultation will occur during the public comment period and specific mitigative measures may be identified in consultation with the appropriate agencies.

3.2.2 Floodplain Management Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,988) mandates that federally-funded or authorized actions within the 100 year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain. Compliance with this requirement is detailed in EPA's August 6, 1985 "Policy of Floodplains and Wetlands Assessments for CERCLA Actions." Specific measures to minimize adverse impacts will be identified following consultation with the appropriate agencies.

If the remedial action is found to potentially affect the floodplain, the following information will be produced: a Statement of Findings which will set forth the reasons why the proposed action must be located in or affect the floodplain; a description of significant facts considered in making the decisions to locate in or affect the floodplain or wetlands including alternative sites or actions; a statement indicating whether the selected action conforms to applicable state or local floodplain protection standards; a description of the steps to be taken to design or modify the proposed action to minimize potential harm to or within the floodplain; and a statement indicating how the proposed action affects the natural or beneficial values of the floodplain.

3.2.3 Protection of Wetlands Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,990) mandates that federal agencies and PRPs avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.

In order to comply with this ARAR, EPA will consult with the U.S. Army Corps of Engineers (COE) or the U.S. Fish and Wildlife Service to determine whether wetlands exist at the site and, if present, what category of wetland they represent. Compliance will be addressed in a manner similar to the floodplain requirements described above.

3.2.4 Resource Conservation and Recovery Act (Applicable)

The requirements set forth at 40 CFR § 264.18(a) and (b)[32] provide that (a) any hazardous waste facility must not be located within 61 meters (200 feet) of a fault (see Appendix VI of Part 264), and (b) any hazardous waste facility within the 100 year floodplain must be designed, constructed, operated and maintained to avoid washout. Any discrete disposal or storage facilities which remain on-site as part of remedial activities must meet these standards.

3.2.5 Endangered Species Act (Applicable)

This statute and implementing regulations (16 USC §§ 1531-1543, 50 CFR § 402, 40 CFR § 6.302(h)) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.

Compliance with this requirement involves consultation between EPA and the U.S. Fish and Wildlife Service, resulting in a determination as to whether there are listed or proposed species or critical habitats present on the site, and, if so, whether any proposed activities will impact such wildlife or habitat. At this time, the U.S. Fish and Wildlife Service has not identified any threatened or endangered species or critical habitat on the site. During the public comment period, additional consultation will occur.

3.2.6 National Historic Preservation Act (Applicable)

This statute and implementing regulations (16 U.S.C. § 470, 40 CFR § 6.310(b), 36 CFR Part 800), require federal agencies or federal projects to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure or object that is included in, or eligible for, the Register of Historic Places. To comply with this ARAR, EPA must consult the State Historic Preservation Officer (SHPO), who can identify cultural resources and assess whether proposed cleanup actions will impact the resources. If remedial action is likely to have an adverse effect on any cultural resources which are on or near the site, EPA must examine whether feasible alternatives exist that would avoid such effects. If effects cannot reasonably be avoided, measures should be implemented to minimize or mitigate the potential effect.

NHPA regulations reserve formal determination of eligibility for the National Register of Historic Places and "no adverse effects" determinations for Federal agencies. The EPA is using the Cultural Resource Inventory for the Montana Pole and Treating Plant NPL Site completed by ARCO and supplementing this with site-specific historical inventory and adverse effects determinations. The EPA will continue to consult with the SHPO to identify specific mitigative measures, if necessary.

Research into the Montana Pole and Treating Plant revealed that the facility began operations in July 1946 and remained in business until May 17, 1984 (Camp, Dresser, & McKee 1990). Subsequent salvage and cleanup operations conducted by the EPA on the site removed most of the plant's facilities. The area was surveyed for prehistoric cultural remains but due to the disturbed condition of the site area, the potential for the existence of such materials is minimal and none

[32] These requirements are applicable through their incorporation by reference in Montana's regulations for its authorized RCRA program. ARM 16.44.702.

have been observed. In addition, the plant is less than 50 years old and therefore it does not qualify as a historic site. No further cultural resource inventory or evaluation has been conducted on the site.

In April 1992, ARCO, EPA, MDHES, the Advisory Council on Historic Preservation, the State Historic Preservation Officer, and the local governments of Butte/Silver Bow, Anaconda/Deer Lodge, and Walkerville entered into a Programmatic Agreement to ensure the consideration of cultural and historic values in a systematic and comprehensive manner throughout the Clark Fork Basin in connection with remedial action at the four Clark Fork Superfund sites. This Programmatic Agreement may provide additional consideration of the factors to be addressed under the National Historic Preservation Act, and the other two cultural resources statutes that are ARARs, the Archaeological and Historic Preservation Act and the Historic Sites, Buildings and Antiquities Act, discussed below.

3.2.7 Archaeological and Historic Preservation Act (Applicable)

This statute and implementing regulations (16 U.S.C. § 469, 40 CFR § 6.301(c)) establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of federal construction project or a federally licensed activity or program. This requires the EPA or the PRP to survey the site for covered scientific, prehistorical or archaeological artifacts. The results of this survey will be reflected and documented in the administrative record. Preservation of appropriate data concerning the artifacts is hereby identified as an ARAR requirement, to be completed during the implementation of this remedial action.

3.2.8 Historic Sites, Buildings and Antiquities Act (Applicable)

This act (16 U.S.C. § 461 et seq.; 40 CFR § 6.301(a)) states that "[i]n conducting an environmental review of a proposed EPA action, the responsible official shall consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks." "National natural landmarks" are defined under 36 CFR § 62.2 as:

> [A]rea(s) of national significance located within [the U.S.] that contains(s) an outstanding representative example(s) of the nation's natural heritage, including terrestrial communities, aquatic communities, landforms, geological features, habitats of natural plant and animal species, or fossil evidence of development of life on earth.

Under the Historic Sites Act of 1935, the Secretary of the Interior is authorized to designate areas as National Natural Landmarks for listing on the National Registry of Natural Landmarks. To date no such landmarks are identified in the area.

3.3 FEDERAL ACTION-SPECIFIC ARARS

3.3.1 Clean Water Act (Applicable)

Under 40 CFR Part 403, standards are set to control pollutants which contact publicly-owned treatment works (POTWs) or which may contaminate sewage sludge. 40 CFR Part 421 limits discharges to POTWs. If groundwater that is pumped and treated is discharged to a POTW, these requirements will be applicable. Because the POTW is off-site, both administrative and substantive permit requirements specified in these regulations must be met.

There are three categories of limitations for discharges into a POTW. The first is the general standard that applies to all discharges into a POTW. Second, POTWs may issue discharge permits to industrial users to enforce specific limits for a particular facility. Third, EPA has established pretreatment standards for specific industrial subcategories. All three of these standards may be applicable to a particular wastewater stream. Generally, discharges into a POTW cannot cause pass through or interference with a POTW. "Pass through" means a discharge which exits the POTW causing a violation of the POTW's National Pollutant Discharge Elimination System ("NPDES") permit. "Interference" is a discharge which inhibits or disrupts a POTW's treatment process or operation, causing a violation of the POTW's NPDES permit.

3.3.2 Safe Drinking Water Act (Applicable)

The underground injection control (UIC) program requirements found at 40 CFR Part 144 would be applicable for alternatives that involve reinjection of pumped and treated groundwater. The program divides wells into five classes for permitting purposes. Class I wells are used to inject hazardous waste or fluids beneath the lower-most formation containing, within one-quarter mile, an underground source of drinking water. Class IV wells are used to dispose of hazardous waste into or above a formation which contains, within one-quarter mile of the well, an underground source of drinking water. Class IV wells are generally prohibited, except for reinjection of treated groundwater into the same formation from which it was withdrawn, as part of a CERCLA cleanup or RCRA corrective action. Class II and III wells deal with mining and oil and gas production and so are inapplicable to any remedial action at the site. Class V wells constitute all other injection wells. There is no regulation of Class V wells.

The aquifer underlying the site would be considered an underground source of drinking water, so any well injecting above the aquifer would be a Class IV well. Generally, the construction, operation, and maintenance of a Class IV well is prohibited by 40 CFR § 144.13. However, wells used to inject contaminated ground water that has been treated and is being reinjected into the same formation from which it was drawn are not prohibited if such injection is approved by EPA pursuant to provisions for cleanup of releases under CERCLA, or pursuant to requirements and provisions under RCRA. 40 CFR § 144.23 requires that Class IV wells be plugged or otherwise closed in a manner acceptable to the EPA Regional Administrator.

3.3.3 Resource Conservation and Recovery Act (Applicable/Relevant and Appropriate)

3.3.3.1 Criteria for Classification of Solid Waste Disposal Facilities Practices (Relevant and Appropriate)

The criteria contained in 40 CFR Part 257 are used in accordance with RCRA guidance in determining which practices pose a reasonable probability of having an adverse effect on human health and the environment. Part 257.3-1(a) states that facilities or practices in the floodplain shall not result in the washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources. Part 257.3-2 provides for the protection of threatened or endangered species. Part 257.3-3 provides that a facility shall not cause the discharge of pollutants into waters of the United States. Part 257.3-4 states that a facility or practice shall not contaminate underground drinking water.

3.3.3.2 Standards Applicable to Transporters of Hazardous Waste (Applicable)

The regulations at 40 CFR Part 263[33] establish standards that apply to persons that transport hazardous waste within the United States. If hazardous waste is transported on a rail-line or public highway on-site, or if transportation occurs off-site, these regulations will be applicable.

3.3.3.3 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (Applicable)

A. Releases from Solid Waste Management Units

The regulations at 40 CFR 264, Subpart F,[34] establish requirements for groundwater protection for RCRA-regulated solid waste management units (i.e., waste piles, surface impoundments, land treatment units, and landfills). Subpart F provides for three general types of groundwater monitoring: detection monitoring (40 CFR § 264.98); compliance monitoring (40 CFR § 264.99); and corrective action monitoring (40 CFR § 264.100). Monitoring wells must be cased according to § 264.97(c).

Monitoring is required during the active life of a hazardous waste management unit. At closure, if all hazardous waste, waste residue, and contaminated subsoil is removed, no monitoring is required. If hazardous waste remains, the monitoring requirements continue during the 40 CFR § 264.117 closure period.

B. Closure and Post-Closure

40 CFR Part 264, Subpart G,[35] establishes that hazardous waste management facilities must be closed in such a manner as to (a) minimize the need for further maintenance and (b) control, minimize or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

Facilities requiring post-closure care must undertake appropriate monitoring and maintenance actions, control public access, and control post-closure use of the property to ensure that the integrity of the final cover, liner, or containment system is not disturbed. 40 CFR § 264.117. In addition, all contaminated equipment, structures and soil must be properly disposed of or decontaminated unless exempt. 40 CFR § 264.114. A survey plat should be submitted to the local zoning authority and to the EPA Regional Administrator indicating the location and dimensions of landfill cells or other hazardous waste disposal units

[33] See also the substantially equivalent regulations at ARM 16.44.401-425 which are implemented as part of Montana's authorized RCRA program.

[34] These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

[35] These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

with respect to permanently surveyed benchmarks. 40 CFR § 264.116. 40 CFR § 264.228(a) requires that at closure, free liquids must be removed or solidified, the wastes stabilized, and the waste management unit covered.

C. Waste Piles (Applicable)

40 CFR Part 264, Subpart L,[36] establishes a framework for the safe operation of a waste pile until permanent disposal occurs. The framework includes a run-on control system, and a run-off control system and collection and holding systems to prevent the further release of contaminants from the waste pile.

D. Land Treatment (Applicable)

The requirements of 40 CFR Part 264, Subpart M,[37] regulate the management of "land treatment units"[38] that treat or dispose of hazardous waste; these requirements are applicable for any land treatment units established at the site.

The owner or operator of a land treatment unit must design treatment so that hazardous constituents placed in the treatment zone are degraded, transformed, or immobilized within the treatment zone. "Hazardous constituents" are those identified in Appendix VIII of 40 CFR Part 261 that are reasonably expected to be in, or derived from, waste placed in or on the treatment zone. Design measures and operating practices must be set up to maximize the success of degradation, transformation, and immobilization processes. The treatment zone is the portion of the unsaturated zone below and including the land surface in which the owner or operator intends to maintain the conditions necessary for effective degradation, transformation, or immobilization of hazardous constituents. The maximum depth of the treatment zone must be no more than 1.5 meters (five feet) from the initial soil surface; and more than one meter (three feet) above the seasonal high water table.

Subpart M also requires the construction and maintenance of control features that prevent the run-off of hazardous constituents and the run-on of water to the treatment unit. The unit must also be inspected weekly and after storms for deterioration, malfunctions, improper operation of run-on and run-off control systems, and improper functioning of wind dispersal control measures.

An unsaturated zone monitoring program must be established to monitor soil and soil-pore liquid to determine whether hazardous constituents migrate out of the treatment zone. Specifications related to the monitoring program are contained in section 264.278.

36 These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

37 These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

38 Land treatment occurs when hazardous waste is applied onto or incorporated into the soil surface.

E. Landfills (Applicable)

40 CFR Part 264, Subpart N,[39] applies to entities that dispose of hazardous waste in landfills.[40] The regulations specify appropriate liner systems and leachate collection systems for landfills, run-on and run-off management systems, and wind dispersal controls for landfills. These regulations set forth specific requirements for landfill monitoring and inspection, surveying and recordkeeping, and closure and post-closure care.

F. Incineration (Applicable)

The regulations at 40 CFR §§ 264.340 - 351 and 40 CFR Part 265, Subpart O,[41] will be ARARs for any alternative involving on-site incineration of hazardous waste. Since permits are not required for on-site incineration, only the substantive standards of the Part 264 permit requirements would be applicable. The standards require an owner or operator of a hazardous waste incinerator to conduct a waste analysis in conjunction with obtaining a treatment, disposal, and storage permit for the incinerator. A permit designates one or more Principal Organic Hazardous Constituents (POHCs) from those constituents listed in 40 CFR Part 261, Appendix VIII. A POHC designation is based on the degree of difficulty of incineration of the organic constituents in the waste feed from trial burns. Organic constituents that represent the greatest degree of difficulty are most likely to be designated a POHC. Incineration of POHCs designated in the permit must achieve a 99.99% destruction and removal efficiency. Incineration of dioxins must achieve a destruction and removal efficiency of 99.9999%. 40 CFR § 264.343(a).

An incinerator burning hazardous waste and producing stack emissions of more than 1.8 kilograms per hour (4 pounds per hour) of hydrogen chloride (HCl) must control HCl emissions such that the rate of emission is no greater than the larger of either 1.8 kilograms per hour of 1% of the HCl in the stack gas prior to entering any pollution control equipment. 40 CFR § 264.343(b). A permitted incinerator must not emit particulate matter in excess of 180 milligrams per dry standard cubic meter (40 CFR § 264.343(c)). The owner or operator must monitor combustion temperature, waste feed rate, CO emissions, and combustion gas velocity. The incinerator must be visually inspected daily, and the emergency waste feed cutoff system and associated alarms must be tested weekly. At closure, all hazardous waste residues must be removed from the incinerator site.

3.3.3.4 Land Disposal Restrictions

If a listed waste for which treatment standards have been set is actively managed, and placement occurs, the RCRA land disposal restrictions set forth at 40 CFR Part 268 are applicable. Placement does not occur when hazardous waste is consolidated within a unit, capped in place, or treated in situ. CERCLA Compliance with Other Laws Manual 2-16, 2-17 (August 1988).

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39 These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

40 These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702.

41 These regulations are incorporated by reference and are implemented by DHES as part of Montana's authorized RCRA program. See ARM 16.44.702 and 16.44.609 (Interim status).

40 CFR Part 268 mandates that waste subject to ban on land disposal must attain specified concentration levels, achievable by best demonstrated available treatment technologies (BDAT), for each hazardous constituent in each listed waste, if residual is to be land disposed. These concentration levels are set forth in Subpart D of the regulations. While levels are set by BDAT, any treatment technology may be used if it will achieve the specified concentration levels.

BDAT treatment (or its equivalent) is required prior to land treatment or disposal of these wastes. Because land treatment is considered a form of land disposal, and because the contaminated soils and sediments are F032 and F034 soil and debris, these requirements are considered applicable to any alternatives involving treatment or disposal of these wastes. It is unknown at this time whether land treatment at the site will reduce concentrations of contaminants below BDAT concentrations, so that the land disposal restrictions would eventually be met. Because several alternatives contemplate land treatment for soil and debris containing listed wastes, a treatability variance (40 CFR § 268.44) or no migration petition (40 CFR § 268.6) may be required in order to comply with the land disposal restrictions.

3.3.3.5 Discharge to POTWs (Applicable)

All discharges of RCRA hazardous wastes to POTWs must comply with the RCRA permit-by-rule requirements at 40 CFR § 270.60. The regulations provide for permitting of a POTW when the owner or operator of the POTW: obtains and complies with an NPDES permit; complies with regulations related to waste identification, manifests, operating records, and reporting. The regulations also require that the waste meet all federal, state, and local pretreatment requirements which would be applicable to the waste if it were being discharged into the POTW through a sewer, pipe, or similar conveyance.

3.3.4 Hazardous Materials Transportation Act (Applicable)

The Hazardous Materials Transportation Act (49 USC §§ 1801-1813), as implemented by the Hazardous Materials Transportation Regulations (49 CFR Parts 10, 171-177), regulates the transportation of hazardous materials. The regulations apply to any alternatives involving the transport of hazardous waste off-site, on public highways on-site, or by rail line.

3.4 FEDERAL STANDARDS TO BE CONSIDERED (TBC's)

3.4.1 Safe Drinking Water Act

3.4.1.1 Proposed MCLs

Proposed Maximum Contaminant Levels are unpromulgated versions of the MCLs discussed in the ARARs section. MCLs apply to public water systems. However, they may be relevant and appropriate to surface or groundwater if those waters are used as drinking water. Because the aquifer underlying the site is a potential drinking water source, and current or adopted MCL's are ARARs, the proposed MCLs are TBCs. The contaminant levels identified below have been proposed as MCLs. See 54 Fed. Reg. 22062, 22155-57 (May 22, 1989), 55 Fed Reg. 30370, 30445 (July 25, 1990), and 56 Fed Reg. 3600 (January 30, 1991)(to be codified at 40 CFR § 141.61).

Compound	Proposed MCL (mg/l)
PAHs:	
Benzo(a)pyrene	0.0002
Benz(a)anthracene	0.0001
Benzo(b)fluoranthene	0.0002
Benzo(k)fluoranthene	0.0002
Chrysene	0.0002
Dibenz(a,h)anthracene	0.0003
Indeno(1,2,3-CD)pyrene	0.0004
2,3,7,8-TCDD (dioxin)	5.0×10^{-8}

3.4.2 Federal Guidance Documents

Many of the procedures and standards to be used in a CERCLA action are set forth in guidance documents issued by EPA. A list of the types of guidance that are TBC is included in the preamble to the Final NCP, 55 Fed. Reg. 8765 (March 8, 1990). That guidance, along with current updates of and additions to that guidance, is to be considered in conducting the RI/FS and selecting and implementing the remedy at the site.

4.0 STATE OF MONTANA ARARS

4.1 OVERVIEW

As provided by Section 121 of CERCLA, 42 U.S.C. § 9621, only those state standards that are more stringent than any federal standard and that have been identified by the state in a timely manner are appropriately included as ARARs. DHES has identified here some state standards that are potentially duplicative of federal standards to ensure their timely identification and consideration in the event that they are not identified or retained in the federal ARARs. Duplicative or less stringent standards will be deleted as appropriate when the final determination of ARARs is presented.

CERCLA defines as ARARs only federal environmental laws and state environmental or facility siting laws. Remedial design, implementation, and operation and maintenance must, nevertheless, comply with all other applicable laws, both state and federal. Many such laws, while not strictly environmental or facility siting laws, have environmental impacts. Moreover, applicable laws that are not ARARs because they are not environmental or facility siting laws are not subject to the ARAR waiver provisions, and the administrative as well as the substantive provisions of such laws must be observed. The State of Montana has included, in a separate list attached to the state's ARARs list, a non-comprehensive identification of other state law requirements, which must be observed during remedial design, remedy implementation, operation or maintenance.

4.2 MONTANA CONTAMINANT-SPECIFIC ARARS

4.2.1 Water Quality

4.2.1.1 Surface Water Quality Standards (Applicable)

Under the state Water Quality Act, §§ 75-5-101 et seq., MCA, the state has promulgated regulations to preserve and protect the quality of surface waters in the state. These regulations classify state waters according to quality, place restrictions on the discharge of pollutants to state waters and prohibit the degradation of state waters. The requirements listed below would be applicable to any discharge to surface waters in connection with the remedial action.

ARM 16.20.604(1)(b)[42] (Applicable) provides that Silver Bow Creek (mainstem) from the confluence of Blacktail Deer Creek to Warm Springs Creek is classified "I" for water use.

The "I" classification standards are contained in ARM 16.20.623 (Applicable) of the Montana water quality regulations. This section states:

> [T]he goal of the state of Montana is to have these waters fully support the following uses: drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

[42] Unless otherwise specified, all regulatory citations are to the Administrative Rules of Montana.

In order to achieve this goal the I classification standards limit discharges of toxic or deleterious substances from new point sources to the larger of either Gold Book levels[43] or one-half of the mean instream concentrations immediately upstream of the discharge point.[44] The effect of this requirement is to require eventual attainment of the Gold Book levels, while allowing consideration of the site specific stream quality (1/2 the mean instream concentration). As the quality of the stream improves due to control of other sources, dischargers will be required to improve the quality of their discharges down to the Gold Book levels.

I classification standards also include the following criteria:

1. During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters (ml), nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliform per 100 ml.

2. Dissolved oxygen concentration must not be reduced below 3.0 milligrams per liter.

3. Hydrogen ion concentration (pH) must be maintained within the range of 6.5 to 9.5.

4. No increase in naturally occurring turbidity, temperature, concentrations of sediment and settleable solids, oils, floating solids, or true color is allowed which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife.

5. No discharges of toxic or deleterious substances may commence or continue which lower or are likely to lower the overall water quality of these waters.

Additional restrictions on any discharge to surface waters are included in:

ARM 16.20.631 (Applicable), which requires that industrial waste[45] must receive, as a minimum, treatment equivalent to the best practicable control technology currently available (BPCTCA) as defined in 40 CFR Subchapter N and subsequent amendments.[46] This section also requires that in designing a disposal system, stream flow dilution requirements must be based on the minimum consecutive 7-day average flow which may be expected to occur on the average of once in 10 years.

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43 ARM 16.20.603(10) defines Gold Book levels as "the freshwater acute or chronic levels or the levels for water and fish ingestion that are listed in Update Number Two (5/1/87) of Quality Criteria for Water 1986 (EPA 440/5-86-001)."

44 Mean instream concentration is the monthly instream concentration, as defined by the MDHES Water Quality Bureau.

45 Section 75-5-103, MCA, defines "Industrial waste" as "any waste substance from the process of business or industry or from the development of any natural resource, together with any sewage that may be present."

46 See the discussion of the Categorical Industrial Pretreatment Standards for the Wood Preserving Steam Subcategory, identified as a relevant and appropriate requirement in the federal ARARs section above.

ARM 16.20.633 (Applicable), which prohibits discharges containing substances that will:

(a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;
(b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;
(c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;
(d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life;
(e) create conditions which produce undesirable aquatic life.

ARM 16.20.925 (Applicable), which adopts and incorporates the provisions of 40 C.F.R. Part 125 for criteria and standards for the imposition of technology-based treatment requirements in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125 are applicable, i.e., for toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case by case basis using best professional judgment (BPJ). See CERCLA Compliance with Other Laws Manual, Vol. I, August 1988, p. 3-4 and 3-7.

The Water Quality Act and regulations also include nondegradation provisions which require that waters which are of higher quality than the applicable classification be maintained at that high quality, and discharges which would degrade that water are prohibited. Montana's standard for nondegradation of water quality is applicable for all constituents for which pertinent portions of Silver Bow Creek are of higher quality than the I classification. If any remedial action constitutes a new source of pollution or an increased source of pollution,[47] the nondegradation standard requires the degree of waste treatment necessary to maintain the existing water quality for constituents that are of higher quality than the applicable classification.

ARM 16.20.701 (Applicable) defines "degradation"[48] and provides that "nonpoint source pollutants from lands where all reasonable land, soil and water management or conservation practices have been applied are not considered degradation."

[47] Any point source discharge to surface waters resulting from remedial action would constitute a new source, since existing sources of wood preservative contaminant discharges to the creek are from uncontrolled non-point sources. A new point source discharge must be regarded as a new source.

[48] ARM 16.20.634 provides that discharges to surface waters may be entitled to a mixing zone which will have a minimum impact on surface water quality, as determined by the department. However, in determining when such mixing zones will be allowed, the Water Quality Bureau's policy is that mixing zones are not recognized or allowed for discharges of toxic or deleterious substances (as defined in ARM 16.20.603(25)). Thus "degradation" occurs if a discharge contains a higher concentration of the toxic or deleterious substance than the receiving water, provided that the receiving water is of higher quality than the established standard for that substance in the stream.

ARM 16.20.702 (Applicable) applies nondegradation requirements to any activity of man which would cause a new or increased source of pollution to state waters. This section states when exceptions to nondegradation requirements apply, except that in no event may such degradation affect public health, recreation, safety, welfare, livestock, wild birds, fish and other wildlife or other beneficial uses.

ARM 16.20.703 (Applicable) establishes the substantive nondegradation standard (quality of receiving waters whose quality is higher than established water quality standards is not to be degraded by the discharge of pollutants), and requires that water quality permits incorporate nondegradation standards. In accordance with CERCLA § 121(e), if the discharge occurs entirely on-site, only the substantive nondegradation standard, and not the permit requirement, would apply. However, if the discharge occurs off-site, the permit requirement would also be applicable. This rule also provides that determination of degradation is to ensure that baseline quality of the receiving waters will not be degraded at any flow greater than the 7-day, 10-year low flow of the receiving waters.

4.2.1.2 Montana Groundwater Pollution Control System (Applicable)

ARM 16.20.1002 (Applicable) classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and states that groundwater is to be classified according to actual quality or actual use, whichever places the groundwater in a higher class. Class I is the highest quality class; class IV the lowest. The groundwater at the Montana Pole site is at least Class II groundwater.

ARM 16.20.1003 (Applicable) establishes the groundwater quality standards applicable with respect to each groundwater classification. Concentrations of dissolved substances in Class I or II groundwater (or Class III groundwater which is used as a drinking water source) may not exceed Montana MCL values for drinking water. This requirement effectively makes the current MCL values applicable and not just relevant and appropriate requirements. Concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to public health. Maximum allowable concentration of these substances also must not exceed acute or chronic problem levels that would adversely affect existing or designated beneficial uses of groundwater of that classification.

ARM 16.20.1011 (Applicable) provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless the board is satisfied that a change is justifiable for economic or social development and will not preclude present or anticipated use of such waters.

4.3 MONTANA LOCATION-SPECIFIC ARARS

4.3.1 Floodplain and Floodway Management

4.3.1.1 Floodplain and Floodway Management Act (Applicable or Relevant and Appropriate)

Section 76-5-401, MCA, (Applicable) specifies the uses permissible in a floodway and generally prohibits permanent structures, fill, or permanent storage of materials or equipment.

Section 76-5-402, MCA, (Applicable) specifies uses allowed in the floodplain, excluding the floodway, and allows structures meeting certain minimum standards.

Section 76-5-403, MCA, (Applicable) lists certain uses which are prohibited in a designated floodway, including:

1. any building for living purposes or place of assembly or permanent use by human beings,

2. any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway, or

3. the construction or permanent storage of an object subject to flotation or movement during flood level periods.

4.3.1.2 <u>Floodplain Management Regulations (Applicable or Relevant and Appropriate)</u>

ARM 36.15.216 (Relevant and Appropriate) specifies factors to consider in determining whether a permit should be issued to establish or alter an artificial obstruction or nonconforming use in the floodplain or floodway. While permit requirements are not directly applicable to activities conducted entirely on site, the criteria used to determine whether to approve establishment or alteration of an artificial obstruction or nonconforming use should be applied by the decision-makers in evaluating proposed remedial alternatives which involve artificial obstructions or nonconforming uses in the floodway or floodplain. Thus the following criteria are relevant and appropriate considerations in evaluating any such obstructions or uses:

1. the danger to life and property from backwater or diverted flow caused by the obstruction;

2. the danger that the obstruction will be swept downstream to the injury of others;

3. the availability of alternative locations;

4. the construction or alteration of the obstruction in such a manner as to lessen the danger;

5. the permanence of the obstruction; and

6. the anticipated development in the foreseeable future of the area which may be affected by the obstruction.

ARM 36.15.603 (Relevant and Appropriate) provides that proposed diversions or changes in place of diversion must be evaluated by the DNRC to determine whether they may significantly affect flood flows and, therefore, require a permit. While permit requirements are not applicable for remedial actions conducted entirely on site, the following criteria used to determine when a permit shall <u>not</u> be granted are relevant and appropriate:

1. the proposed diversion will increase the upstream elevation of the 100-year flood a significant amount (½ foot or as otherwise determined by the permit issuing authority);

2. the proposed diversion is not designed and constructed to minimize potential erosion from a flood of 100-year frequency; and

3. any permanent diversion structure crossing the full width of the stream channel is not designed and constructed to safely withstand up to a flood of 100-year frequency.

ARM 36.15.604 (Relevant and Appropriate) precludes new construction or alteration of an artificial obstruction that will significantly increase the upstream elevation of the flood of 100-year frequency (½ foot or as otherwise determined by the permit issuing authority) or significantly increase flood velocities.

ARM 36.15.605(1) (Relevant and Appropriate) and ARM 36.15.605(2) (Applicable) enumerate artificial obstructions and nonconforming uses that are prohibited within the designated floodway except as allowed by permit and includes "a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway ... ." Solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials are also prohibited.

ARM 36.15.606 (Relevant and Appropriate) enumerates flood control works that are allowed within designated floodways pursuant to permit. Although the permit requirements are not applicable for activities conducted entirely on site, the following conditions are relevant and appropriate:

1. flood control levies and flood walls are allowed if they are designed and constructed to safely convey a flood of 100-year frequency and their cumulative effect combined with allowable flood fringe encroachments does not increase the unobstructed elevation of a flood of 100-year frequency more than ½ foot at any point;

2. riprap, if not hand placed, is allowed if it is designed to withstand a flood of 100-year frequency, does not increase the elevation of the 100-year frequency flood, and will not increase erosion upstream, downstream, or across stream from the riprap site;

3. channelization projects are allowed if they do not significantly increase the magnitude, velocity, or elevation of the flood of 100-year frequency downstream from such projects;

4. dams are allowed if they are designed and constructed in accordance with approved safety standards and they will not increase flood hazards downstream either through operational procedures or improper hydrologic design.

ARM 36.15.703 (Applicable) is applicable in flood fringe areas (i.e., areas in the floodplain but outside of the designated floodway) of the site and prohibits, with limited exceptions, solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials.

4.3.1.3 Natural Streambed and Land Preservation Standards (Applicable)

ARM 36.2.404 (Applicable) establishes minimum standards which would be applicable if a remedial action alters or affects a streambed, including any channel change, new diversion, riprap or other streambank protection project, jetty, new dam or reservoir or other commercial, industrial or residential development. No such project may be approved unless reasonable efforts will be made consistent with the purpose of the project to minimize the amount of stream channel alteration, insure that the project will be as permanent a solution as possible and will create a reasonably permanent and stable situation, insure that the project will pass anticipated water flows without creating harmful erosion upstream or downstream, minimize turbidity, effects on fish and aquatic habitat, and adverse effects on the natural beauty of the area and insure that streambed gravels will not be used in the project unless there is no reasonable alternative. Soils erosion and sedimentation must be kept to a minimum. See also § 75-7-102, MCA.

4.4 MONTANA ACTION-SPECIFIC ARARS

In the following action-specific ARARs, the nature of the action triggering applicability of the requirement is stated in parenthesis as part of the heading for each requirement.

4.4.1. Water Quality

4.4.1.1 Groundwater Act (Applicable) (Construction and maintenance of groundwater wells)

Section 85-2-505, MCA, (Applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

4.4.1.2 Public Water Supply Regulations (Applicable) (Reconstruction or modification of public water or sewer lines on the site)

If remedial action at the site requires any reconstruction or modification of any public water supply line or sewer line, the construction standards specified in ARM 16.20.401(3) (Applicable) must be observed. A public sewer line crosses the Montana Pole site, and the sewer line bedding is considered a potential pathway of contamination.

4.4.2 Air Quality[49]

4.4.2.1 Air Quality Regulations (Applicable) (Excavation/earth-moving; transportation; incineration; storage of petroleum distillates)

Dust suppression and control of certain substances likely to be released into the air as a result of earth moving, transportation and similar actions may be necessary to meet air quality requirements. The ambient air standards for specific contaminants and for particulates are set forth in the federal contaminant-specific section above. Additional air quality regulations under the state Clean Air Act, §§ 75-2-101 et seq., MCA, are discussed below.

ARM 16.8.1302 (Applicable) lists certain wastes that may not be disposed of by open burning[50], including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of 16.8.1307 or 1308.

ARM 16.8.1401(3) and (4) (Applicable) states that no person shall cause or authorize the production, handling, transportation or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken.

ARM 16.8.1404 (Applicable) states that "no person may cause or authorize emissions to be discharged in the outdoor atmosphere ... that exhibit an opacity of twenty percent (20%) or greater averaged over six consecutive minutes."

ARM 16.8.1406 (Applicable) prohibits certain emissions from incinerators, including emissions of particulate matter in excess of 0.10 grains per standard cubic foot of dry flue gas, adjusted to twelve percent carbon dioxide and calculated as if no auxiliary fuel had been used, emissions which exhibit an opacity of ten percent (10%) or greater averaged over six consecutive minutes.

ARM 16.8.1425 (Applicable) prohibits any storage tank for crude oil, gasoline, or certain petroleum distillates of more than 65,000 gallons capacity unless it conforms to the requirements of this section relating to vapor loss control devices.

ARM 26.4.761 (Relevant and Appropriate) specifies measures that must be implemented to control fugitive dust emissions during certain mining and reclamation activities. Such measures would be relevant and appropriate

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[49] The air quality ARARs included in this analysis are identified on the assumption that no remedial action at the site will constitute a "major stationary source," or "major modification," as defined in ARM 16.8.921. Should any part of a remedy constitute such a source, some additional requirements would be applicable, including the ambient air increments of ARM 16.8.925 et seq.

Similarly, if any part of a remedy should constitute a new or altered source of air pollution which has the potential to emit more than 25 tons per year of any pollutant addressed by the Clean Air Act regulations, the owner or operator must install the maximum air pollution control capability which is technically practicable and economically feasible, as provided by ARM 16.8.1103 (best available control technology shall be utilized).

[50] "'Open burning' means combustion of any material directly in the open air without a receptacle, or in a receptacle other than a furnace, multiple chambered incinerator or wood waste burners ..." ARM 16.8.1301(5).

requirements to control fugitive dust emissions during excavation, earth moving and transportation activities conducted as part of the remedy at the site.

4.4.2.2 Solid Waste and Hazardous Waste Regulations

Several regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 et seq., MCA, and the Hazardous Waste Management Act, §§ 75-10-401 et seq., MCA, are discussed in the federal section of ARARs, because they implement those federal programs in the state. The Solid Waste Management Act was significantly revised in the 1991 Montana Legislature, and the regulations under that Act are currently being revised. Some of these changes may be implemented prior to the anticipated ROD date and will be identified as they are promulgated.

4.4.2.3 Underground Storage Tank Regulations (Applicable) (Excavation or earth-moving)

If in the process of any soil removal at the site, underground storage tanks are encountered and have to be removed or replaced, the following requirements may be applicable.

ARM 16.45.201 (Applicable) specifies the standards for design, construction and installation of new underground storage tanks.

ARM 16.45.701 through 16.45.705 (Applicable) specify the requirements for closure, removal or change in service of an underground storage tank, including assessing the site for possible releases (16.45.703).

ARM 16.45.1216 (Applicable) provides the requirements for issuance of a permit for closure, removal or installation of an underground storage tank. Although the permit requirement may not be applicable, the substantive requirements specified in the rule are applicable. Installation or closure of a tank must satisfy the rules of the department and the state fire marshal, must satisfy the rules governing disposal of the tanks and tank contents, and must be conducted in such a place and manner as to protect the public's health, welfare and safety and the environment.

4.4.2.4 Reclamation and Revegetation Requirements (Relevant and Appropriate) (Excavation)

ARM 26.4.501 and 501A (Relevant and Appropriate) give general backfilling and final grading requirements.

ARM 26.4.514 (Relevant and Appropriate) sets out contouring requirements.

ARM 26.4.519 (Relevant and Appropriate) provides that an operator may be required to monitor settling of regraded areas.

ARM 26.4.638 (Relevant and Appropriate) specifies sediment control measures to be implemented during operations.

ARM 26.4.702 (Relevant and Appropriate) requires that during the redistributing and stockpiling of soil (for reclamation):

1. regraded areas must be deep-tilled, subsoiled, or otherwise treated to eliminate any possible slippage potential, to relieve compaction, and to

promote root penetration and permeability of the underlying layer; this preparation must be done on the contour whenever possible and to a minimum depth of 12 inches;

2. redistribution must be done in a manner that achieves approximate uniform thicknesses consistent with soil resource availability and appropriate for ~~the~~ postmining vegetation, land uses, contours, and surface water drainage systems; and

3. redistributed soil must be reconditioned by subsoiling or other appropriate methods.

ARM 26.4.703 (Relevant and Appropriate) When using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 26.4.701 and 702.

ARM 26.4.711 (Relevant and Appropriate) requires that a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected shall be established except on road surfaces and below the low-water line of permanent impoundments. Vegetative cover is considered of the same seasonal variety if it consists of a mixture of species of equal or superior utility when compared with the natural (or pre-existing) vegetation during each season of the year.

ARM 26.4.713 (Relevant and Appropriate) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation but may not be more than 90 days after soil has been replaced.

ARM 26.4.714 (Relevant and Appropriate) requires use of a mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 26.4.716 (Relevant and Appropriate) establishes the required method of revegetation, and provides that introduced species may be substituted for native species as part of an approved plan.

ARM 26.4.718 (Relevant and Appropriate) requires the use of soil amendments and other means such as irrigation, management, fencing, or other measures, if necessary to establish a diverse and permanent vegetative cover.

ARM 26.4.728 (Relevant and Appropriate) sets forth requirements for the composition of vegetation on reclaimed areas.

4.5 OTHER MONTANA LAWS

The following "other laws" are included here to provide a reminder of other legally applicable requirements for actions being conducted at the site. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ARARs because they are not "environmental or facility siting laws." As applicable laws other than ARARs, they are not subject to ARAR waiver provisions.

Section 121(e) of CERCLA exempts removal or remedial actions conducted entirely on an NPL site from federal, state or local permit requirements, and this exemption appears broad enough to cover even permits required under "other laws." However, the administrative/substantive distinction used in identifying ARARs applies only to ARARs and not to other applicable laws. Thus even the administrative requirements, e.g., notice requirements, of these other laws must be complied with in this action. Similarly, fees that are based on something other than issuance of a permit are applicable.

4.5.1 Groundwater Act

Section 85-2-516, MCA, states that within 60 days after any well is completed a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

4.5.2 Water Rights

Section 85-2-101, MCA, declares that all waters within the State are the State's property, and may be appropriated for beneficial uses. The wise use of water resources is encouraged for the maximum benefit to the people and with minimum degradation of natural aquatic ecosystems.

Parts 3 and 4 of Title 85, MCA, set out requirements for obtaining water rights and appropriating and utilizing water. All requirements of these parts are laws which must be complied with in any action using or affecting waters of the state. Some of the specific requirements are set forth below.

Section 85-2-301, MCA, of Montana law provides that a person may only appropriate water for a beneficial use.

Section 85-2-302, MCA, specifies that a person may not appropriate water or commence construction of diversion, impoundment, withdrawal or distribution works therefor except by applying for and receiving a permit from the Montana Department of Natural Resources and Conservation. While the permit itself may not be required under federal law, appropriate notification and submission of an application should be performed and a permit should be applied for in order to establish a priority date in the prior appropriation system. A 1991 amendment imposes a fee of $1.00 per acre foot for appropriations of ground water, effective until July 1, 1993.

Section 85-2-306, MCA, specifies the conditions on which groundwater may be appropriated, and, at a minimum, requires notice of completion and appropriation within 60 days of well completion.

Section 85-2-311, MCA, specifies the criteria which must be met in order to appropriate water and includes requirements that:

1. there are unappropriated waters in the source of supply;

2. the proposed use of water is a beneficial use; and

3. the proposed use will not interfere unreasonably with other planned uses or developments.

Section 85-2-402, MCA, specifies that an appropriator may not change an appropriated right except as provided in this section with the approval of the DNRC.

Section 85-2-412, MCA, provides that, where a person has diverted all of the water of a stream by virtue of prior appropriation and there is a surplus of water, over and above what is actually and necessarily used, such surplus must be returned to the stream.

4.5.3 Occupational Health Act, §§ 50-70-101 <u>et</u> <u>seq</u>., MCA.

ARM § 16.42.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.95 applies.

ARM § 16.42.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.

4.5.4 Montana Safety Act

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

4.5.5 Employee and Community Hazardous Chemical Information Act

Sections 50-78-201, 202, and 204, MCA, state that each employer must post notice of employee rights, maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used. Employees must be informed of the chemicals at the work place and trained in the proper handling of the chemicals.

APPENDIX B

DETAILED COST ESTIMATES

List of Tables

TABLE B-1

DETAILED COST ESTIMATE FOR
GROUNDWATER MONITORING

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Well Installation (a)	4	each	$1,200	$2,000	$4,800	$8,000
		Total Capital Cost			$4,800	$8,000
O&M COSTS						
Reporting	1	lump sum		$30,000	$30,000	$30,000
Analytical (a)						
1,3,7,8 TCDD	40	each		$340		$13,600
1,3,7,8 TCDD/F	40	each		$600		$24,000
Cl4-Cl8 Totals	40	each		$750		$30,000
PAH	40	each		$350	$14,000	$14,000
Phenols	40	each		$350	$14,000	$14,000
		Cost per Sample		$2,390	$28,000	$95,600
		Subtotal 1			$58,000	$125,600
Contingency @ 20%					$11,600	$25,120
		Total O&M Cost	**(with dioxins/furans)**			$151,000
		Total O&M Cost	**(without dioxins/furans)**			$70,000

NOTE: Number of samples for analysis includes samples from each of 15 monitoring wells, duplicate samples, and 4 QA samples (MS/MSD) collected twice a year.

(a) Vendor Quote

TABLE B-2

DETAILED COST ESTIMATE FOR
CLAY CAPPING

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Mobilization	1	lump sum	$250,000	$500,000	$250,000	$500,000
Cap Construction	19,000	sq. yd.	$12	$15	$228,000	$285,000
Clay (a)	20,000	cu. yd.	$8	$10	$160,000	$200,000
Topsoil (a)	25,000	cu. yd.	$6	$8	$150,000	$200,000
Fill Material (a)	18,000	cu. yd.	$4	$6	$72,000	$108,000
60-mil HDPE Liner	170,000	sq. ft.	$2	$4	$340,000	$680,000
Permits and Fees	1	lump sum	$15,000	$22,000	$15,000	$22,000
Fencing	45,000	linear ft	$9	$13	$405,000	$585,000
Gates	4	each	$1,300	$2,500	$5,200	$10,000
Corner Poles	16	each	$40	$60	$640	$960
No Tresspassing Signs	20	each	$20	$27	$400	$540
H & S (a)	1	lump sum	$30,000	$70,000	$30,000	$70,000
					$1,656,240	$2,661,500
Contingency @ 20%					$331,248	$532,300
		Total Capital Cost			$1,987,000	$3,194,000
		Total Unit Cost ($/sq. ft.)			$12	$19
O&M COSTS						
Cap Maintenance	170,000	sq. ft.	$0.25	$0.34	$42,500	$57,800
Contingency @ 20%					$8,500	$11,560
		Total O&M Cost			$50,000	$70,000

All costs are best engineering judgement except where noted
(a) Vendor Quote

TABLE B-3

DETAILED COST ESTIMATE FOR ON-SITE INCINERATION ALTERNATIVE 3

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Mobilization/Demobilization (a)	1	lump sum	$760,000	$3,000,000	$760,000	$3,000,000
Testing and Lab Services for soil (a)	1	lump sum	$23,000	$250,000	$23,000	$250,000
Debris Removal (a)	30	cubic yards	$73	$92	$2,190	$2,760
Site Preparation (a)	1	lump sum	$875,700	$3,469,400	$875,700	$3,469,400
Soil Incineration (a)	23,000	cu. yd.	$177	$189	$4,071,000	$4,335,500
Ash Fixation (a)	8,000	cu. yd.	$196	$236	$1,568,000	$1,888,000
Fill from Off Site (a) Assume 20% of soil volume is lost due to incineration	4,600	cu. yd.	$11	$25	$50,600	$115,000
Site Restoration (a)	1	lump sum	$8,142	$12,374	$8,142	$12,374
Project Closeout Survey (a)	1	lump sum	$782	$1,166	$782	$1,166
Testing and Lab Services for Ash (a)	1	lump sum	$400,000	$1,200,000	$400,000	$1,200,000
Emergency Response & Waste Characterization (a)	20	events	$3,300	$5,090	$66,000	$101,800
			Subtotal		$7,825,000	$14,376,000
Contingency @ 20%					$1,565,000	$2,875,200
			Total Capital Cost		$9,390,000	$17,251,200
			Unit Cost ($/cu. yd.)		$408	$750

(a) Vendor Quote

TABLE B-4

DETAILED COST ESTIMATE FOR ON-SITE INCINERATION ALTERNATIVE 4

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Mobilization/Demobilization (a)	1	lump sum	$7,597,167	$7,597,167	$7,597,167	$7,597,167
On Site Laboratory (a)	1	lump sum	$4,793,890	$4,793,890	$4,793,890	$4,793,890
			Subtotal		$12,391,000	$12,391,000
Contingency @ 20%					$2,478,200	$2,478,200
			Total Capital Cost		$14,869,000	$14,869,000
O&M COSTS						
Debris Removal (a)	50	cu. yd.	$73	$92	$3,650	$4,600
Site Preparation (a)	1	lump sum	$410,000	$622,000	$410,000	$622,000
Soil Incineration (a)	113,000	cu. yd.	$263	$400	$29,719,000	$45,200,000
Ash Fixation (a)	5,450	cu. yd.	$85	$128	$463,250	$697,600
Fill from Off Site (a) Assume 20% of soil volume is lost due to incineration	22,600	cu. yd.	$11	$30	$248,600	$678,000
Wastewater Management (a)	1	lump sum	$60,900	$92,400	$60,900	$92,400
Storm Drainage System (a)	1	lump sum	$16,200	$24,600	$16,200	$24,600
Site Restoration (a)	1	lump sum	$35,400	$53,800	$35,400	$53,800
Off-site Disposal of Hazardous Waste (a)	50	cu. yd.	$726	$1,100	$36,300	$55,000
Off-site Disposal of Non-hazardous Waste (a)	50	cu. yd.	$20	$31	$1,000	$1,550
Project Closeout Survey (a)	1	lump sum	$3,400	$5,070	$3,400	$5,070
Testing and Lab Services for ash (a)	1	lump sum	$372,000	$565,200	$372,000	$565,200
Emergency Response & Waste Characterization (a)	50	Events	$3,300	$5,090	$165,000	$254,500
			Subtotal		$31,535,000	$48,254,000
Contingency @ 20%					$6,307,000	$9,650,800
			Total Capital Cost		$37,842,000	$57,904,800
			Unit Cost ($/cu. yd.)		$335	$512

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TABLE B-5

DETAILED COST ESTIMATE FOR
ON-SITE INCINERATION
ALTERNATIVE 5

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Mobilization/Demobilization (a)	1	lump sum	$7,597,167	$7,597,167	$7,597,167	$7,597,167
On Site Laboratory (a)	1	lump sum	$4,793,890	$4,793,890	$4,793,890	$4,793,890
			Subtotal		$12,391,000	$12,391,000
Contingency @ 20%					$2,478,200	$2,478,200
			Total Capital Cost		$14,869,000	$14,869,000
O&M COSTS						
Debris Removal (a)	50	cu. yd.	$73	$92	$3,650	$4,600
Site Preparation (a)	1	lump sum	$750,000	$1,156,700	$750,000	$1,156,700
Soil Incineration (a)	208,000	cu. yd.	$263	$400	$54,704,000	$83,200,000
Ash Fixation (a)	10,100	cu. yd.	$85	$128	$858,500	$1,292,800
Fill from Off Site (a) Assume 20% of soil volume is lost due to incineration	41,600	cu. yd.	$11	$30	$457,600	$1,248,000
Wastewater Management (a)	1	lump sum	$111,000	$171,600	$111,000	$171,600
Storm Drainage System (a)	1	lump sum	$29,700	$45,600	$29,700	$45,600
Site Restoration (a)	1	lump sum	$65,000	$99,900	$65,000	$99,900
Off-site Disposal of Hazardous Waste (a)	100	cu. yd.	$726	$1,100	$72,600	$110,000
Off-site Disposal of Non-hazardous Waste (a)	100	cu. yd.	$20	$31	$2,000	$3,100
Project Closeout Survey (a)	1	lump sum	$3,400	$5,070	$3,400	$5,070
Testing and Lab Services for ash (a)	1	lump sum	$682,300	$1,049,700	$682,300	$1,049,700
Emergency Response & Waste Characterization (a)	50	Events	$3,300	$5,090	$165,000	$254,500
			Subtotal		$57,905,000	$88,642,000
Contingency @ 20%					$11,581,000	$17,728,400
			Total Capital Cost		$69,486,000	$106,370,400
			Unit Cost ($/cu. yd.)		$334	$511

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TABLE B-6

DETAILED COST ESTIMATE FOR ENGINEERED BIOREMEDIATION

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Mobilization/Demobilization (a)	Alt. 3	lump sum	$544,000	$1,938,000	$544,000	$1,938,000
	Alt. 4	lump sum	$2,180,000	$4,905,000	$2,180,000	$4,905,000
	Alt. 5	lump sum	$2,180,000	$4,905,000	$2,180,000	$4,905,000
Treatability Study (a)	1	lump sum	$5,000	$100,000	$5,000	$100,000
Health and Safety Plan	1	lump sum	$30,000	$30,000	$30,000	$30,000
Contingency @ 20%						
			Alternative 3 Capital Cost		$695,000	$2,482,000
			Alternative 4 Capital Cost		$2,658,000	$6,042,000
			Alternative 5 Capital Cost		$2,658,000	$6,042,000
O&M COSTS						
Alternative 3						
Soil Analyses (a)	55	per yr.	$700	$2,390	$38,500	$131,450
Leachate Analyses (a)	12	per yr.	$700	$2,390	$8,400	$28,680
Maintenance (Labor)	6	mos.	$36,000	$40,000	$216,000	$240,000
Chemical Additives	23,000	cu. yd.	$20	$24	$460,000	$552,000
			Subtotal		$722,900	$952,130
Contingency @ 20%					$144,580	$190,426
			Total O&M Cost		$867,000	$1,143,000
			Alternative 3 Unit Cost ($/cu. yd.)		$38	$50
Alternative 4						
Soil Analyses (a)	113	per yr.	$700	$2,390	$79,100	$270,070
Leachate Analyses (a)	27	per yr.	$700	$2,390	$18,900	$64,530
Maintenance (Labor)	6	mos.	$36,000	$40,000	$216,000	$240,000
Chemical Additives	113,000	cu. yd.	$20	$24	$2,260,000	$2,712,000
			Subtotal		$2,574,000	$3,286,600
Contingency @ 20%					$514,800	$657,320
			Total O&M Cost		$3,089,000	$3,944,000
			Alternative 4 Unit Cost ($/cu. yd.)		$27	$35
Alternative 5						
Soil Analyses (a)	113	per yr.	$700	$2,390	$79,100	$270,070
Leachate Analyses (a)	27	per yr.	$700	$2,390	$18,900	$64,530
Maintenance (Labor)	6	mos.	$36,000	$100,000	$216,000	$600,000
Chemical Additives	208,000	cu. yd.	$20	$24	$4,160,000	$4,992,000
			Subtotal		$4,474,000	$5,926,600
Contingency @ 20%					$894,800	$1,185,320
			Total O&M Cost		$5,369,000	$7,112,000
			Alternative 5 Unit Cost ($/cu. yd.)		$26	$34

All costs are best engineering judgement except where noted

(a) Vendor Quotes

TABLE B-7

DETAILED COST ESTIMATE FOR
SOIL WASHING

Item/Description	Quantity	Unit Cost Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Pilot Study for Soil Washing (a)	1	lump sum	$25,000	$100,000	$25,000	$100,000
Pilot Study for Bioslurry Reactor (a)	1	lump sum	$50,000	$100,000	$50,000	$100,000
Mobilization & Treatment for Alternative 3 (a)	23,000	cu. yd.	$132	$175	$3,036,000	$4,025,000
Residuals Treatment cost for Alt. 3	2,300	cu. yd.	$263	$438	$604,900	$1,007,400
Mobilization/Demobilization (a)	Alt. 4	lump sum	$1,908,000	$1,908,000	$1,908,000	$1,908,000
	Alt. 5	lump sum	$1,908,000	$1,908,000	$1,908,000	$1,908,000
Health & Safety	1	lump sum	$30,000	$30,000	$30,000	$30,000
Contingency @ 20%						
			Alternative 3 Capital Cost		$4,495,000	$6,315,000
			Alternative 4 Capital Cost		$2,416,000	$2,566,000
			Alternative 5 Capital Cost		$2,416,000	$2,566,000
O & M COSTS						
Alternative 4						
Soil Treatment (a)	113,000	cu. yd.	$92	$100	$10,396,000	$11,300,000
Analytical (a)	75	each	$700	$2,390	$52,500	$179,250
			Subtotal		$10,449,000	$11,479,000
Contingency @ 20%					$2,089,800	$2,295,800
			Total O&M Cost		$12,538,800	$13,774,800
			Alternative 4 Unit Cost ($/cu. yd.)		$111	$122
Alternative 5						
Soil Treatment (a)	208,000	cu. yd.	$92	$100	$19,136,000	$20,800,000
Analytical (a)	75	each	$700	$2,390	$52,500	$179,250
			Subtotal		$19,189,000	$20,979,000
Contingency @ 20%					$3,837,800	$4,195,800
			Total O&M Cost		$23,026,800	$25,174,800
			Alternative 5 Unit Cost ($/cu. yd.)		$111	$121
Alternative 4 Residuals Treatment						
Bioslurry (a)	22,600	cu. yd.	$263	$438	$5,943,800	$9,898,800
Contingency @ 20%					$1,188,760	$1,979,760
			Total O&M Cost		$7,132,560	$11,878,560
			Alternative 4 Residuals Unit Cost ($/cu. yd.)		$63	$105
Alternative 5 Residuals Treatment						
Bioslurry (a)	41,600	cu. yd.	$263	$438	$10,940,800	$18,220,800
Contingency @ 20%					$2,188,160	$3,644,160
			Total O&M Cost		$13,128,960	$21,864,960
			Alternative 4 Residuals Unit Cost ($/cu. yd.)		$63	$105

(a) Vendor Quotes

TABLE B-8

DETAILED COST ESTIMATE FOR BIOTREATMENT with OIL/WATER SEPARATION AND CARBON POLISHING
(Page 1 of 2)

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
SITE PREPARATION						
Building Foundation (a)	1	lump sum	$22,000	$22,000	$22,000	$22,000
Structure (a)	1	lump sum	$42,000	$42,000	$42,000	$42,000
HVAC (a)	1	lump sum	$15,000	$21,000	$15,000	$21,000
				Subtotal 1	$79,000	$85,000
EQUIPMENT COSTS (EC)						
Fluidized Bed System						
Reactor Equipment * (a)	1	lump sum	$353,000	$353,000	$353,000	$353,000
Treatability Study (a)	1	lump sum	$30,000	$30,000	$30,000	$30,000
Carbon Adsorber (a)	1	lump sum	$30,000	$117,500	$30,000	$117,500
				Subtotal 2	$413,000	$500,500
Piping @5% EC	1	lump sum	$25,025	$25,025	$25,025	$25,025
Electrical @ 20% EC	1	lump sum	$100,100	$100,100	$100,100	$100,100
Instrumentation @ 10% EC	1	lump sum	$50,050	$50,050	$50,050	$50,050
Engineering	1	lump sum	$150,000	$150,000	$150,000	$150,000
				Subtotal 3	$817,175	$910,675
Contingency @ 20%					$163,435	$182,135
			Total Capital Cost		$981,000	$1,093,000

* Includes oil/water separator, clarifier, sand filters, bioreactor, all sludge holding tanks, piping, and pumps

TABLE B-8

DETAILED COST ESTIMATE FOR BIOTREATMENT with OIL/WATER SEPARATION AND CARBON POLISHING

(Page 2 of 2)

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Costs Low	Total Costs High
O&M COST						
O/W Separator						
Anionic Polymer (a)	5,110	lb	$3	$3	$15,330	$15,330
Caustic Soda (a)	140	drum	$124	$124	$17,360	$17,360
Sulfuric Acid (a)	24	drum	$135	$135	$3,240	$3,240
				Subtotal 1	$35,930	$35,930
Fluidized Bed						
Sludge Disposal	200	ton	$225	$325	$45,000	$65,000
				Subtotal 2	$80,930	$100,930
Carbon Polishing						
Carbon Polishing/ Diposal (a)	110,000	lb	$2	$4	$165,000	$440,000
Electricity (a)	163,300	kwh	$0.05	$0.05	$8,165	$8,165
				Subtotal 3	$254,095	$549,095
Other						
Administration	1	lump sum	$10,000	$10,000	$10,000	$10,000
Labor	3,000	hours	$28	$30	$84,000	$90,000
Analytical (a)	100	each	$767	$2,117	$76,700	$211,700
				Subtotal 4	$424,795	$860,795
Contingency @ 20%					$84,959	$172,159
		Total Annual O&M			$509,754	$1,032,954
		Unit Cost ($/1,000 gallons)			$7	$14

All costs are best engineering judgement except where noted
(a) Vendor Quotes

TABLE B-9

DETAILED COST ESTIMATE FOR
EXTRACTION SCENARIO 1
TRENCH COSTS

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
CAPITAL COSTS						
Large Drainage Trench						
Excavate/drain aggregate and grading (a)	5,460	ft	$15	$25	$81,900	$136,500
Hauling	2,020	cu yd	$5	$8	$10,100	$16,160
Exraction Trench						
Excavate/Backfill/ Visqueen (a)	1,700	ft	$80	$120	$136,000	$204,000
Pipe Installation (a)	3,400	linear ft.	$8	$10	$27,200	$34,000
Pipe Materials	3,400	linear ft.	$14	$20	$47,600	$68,000
Pump	4	each	$1,500	$1,500	$6,000	$5,700
			Subtotal 1		$308,800	$464,360
Contingency @ 20%					$61,760	$92,872
			Extraction System Total		**$370,560**	**$557,232**
Infiltration Wells (3)						
Caisson	60	vertical linear ft.	$52	$73	$3,120	$4,380
Pipe	60	linear ft.	$15	$20	$870	$1,210
Gravel (a)	6	cu. yd.	$8	$10	$48	$60
Sand (a)	2	cu. yd.	$6	$8	$12	$20
Hauling	8	cu. yd.	$5	$8	$40	$60
Pump	3	each	$1,500	$1,500	$4,500	$4,275
Interception Wells (9)						
Caisson	135	vertical linear ft.	$52	$73	$7,020	$9,860
Pipe	135	linear ft.	$15	$20	$1,958	$2,710
Gravel (a)	15	cu. yd.	$8	$10	$120	$150
Sand (a)	10	cu. yd.	$6	$8	$60	$80
Hauling	25	cu. yd.	$5	$8	$125	$200
Pump	9	each	$1,500	$1,500	$13,500	$4,275
Exterior Piping	7,000	linear ft.	$15	$20	$101,500	$140,700
			Subtotal 1		$132,873	$167,980
Contingency @ 20%					$26,575	$33,596
			Infiltration System Total		**$132,900**	**$168,000**

All costs are best engineering judgement except where noted
(a) Vendor Quote

TABLE B-10

DETAILED COST ESTIMATE FOR
OILY WASTE AND SLUDGE MANAGEMENT

Item/Description	Quantity	Unit	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
MATERIAL HANDLING						
Off Site Incineration (a)	3,500	gallon	$11	$17	$38,500	$59,500
Transportation (a)	3,500	gallon	$3	$5	$10,500	$17,500
			Subtotal		$49,000	$77,000
Contingency @ 20%					$9,800	$15,400
			Total Cost		$58,800	$92,400
			Unit Cost ($/gallon)		$17	$26

(a) Vendor Quote

TABLE B-11

DETAILED COST ESTIMATE FOR DECONTAMINATION AND DISPOSAL OF FORMER PLANT PROCESS EQUIPMENT AND DEBRIS

(Page 1 of 2)

	Item/Description	Volume of Debris (cubic yards)	Total	Cost Notes
CAPITAL COSTS				
1	Sawmill Building	2,677	$252,000	Demolish and decontaminate buildings. Send metal to reclaimer.
2	EPA Buildings (5)	N/A	$100,000	Decontaminate and leave buildings onsite.
3	Auto Garage	132	$128,000	Decontaminate, demolish, dispose hazardous and non-hazardous/evaluation study contents of building.
4	A. Red Brick Building	151	$235,400	If hazardous - decontaminate, demolish, and dispose of.
			$182,550	If non-hazardous - decontaminate, demolish and dispose of.
	B. Red Shed	25	$35,000	If hazardous - decontaminate, demolish, and dispose of.
			$26,250	If non-hazardous - decontaminate, demolish and dispose of.
5	Metal Corrugated Building with Blue Drums and Garbage Cans	37 yds, 40 drs	$103,800	If hazardous - decontaminate, demolish, and dispose of.
			$77,250	If non-hazardous - decontaminate, demolish and dispose of.
6	Concrete Foundation and Debris	20 (debris only)	$38,000	Decontaminate and leave in place.
7	Crane and Concrete Base Equipment	40	$72,000	If hazardous - decontaminate, demolish, and dispose of.
			$58,000	If non-hazardous - decontaminate, demolish and dispose of.
8	Aboveground Storage Tanks	40	$57,000	Decontaminate, demolish, dispose of as non-hazardous.
9	Split Mixed Debris Pile/Wood Panels	406	$75,400	Screen debris. Dispose of as hazardous and non-hazardous.
10	Large Concrete Blocks/Rebar/Soil Pile	40	$26,000	If disposed of as hazardous waste.
			$10,000	Sample, analyze, assume non-hazardous, and leave in place

TABLE B-11

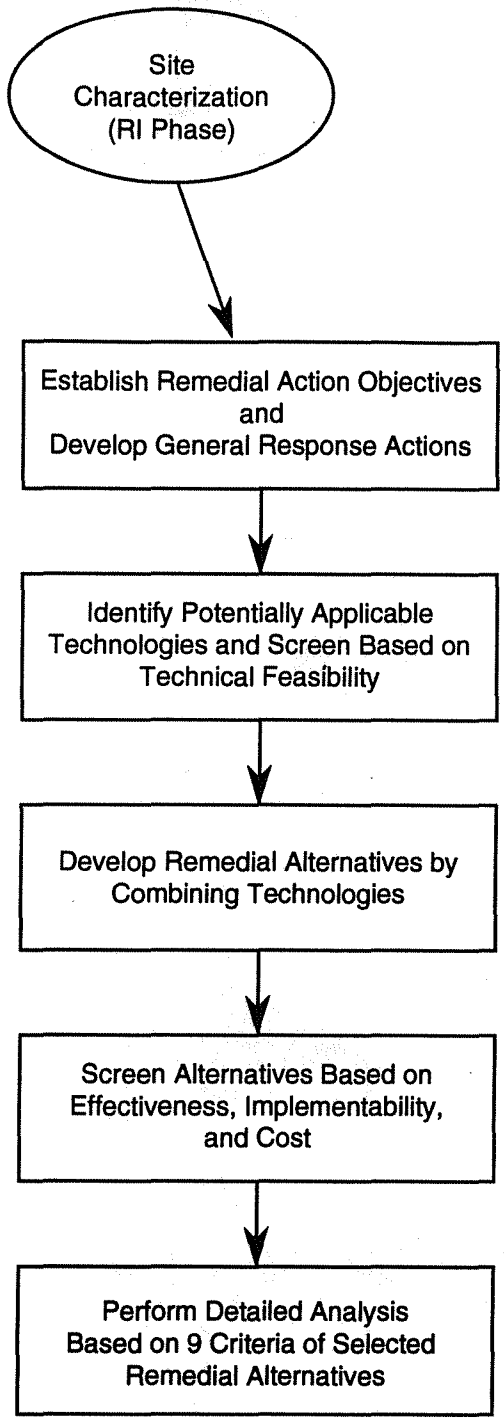
DETAILED COST ESTIMATE FOR DECONTAMINATION AND DISPOSAL OF FORMER PLANT PROCESS EQUIPMENT AND DEBRIS

	Item/Description	Volume of Debris (cubic yards)	Total	Cost Notes
11	Miscellaneous Drums	157 x 55 gal drs., 200 misc < 20 gal	$89,000	Characterize and dispose of at RCRA landfill.
12	Old Landfill of Soil and Debris	4,444	$222,200	Dispose of offsite as non-hazardous.
13	Debris Pile Near Excavated Soil Area (East of Shed)	562	$36,530	Dispose of offsite as non-hazardous.
14	Miscellaneous Railroad Ties	475	$232,650	Characterize and dispose of at RCRA landfill.
15	Oil Broom and Wood Blocks	33	$13,828	Dispose of in a RCRA landfill as hazardous.
	Total Cost Estimate		$1,717,000	**Hazardous Disposal Scenario**
	Total Cost Estimate		$1,599,000	**Non-Hazardous Disposal Scenario**

All costs are best engineering judgement except where noted

Total Volume Estimate Assumes:

Debris	9,082 cu. yd.
Drums (55 gal)	197 drums
Miscellaneous Containers (< 20 gallons)	200 containers

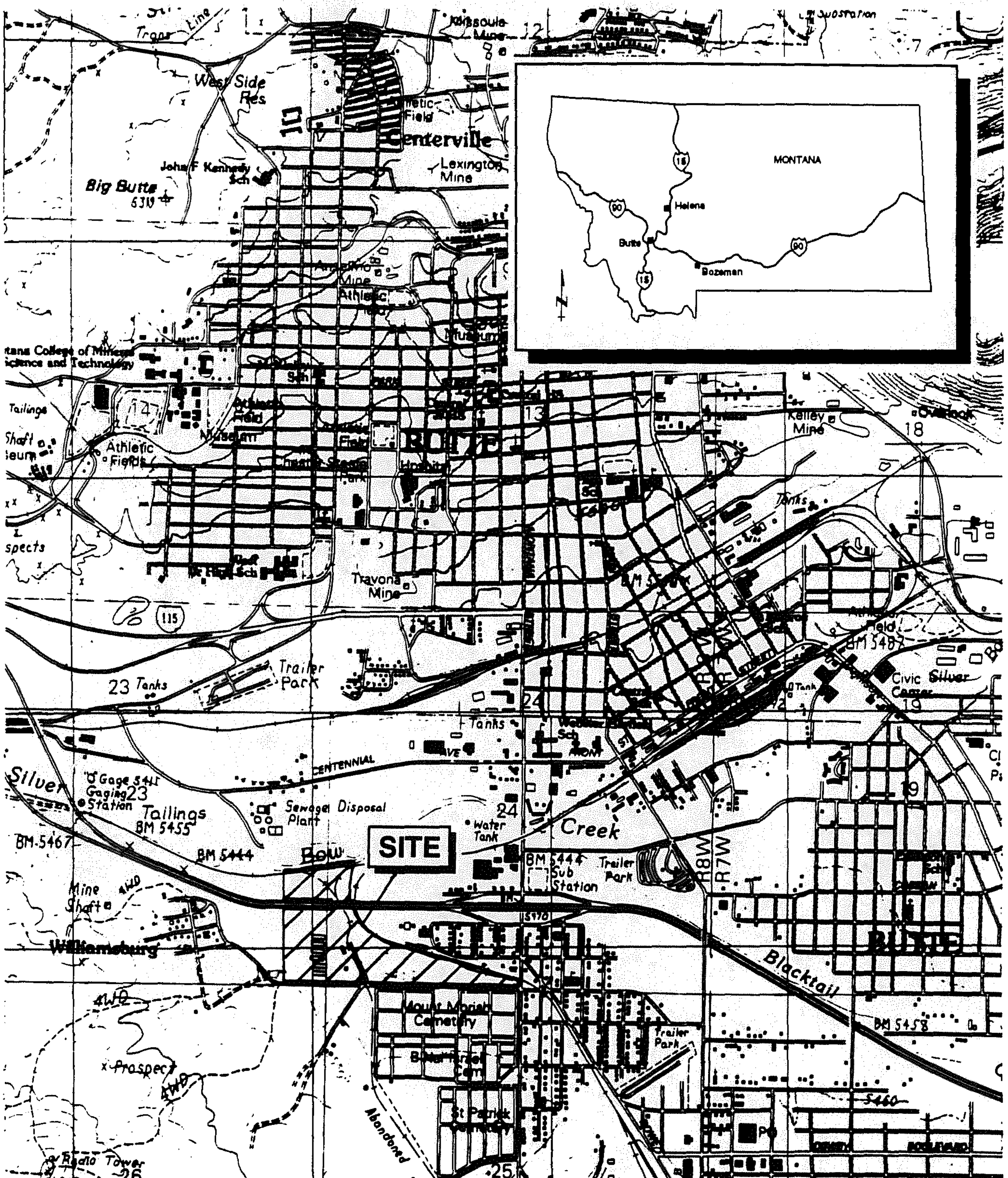


James M. Montgomery

MONTANA POLE AND
TREATING PLAN T SITE
FEASIBILITY STUDY PROCESS
UNDER CERCLA

FIGURE 1-1

M-1



0 1000 2000

SCALE IN FEET

Source: Butte Norh and Butte South, Montana USGS 7.5 Minute Quadrangle Topographical Maps, 1989

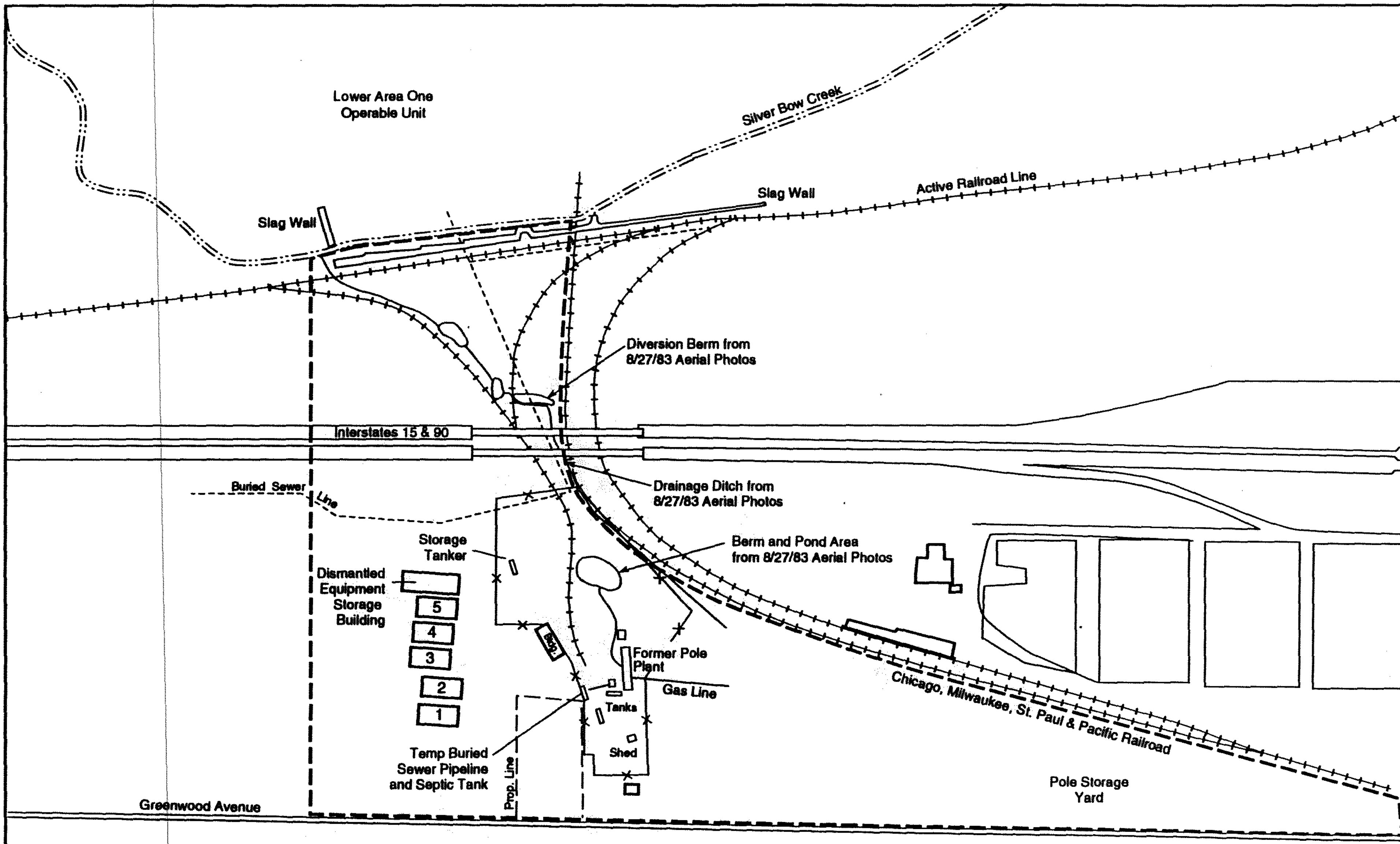
M-2

James M. Montgomery

MONTANA POLE AND
TREATING PLAN T SITE

VICINITY OF MONTANA POLE AND TREATING PLANT SITE BUTTE, MONTANA

FIGURE 1-2



LEGEND

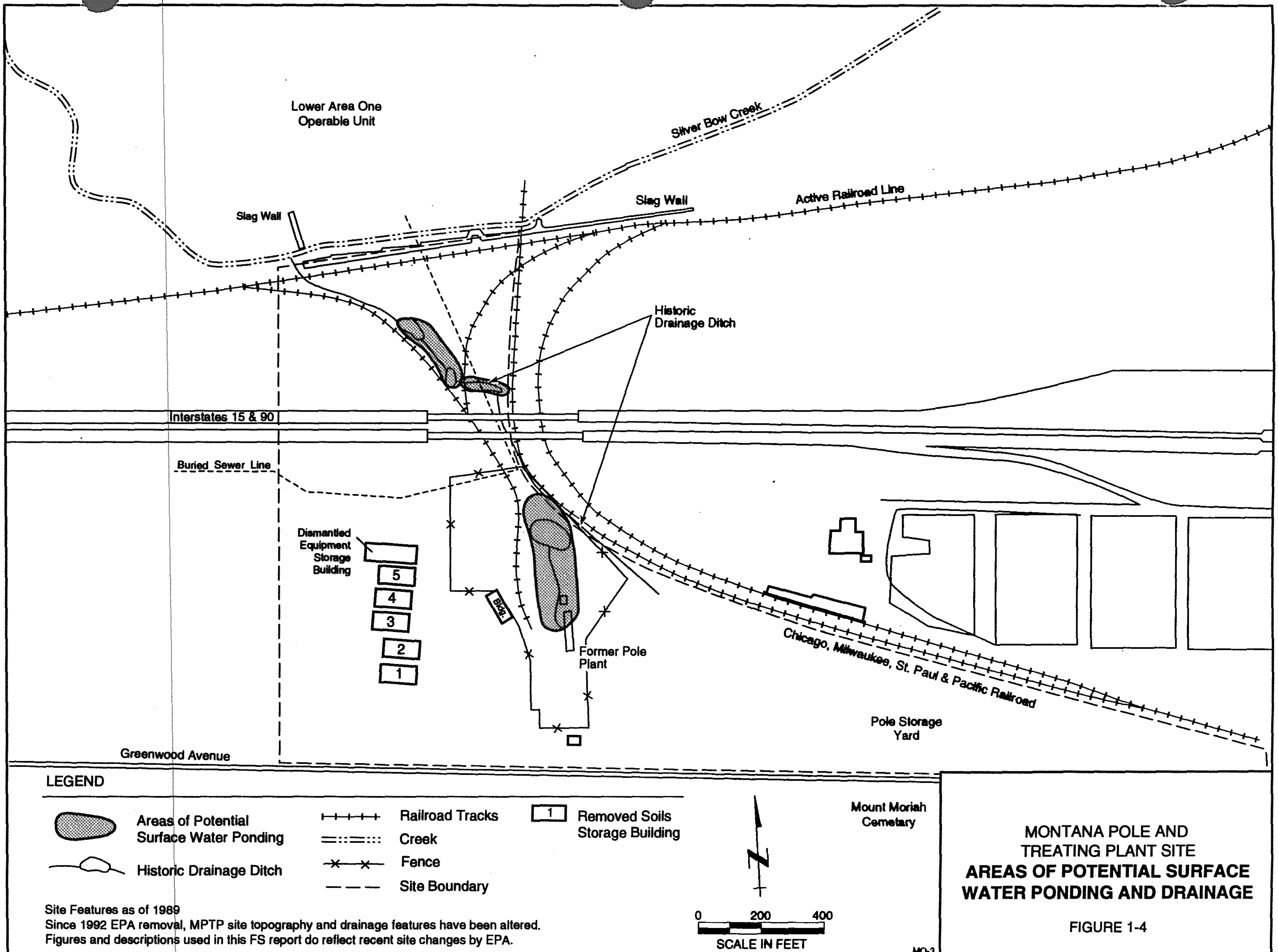
- Railroad Tracks
- Creek
- Fence
- Site Boundary
- Sewer Line

Site Features as of 1989

MO-3

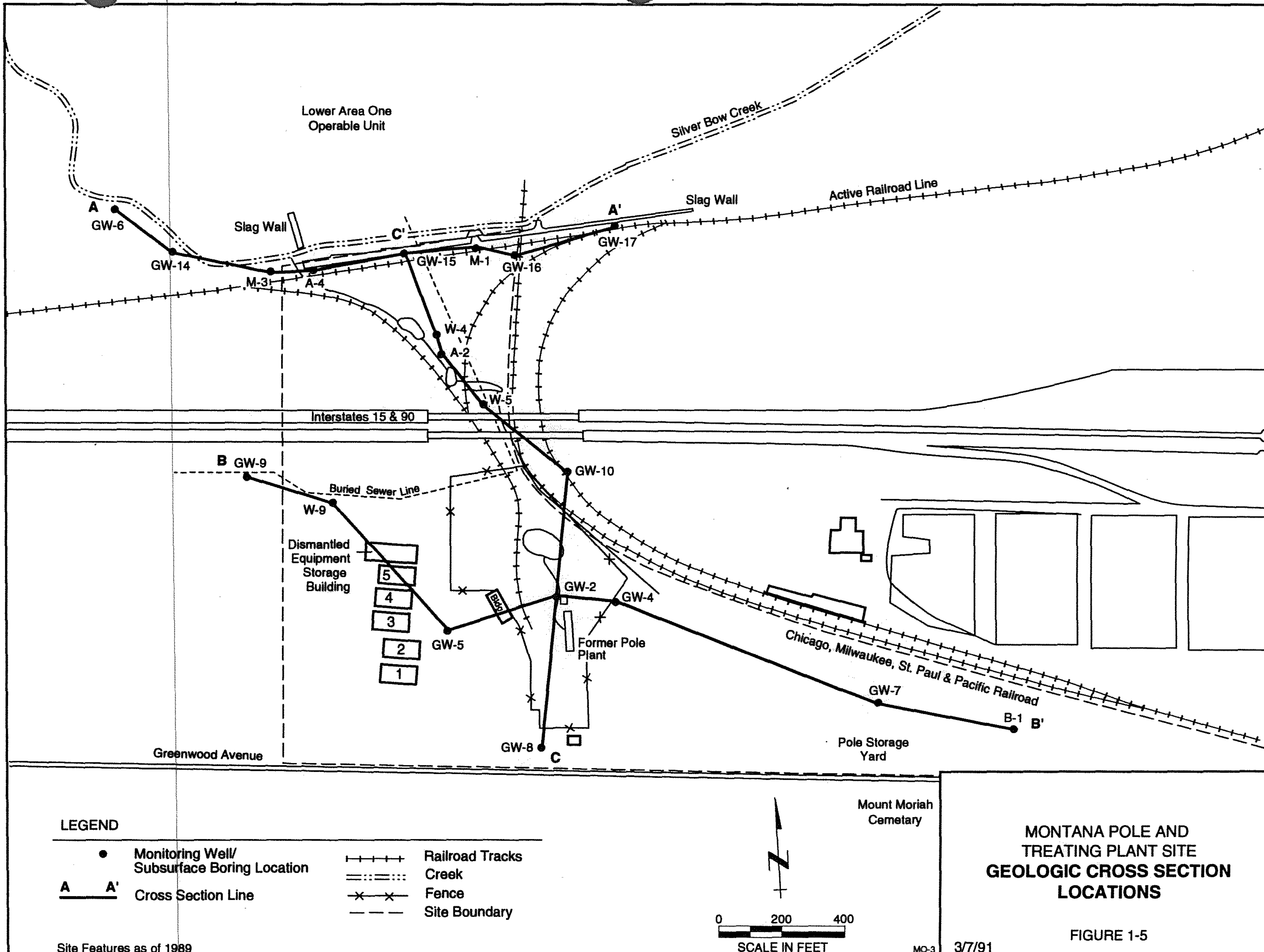
MONTANA POLE AND TREATING PLANT SITE
SITE LAYOUT AND FEATURES

FIGURE 1-3



MONTANA POLE AND
TREATING PLANT SITE
AREAS OF POTENTIAL SURFACE
WATER PONDING AND DRAINAGE

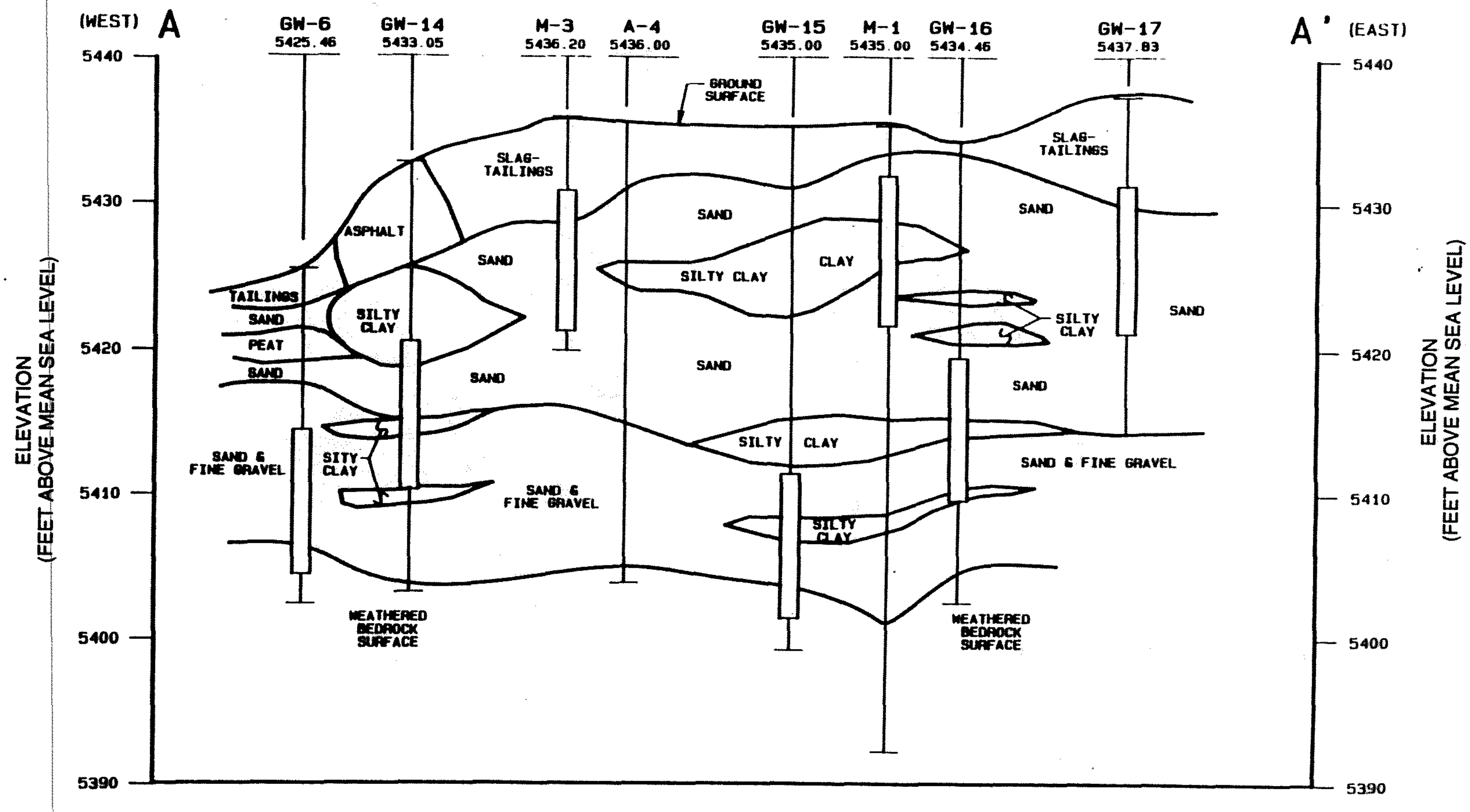
FIGURE 1-4



MONTANA POLE AND
TREATING PLANT SITE
GEOLOGIC CROSS SECTION
LOCATIONS

FIGURE 1-5

3/7/91



LEGEND

WELL SCREEN INTERVAL

GW-6 *WELL NUMBER*

5425.46 *APPROXIMATE GROUND SURFACE ELEVATION*

THIS CROSS SECTION DEPICTS SUBSURFACE CONDITIONS AT LOCATIONS SHOWN BASED ON SITE INVESTIGATIONS. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURING AT THESE SITES.

VERTICAL EXAGGERATION = 30 X

HORIZONTAL SCALE (FEET)

0 150 300 450

MONTANA POLE AND TREATING PLANT SITE

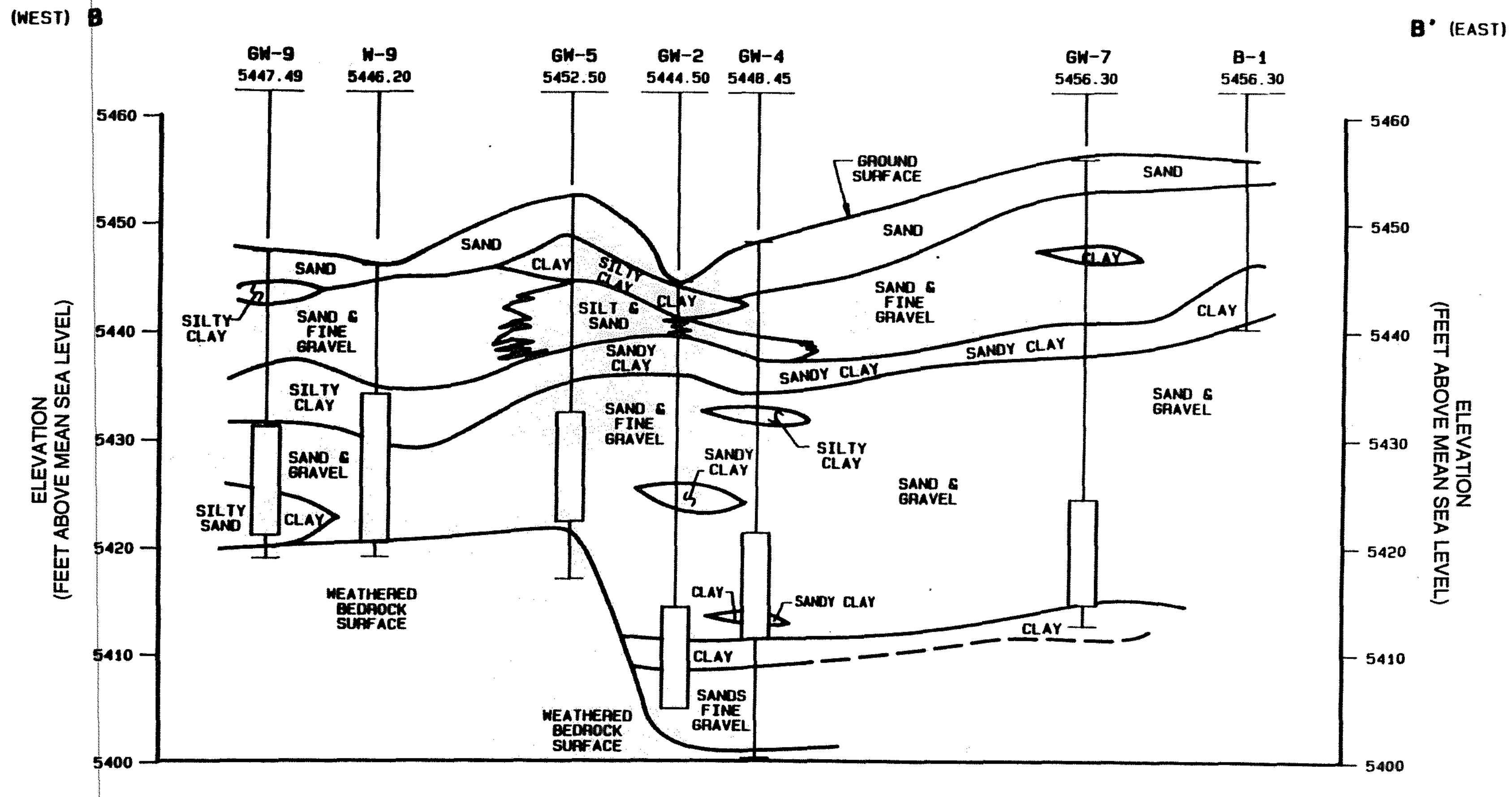
GEOLOGIC CROSS SECTION A-A'

FIGURE 1-6

Site Features as of 1989

MO-3

2/26/91



LEGEND

WELL SCREEN INTERVAL

GW-9 WELL NUMBER

5447.49 APPROXIMATE GROUND SURFACE ELEVATION

THIS CROSS SECTION DEPICTS SUBSURFACE CONDITIONS AT LOCATIONS SHOWN BASED ON SITE INVESTIGATIONS. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURING AT THESE SITES.

VERTICAL EXAGGERATION = 30 X

HORIZONTAL SCALE (FEET)

0 200 400 600

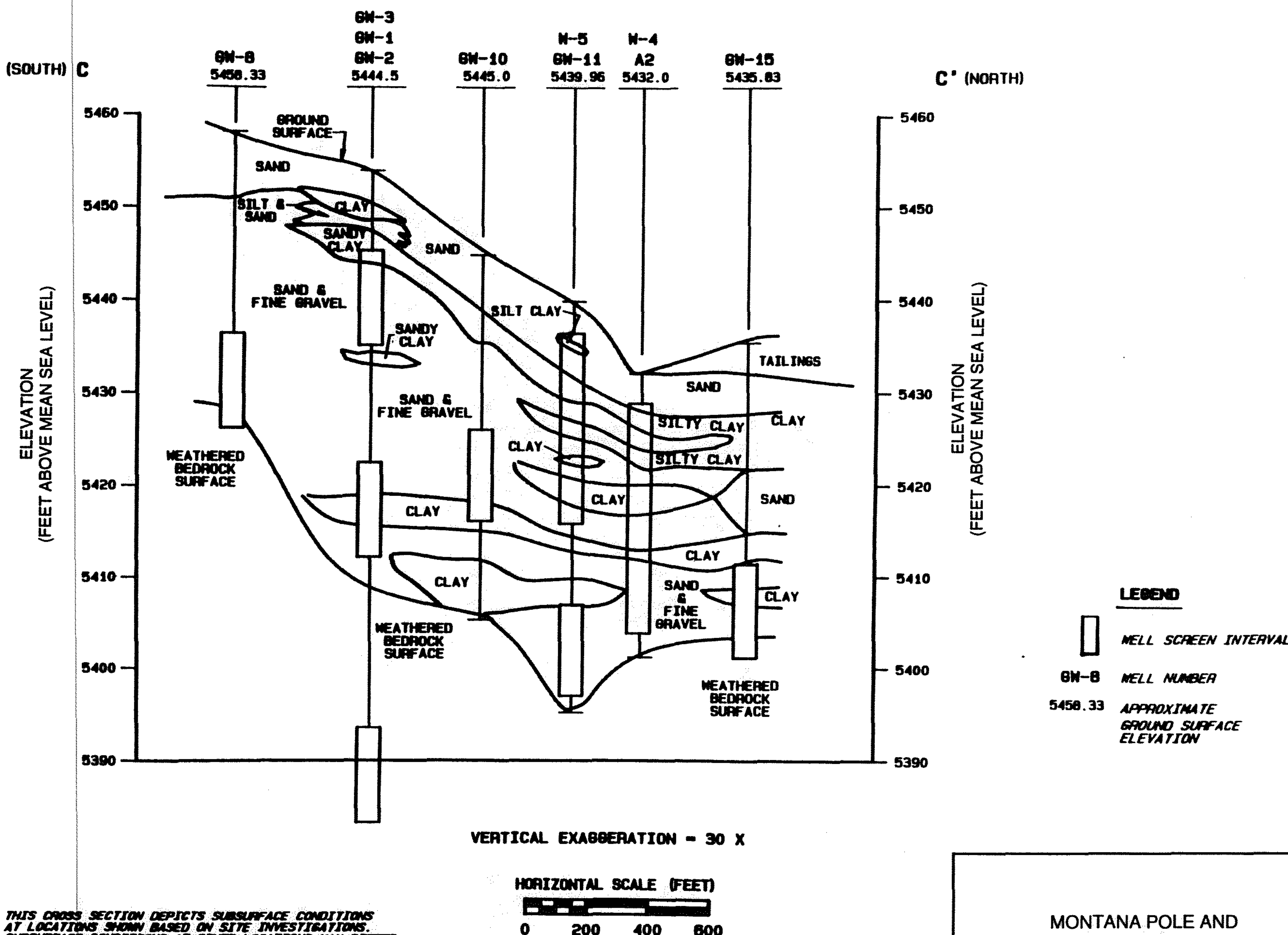
MONTANA POLE AND
TREATING PLANT SITE
GEOLOGIC CROSS SECTION B-B'

FIGURE 1-7

Site Features as of 1989

MO-3

2/26/91



THIS CROSS SECTION DEPICTS SUBSURFACE CONDITIONS AT LOCATIONS SHOWN BASED ON SITE INVESTIGATIONS. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURING AT THESE SITES.

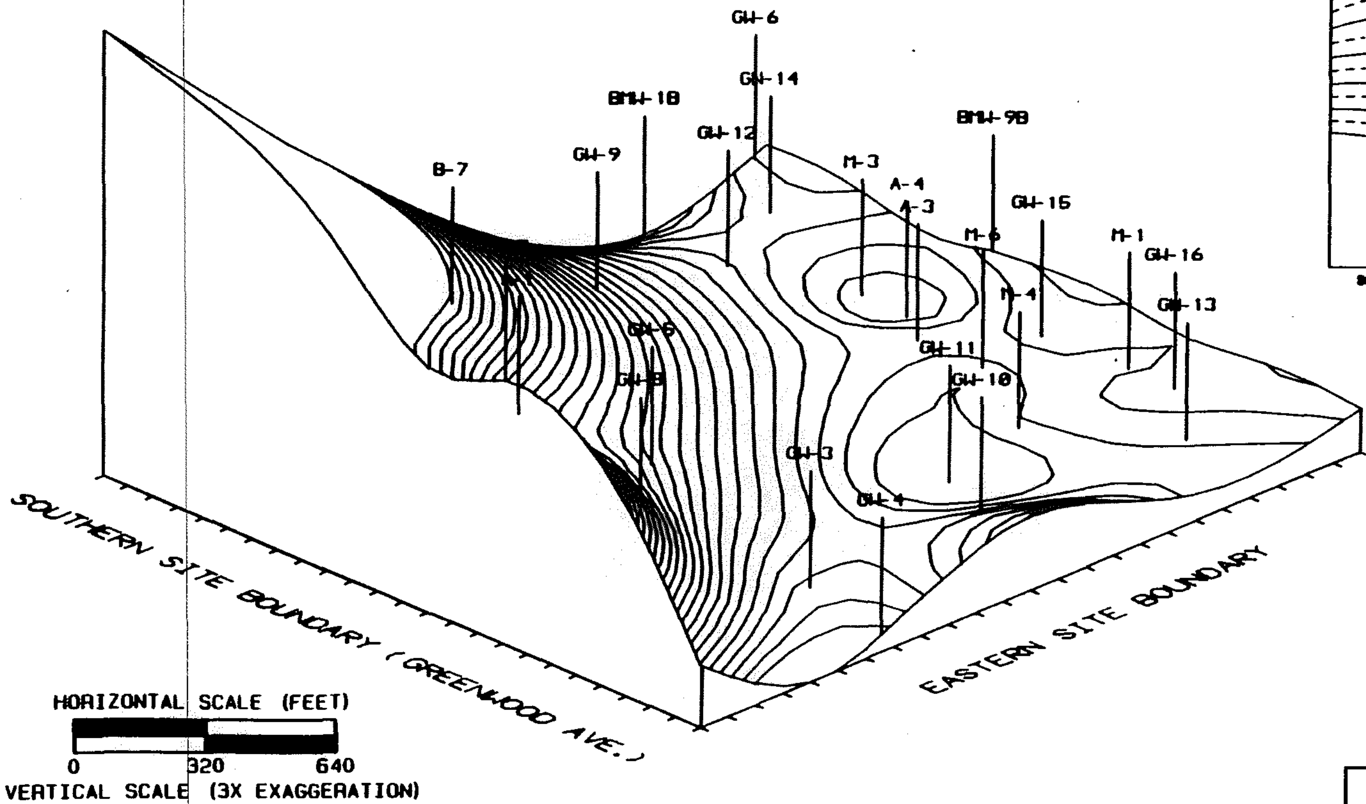
Site Features as of 1989

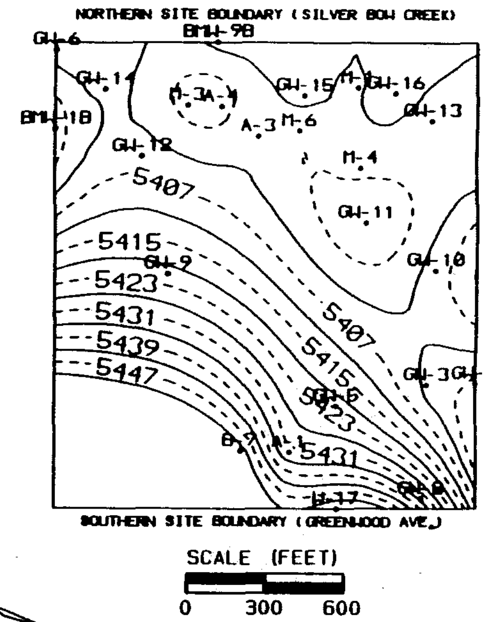
MO-3

MONTANA POLE AND
TREATING PLANT SITE
GEOLOGIC CROSS SECTION C-C'

FIGURE 1-8

3/7/91



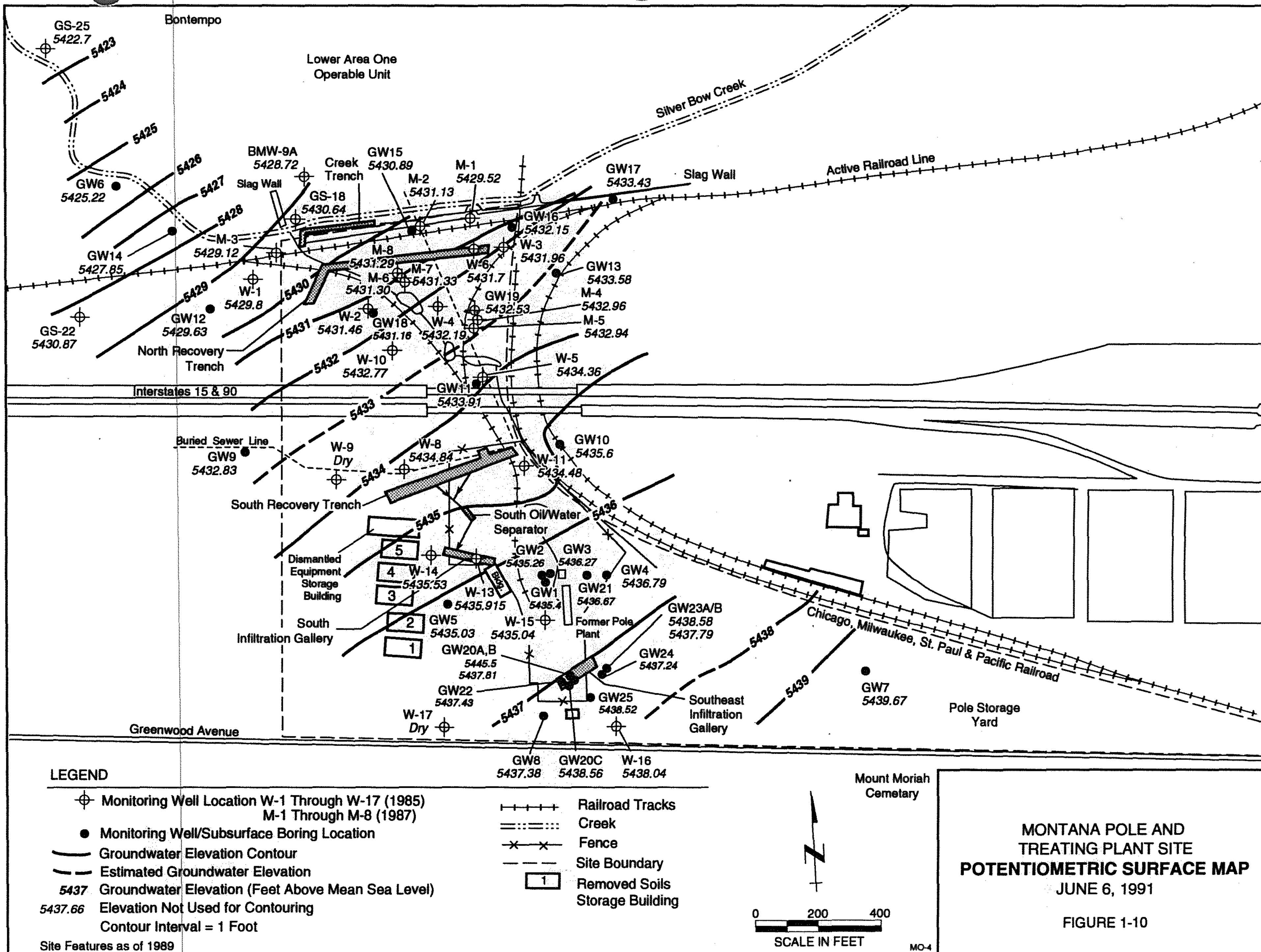


MONTANA POLE AND
TREATING PLANT SITE
THREE DIMENSIONAL PROJECTION
WEATHERED BEDROCK SURFACE

FIGURE 1-9

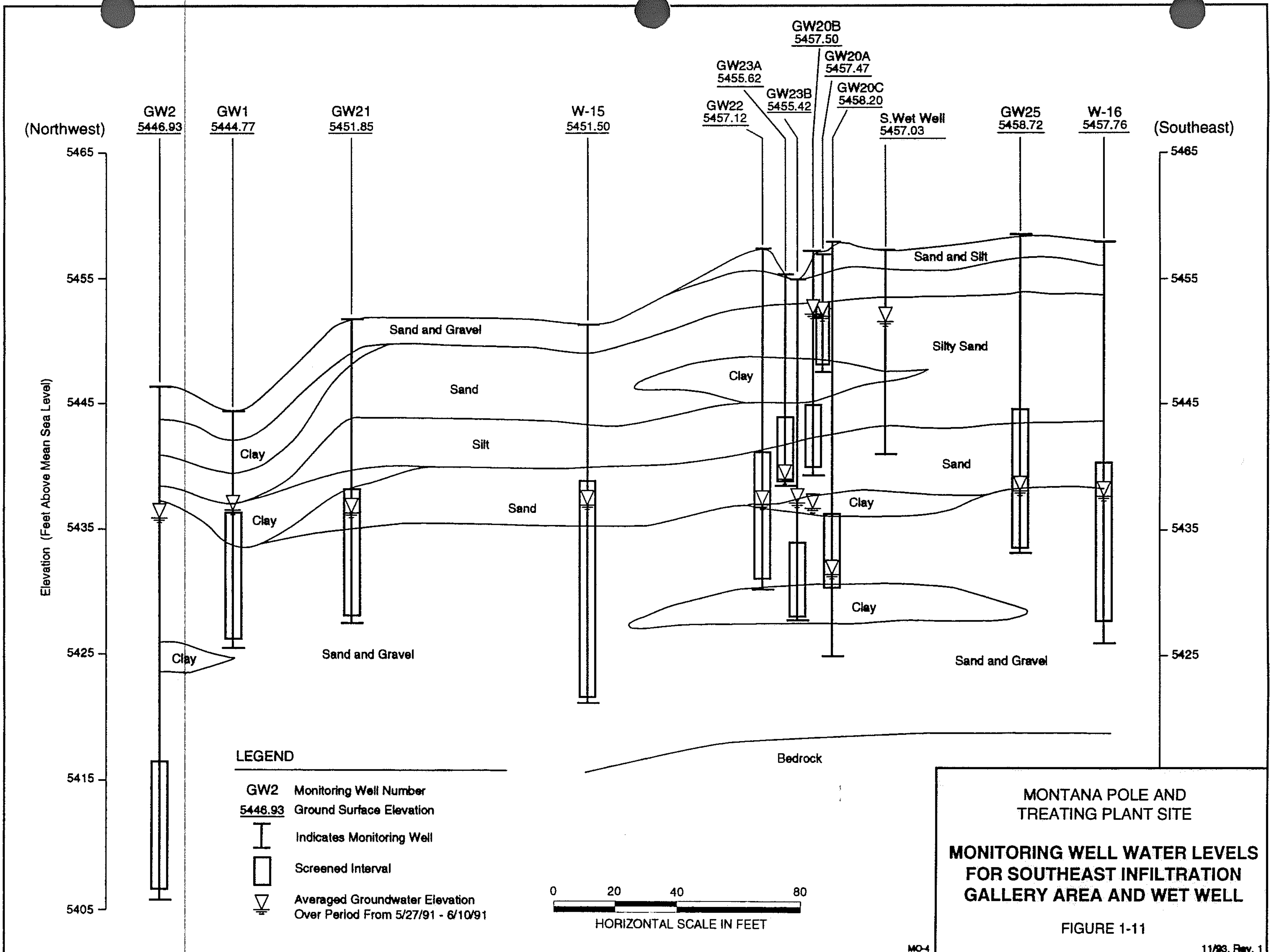
Source: Keystone, 1991

MO-1



MONTANA POLE AND
TREATING PLANT SITE
POTENTIOMETRIC SURFACE MAP
JUNE 6, 1991

FIGURE 1-10

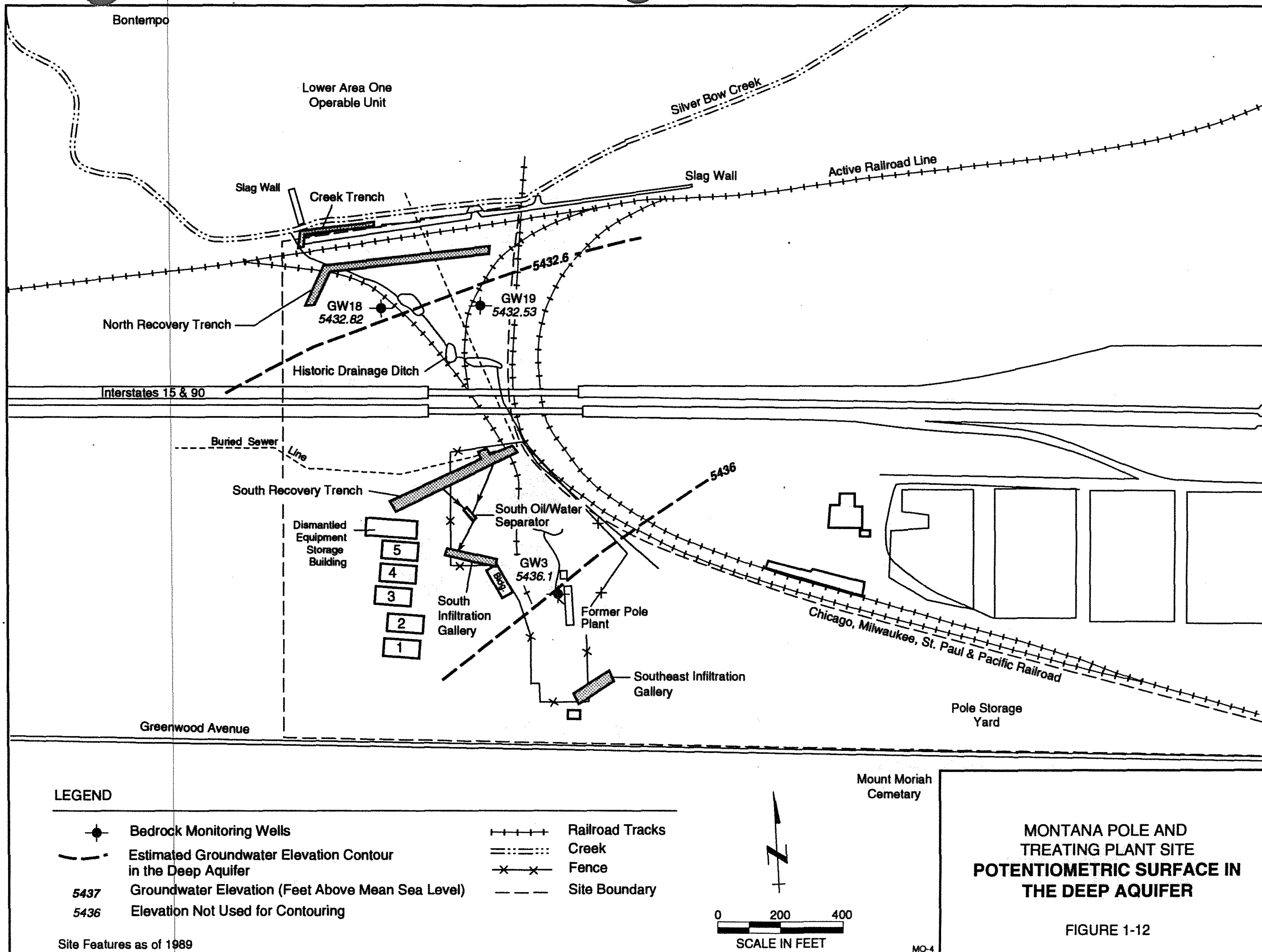


MONTANA POLE AND
TREATING PLANT SITE

MONITORING WELL WATER LEVELS FOR SOUTHEAST INFILTRATION GALLERY AREA AND WET WELL

FIGURE 1-11

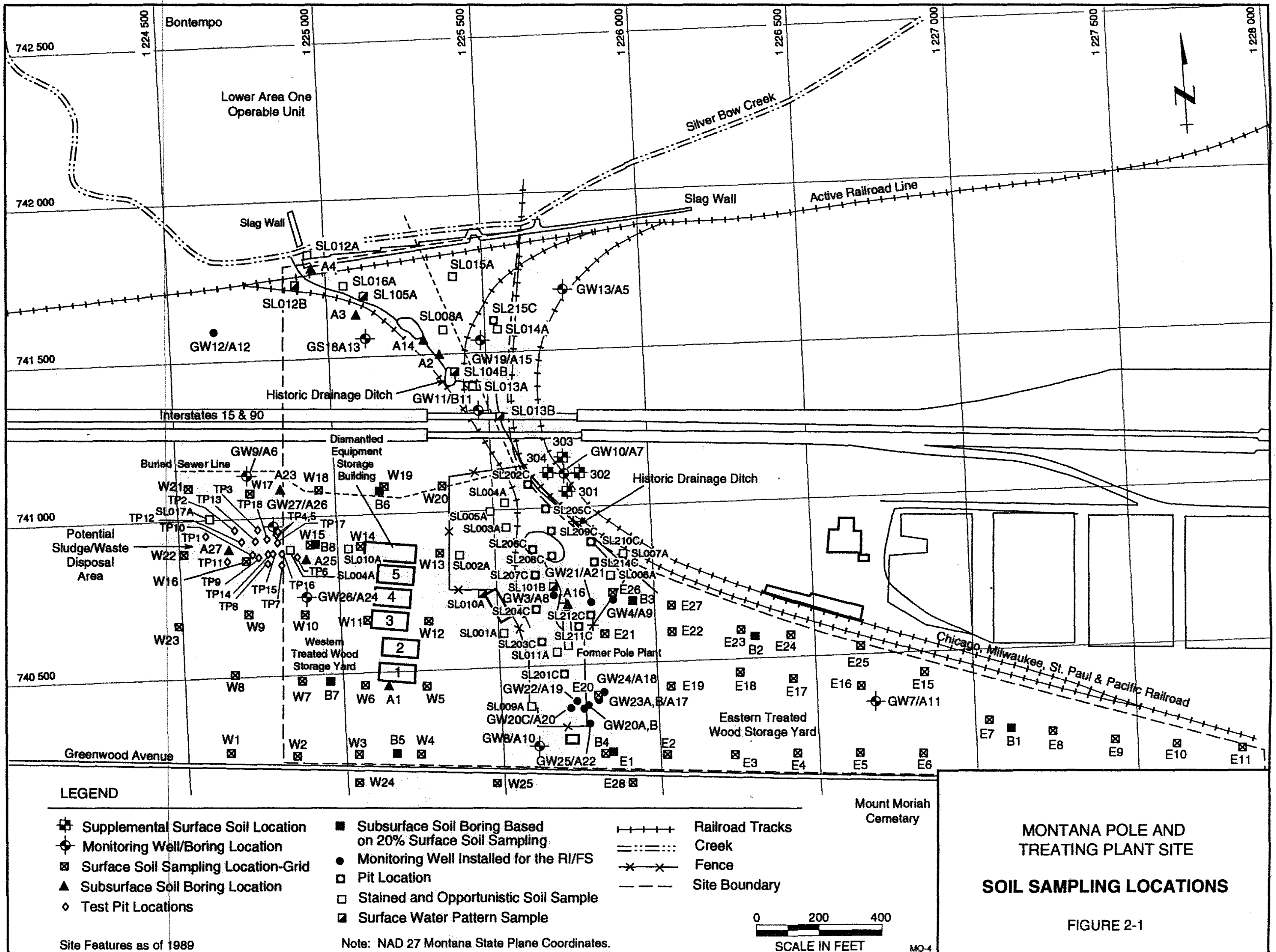
11/93, Rev. 1



MONTANA POLE AND TREATING PLANT SITE

POTENTIOMETRIC SURFACE IN THE DEEP AQUIFER

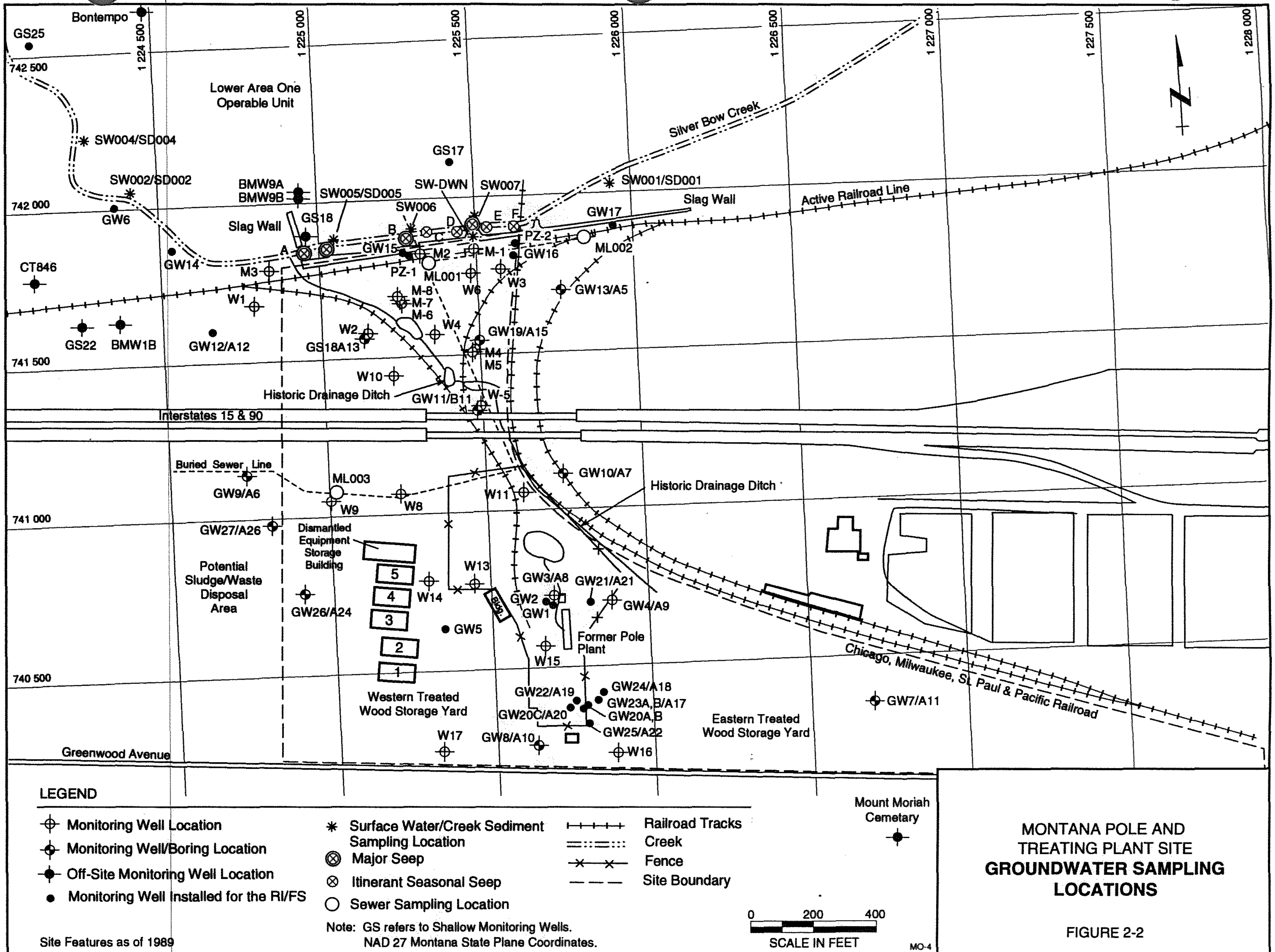
FIGURE 1-12



MONTANA POLE AND TREATING PLANT SITE

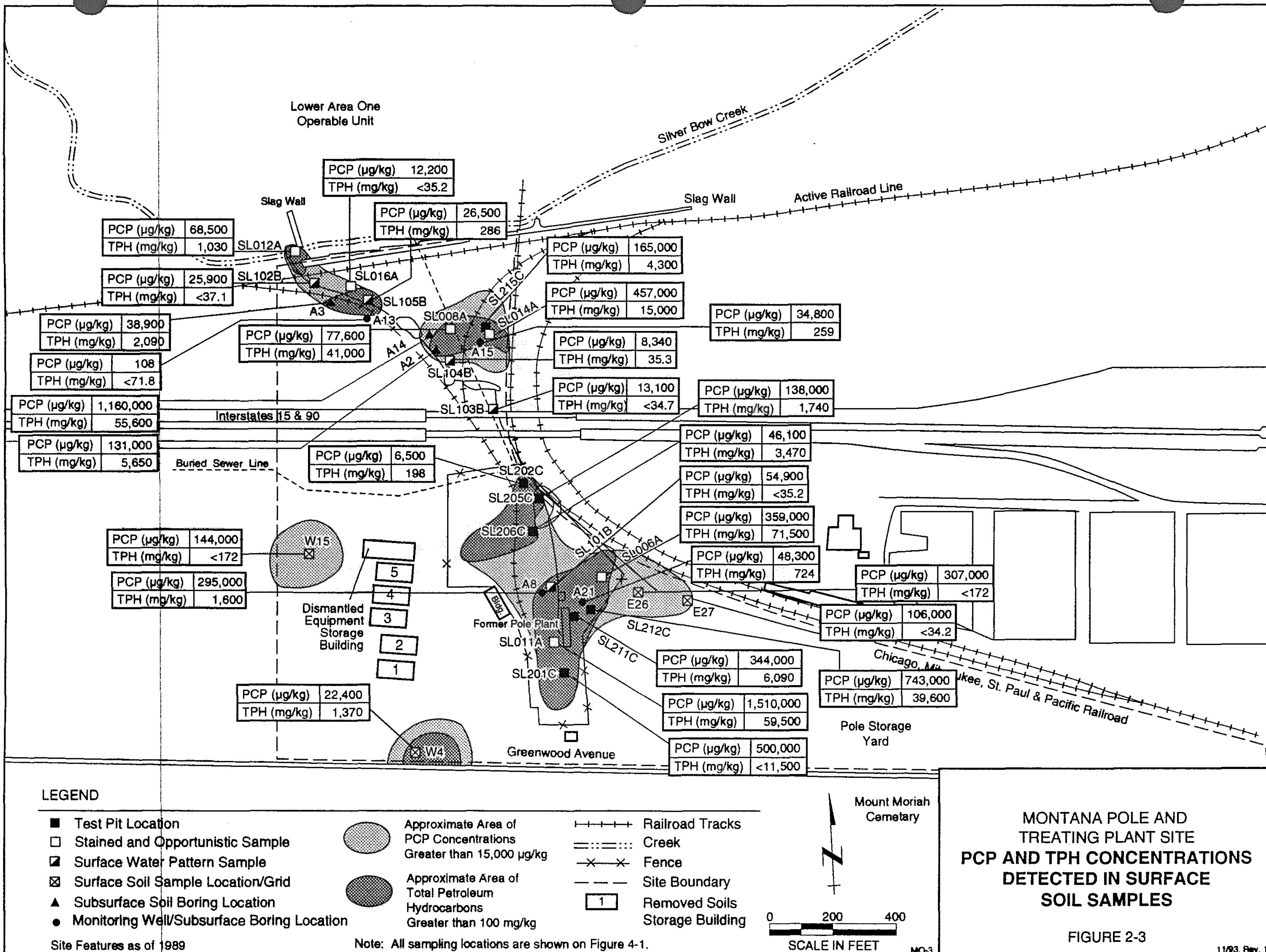
SOIL SAMPLING LOCATIONS

FIGURE 2-1



MONTANA POLE AND TREATING PLANT SITE
GROUNDWATER SAMPLING LOCATIONS

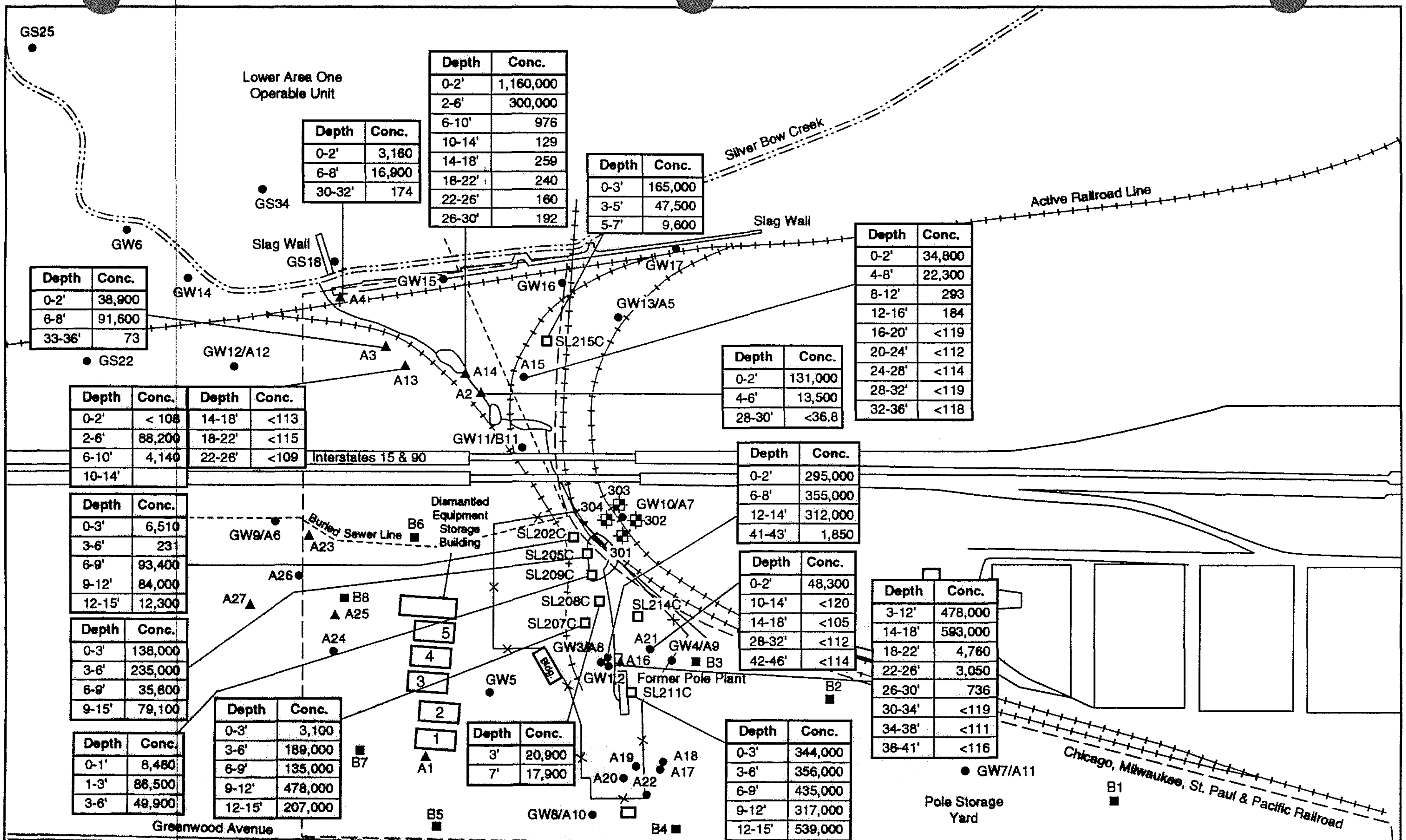
FIGURE 2-2



MONTANA POLE AND TREATING PLANT SITE

PCP AND TPH CONCENTRATIONS DETECTED IN SURFACE SOIL SAMPLES

FIGURE 2-3



Depth	Conc.
0-2'	38,900
6-8'	91,600
33-36'	73

Depth	Conc.
0-2'	3,160
6-8'	16,900
30-32'	174

Depth	Conc.
0-2'	1,160,000
2-6'	300,000
6-10'	976
10-14'	129
14-18'	259
18-22'	240
22-26'	160
26-30'	192

Depth	Conc.
0-3'	165,000
3-5'	47,500
5-7'	9,600

Depth	Conc.
0-2'	34,800
4-8'	22,300
8-12'	293
12-16'	184
16-20'	<119
20-24'	<112
24-28'	<114
28-32'	<119
32-36'	<118

Depth	Conc.
0-2'	131,000
4-6'	13,500
28-30'	<36.8

Depth	Conc.
0-2'	< 108
2-6'	88,200
6-10'	4,140
10-14'	

Depth	Conc.
14-18'	<113
18-22'	<115
22-26'	<109

Depth	Conc.
0-2'	295,000
6-8'	355,000
12-14'	312,000
41-43'	1,850

Depth	Conc.
0-3'	6,510
3-6'	231
6-9'	93,400
9-12'	84,000
12-15'	12,300

Depth	Conc.
0-2'	48,300
10-14'	<120
14-18'	<105
28-32'	<112
42-46'	<114

Depth	Conc.
3-12'	478,000
14-18'	593,000
18-22'	4,760
22-26'	3,050
26-30'	736
30-34'	<119
34-38'	<111
38-41'	<116

Depth	Conc.
0-3'	138,000
3-6'	235,000
6-9'	35,600
9-15'	79,100

Depth	Conc.
0-1'	8,480
1-3'	86,500
3-6'	49,900

Depth	Conc.
0-3'	3,100
3-6'	189,000
6-9'	135,000
9-12'	478,000
12-15'	207,000

Depth	Conc.
3'	20,900
7'	17,900

Depth	Conc.
0-3'	344,000
3-6'	356,000
6-9'	435,000
9-12'	317,000
12-15'	539,000

LEGEND

- ▲ Subsurface Soil Boring Location
- ■ Subsurface Boring Based on 20% Surface Borings
- ● Monitoring Well/Subsurface Boring Location
- □ Test Pit Samples
- ✚ Supplemental Surface Soil Location
- Railroad Tracks
- Creek
- Fence
- Site Boundary

Conc. = Concentration in μg/kg

Site Features as of 1989

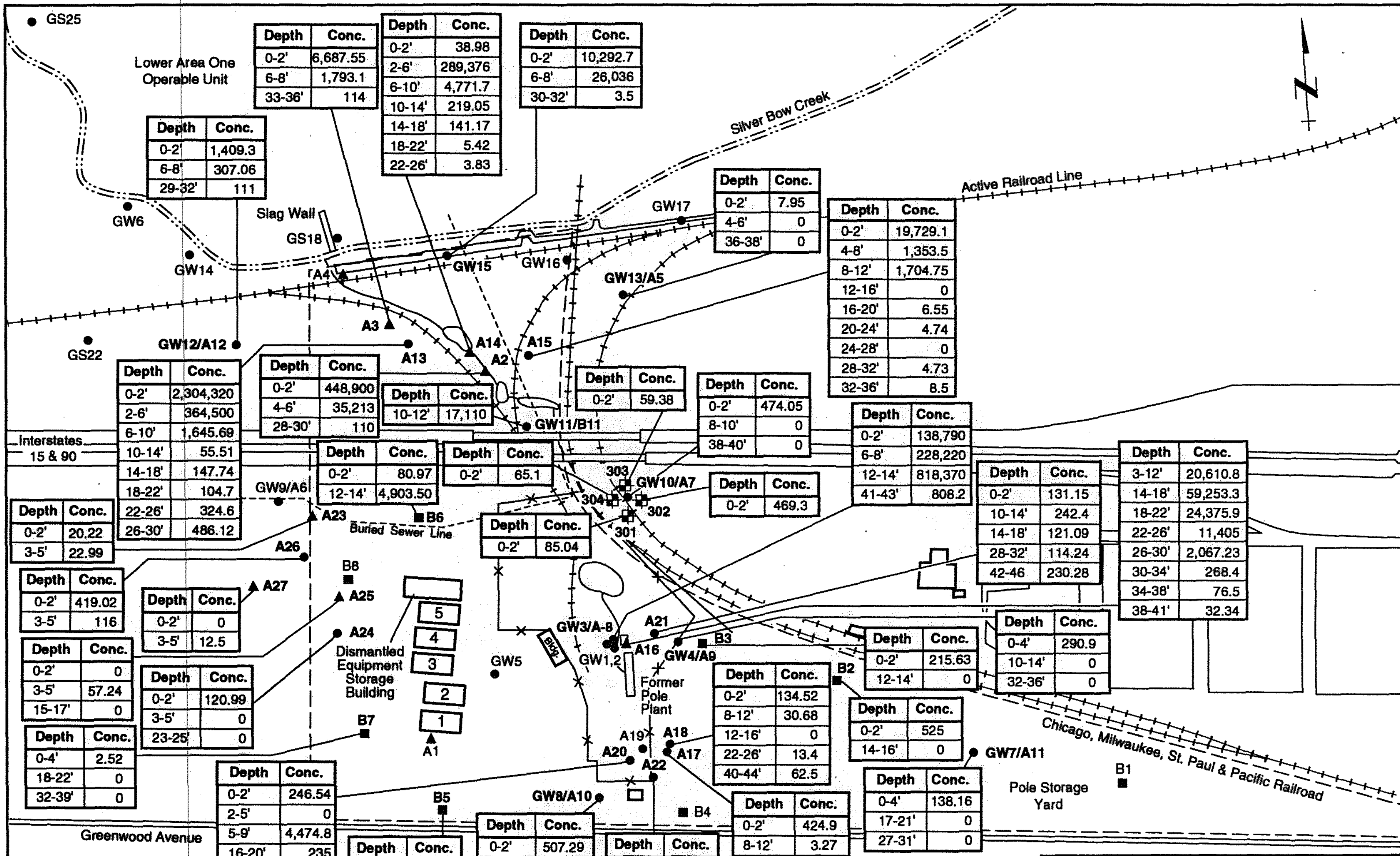
Note: 0-2' measurements are also included in Figure 4-3. All sampling locations are shown on Figure 4-1.

MONTANA POLE AND TREATING PLANT SITE

PCP CONCENTRATIONS DETECTED IN SUBSURFACE SOIL SAMPLES

FIGURE 2-4

11/93, Rev. 1



Depth	Conc.
0-2'	6,687.55
6-8'	1,793.1
33-36'	114

Depth	Conc.
0-2'	38.98
2-6'	289,376
6-10'	4,771.7
10-14'	219.05
14-18'	141.17
18-22'	5.42
22-26'	3.83

Depth	Conc.
0-2'	10,292.7
6-8'	26,036
30-32'	3.5

Depth	Conc.
0-2'	1,409.3
6-8'	307.06
29-32'	111

Depth	Conc.
0-2'	7.95
4-6'	0
36-38'	0

Depth	Conc.
0-2'	19,729.1
4-8'	1,353.5
8-12'	1,704.75
12-16'	0
16-20'	6.55
20-24'	4.74
24-28'	0
28-32'	4.73
32-36'	8.5

Depth	Conc.
0-2'	2,304,320
2-6'	364,500
6-10'	1,645.69
10-14'	55.51
14-18'	147.74
18-22'	104.7
22-26'	324.6
26-30'	486.12

Depth	Conc.
0-2'	448,900
4-6'	35,213
28-30'	110

Depth	Conc.
10-12'	17,110

Depth	Conc.
0-2'	59.38

Depth	Conc.
0-2'	474.05
8-10'	0
38-40'	0

Depth	Conc.
0-2'	138,790
6-8'	228,220
12-14'	818,370
41-43'	808.2

Depth	Conc.
0-2'	80.97
12-14'	4,903.50

Depth	Conc.
0-2'	65.1

Depth	Conc.
0-2'	469.3

Depth	Conc.
0-2'	131.15
10-14'	242.4
14-18'	121.09
28-32'	114.24
42-46	230.28

Depth	Conc.
3-12'	20,610.8
14-18'	59,253.3
18-22'	24,375.9
22-26'	11,405
26-30'	2,067.23
30-34'	268.4
34-38'	76.5
38-41'	32.34

Depth	Conc.
0-2'	20.22
3-5'	22.99

Depth	Conc.
0-2'	85.04

Depth	Conc.
0-2'	419.02
3-5'	116

Depth	Conc.
0-2'	0
3-5'	12.5

Depth	Conc.
0-2'	0
3-5'	57.24
15-17'	0

Depth	Conc.
0-4'	290.9
10-14'	0
32-36'	0

Depth	Conc.
0-2'	215.63
12-14'	0

Depth	Conc.
0-2'	134.52
8-12'	30.68
12-16'	0
22-26'	13.4
40-44'	62.5

Depth	Conc.
0-2'	120.99
3-5'	0
23-25'	0

Depth	Conc.
0-2'	525
14-16'	0

Depth	Conc.
0-4'	2.52
18-22'	0
32-39'	0

Depth	Conc.
0-2'	246.54
2-5'	0
5-9'	4,474.8
16-20'	235
27-31'	124.4

Depth	Conc.
0-4'	138.16
17-21'	0
27-31'	0

Depth	Conc.
0-2'	424.9
8-12'	3.27
12-16'	0
22-26'	35.31

Depth	Conc.
0-2'	507.29
18-26'	0
26-30'	0

Depth	Conc.
0-2'	52.62
14-16'	0

Depth	Conc.
17-21'	25.5
23-27'	0

LEGEND

- ▲ Subsurface Soil Boring Location
- ■ Subsurface Boring Based on 20% Surface Borings
- ● Monitoring Well/Subsurface Boring Location
- Supplemental Surface Soil Location

Conc. = Concentration µg/kg

Site Features as of 1989

Railroad Tracks
Creek
Fence
Site Boundary

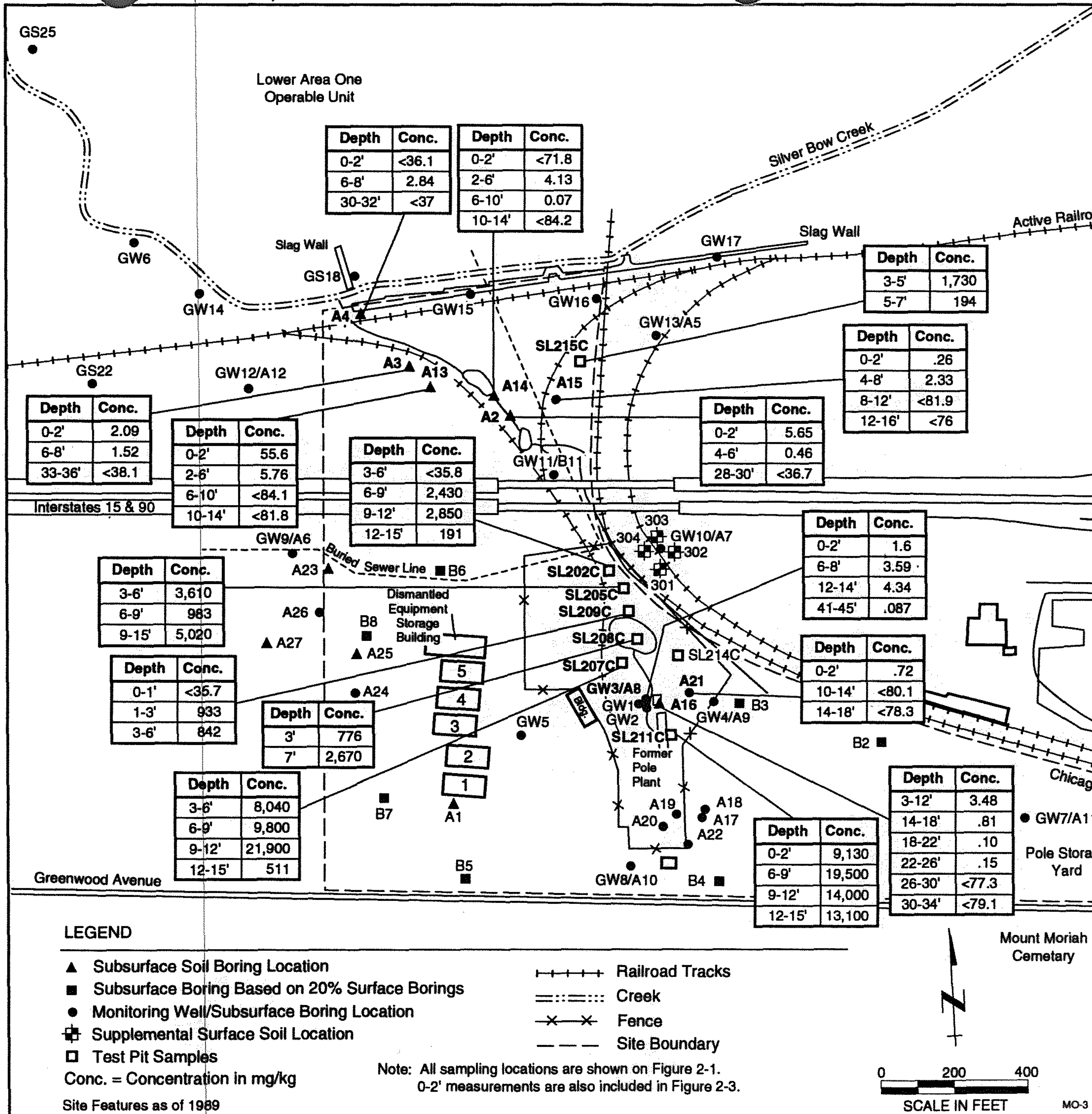
Note:
Total PAH concentrations less than detection limits are indicated by a value of 0.
All sampling locations are shown on Figure 2-1.

0 200 400
SCALE IN FEET

MO-3

MONTANA POLE AND TREATING PLANT SITE
PAH CONCENTRATIONS DETECTED IN SUBSURFACE SOIL SAMPLES

FIGURE 2-5



Depth	Conc.
0-2'	<36.1
6-8'	2.84
30-32'	<37

Depth	Conc.
0-2'	<71.8
2-6'	4.13
6-10'	0.07
10-14'	<84.2

Depth	Conc.
3-5'	1,730
5-7'	194

Depth	Conc.
0-2'	.26
4-8'	2.33
8-12'	<81.9
12-16'	<76

Depth	Conc.
0-2'	2.09
6-8'	1.52
33-36'	<38.1

Depth	Conc.
0-2'	55.6
2-6'	5.76
6-10'	<84.1
10-14'	<81.8

Depth	Conc.
3-6'	<35.8
6-9'	2,430
9-12'	2,850
12-15'	191

Depth	Conc.
0-2'	5.65
4-6'	0.46
28-30'	<36.7

Depth	Conc.
0-2'	1.6
6-8'	3.59
12-14'	4.34
41-45'	.087

Depth	Conc.
3-6'	3,610
6-9'	983
9-15'	5,020

Depth	Conc.
0-2'	.72
10-14'	<80.1
14-18'	<78.3

Depth	Conc.
0-1'	<35.7
1-3'	933
3-6'	842

Depth	Conc.
3'	776
7'	2,670

Depth	Conc.
3-6'	8,040
6-9'	9,800
9-12'	21,900
12-15'	511

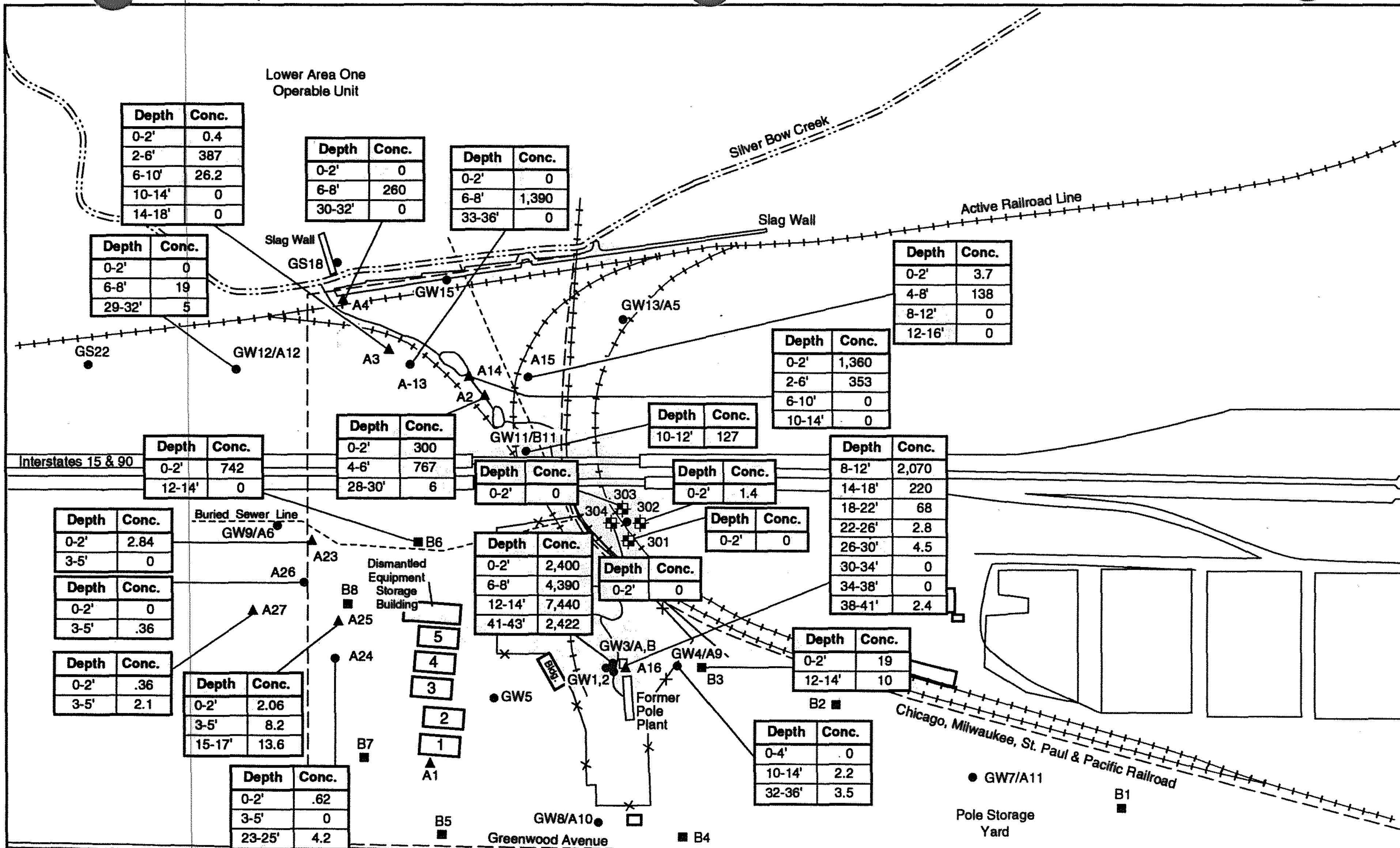
Depth	Conc.
0-2'	9,130
6-9'	19,500
9-12'	14,000
12-15'	13,100

Depth	Conc.
3-12'	3.48
14-18'	.81
18-22'	.10
22-26'	.15
26-30'	<77.3
30-34'	<79.1

MONTANA POLE AND
TREATING PLANT SITE

TPH CONCENTRATIONS DETECTED IN SUBSURFACE SOIL SAMPLES
(Concentrations above 10 mg/kg)

FIGURE 2-6



LEGEND

- ▲ Subsurface Soil Boring Location
- ■ Subsurface Boring Based on 20% Surface Borings
- ● Monitoring Well/Subsurface Boring Location
- ⌖ Supplemental Surface Soil Location
- Railroad Tracks
- Creek
- Fence
- Site Boundary

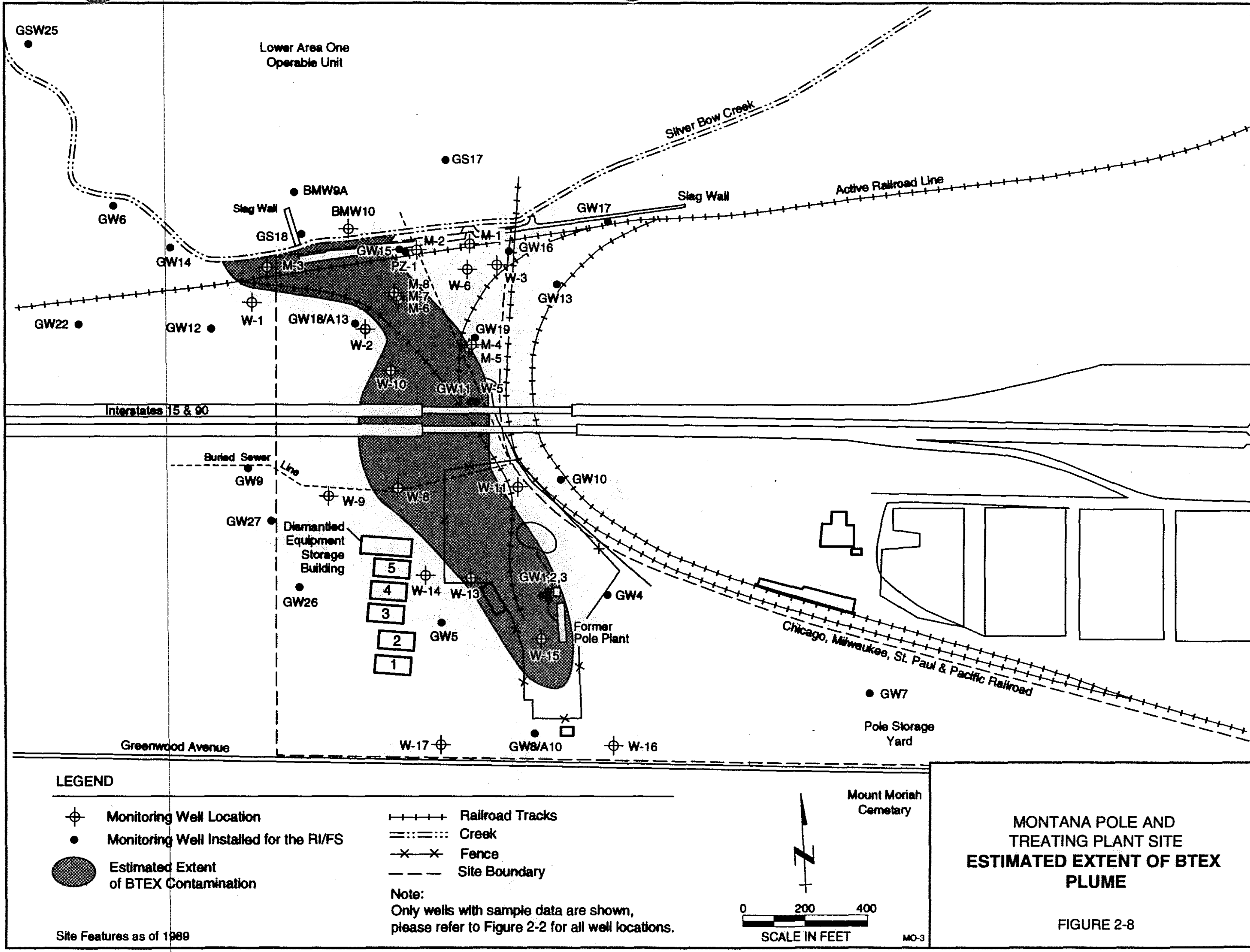
Conc. = Concentration µg/kg

Site Features as of 1989

NOTE: A value of 0 is provided as the BTEX concentration if benzene, toluene, ethylbenzene and xylene are not detected. All sampling locations are shown on Figure 2-1.

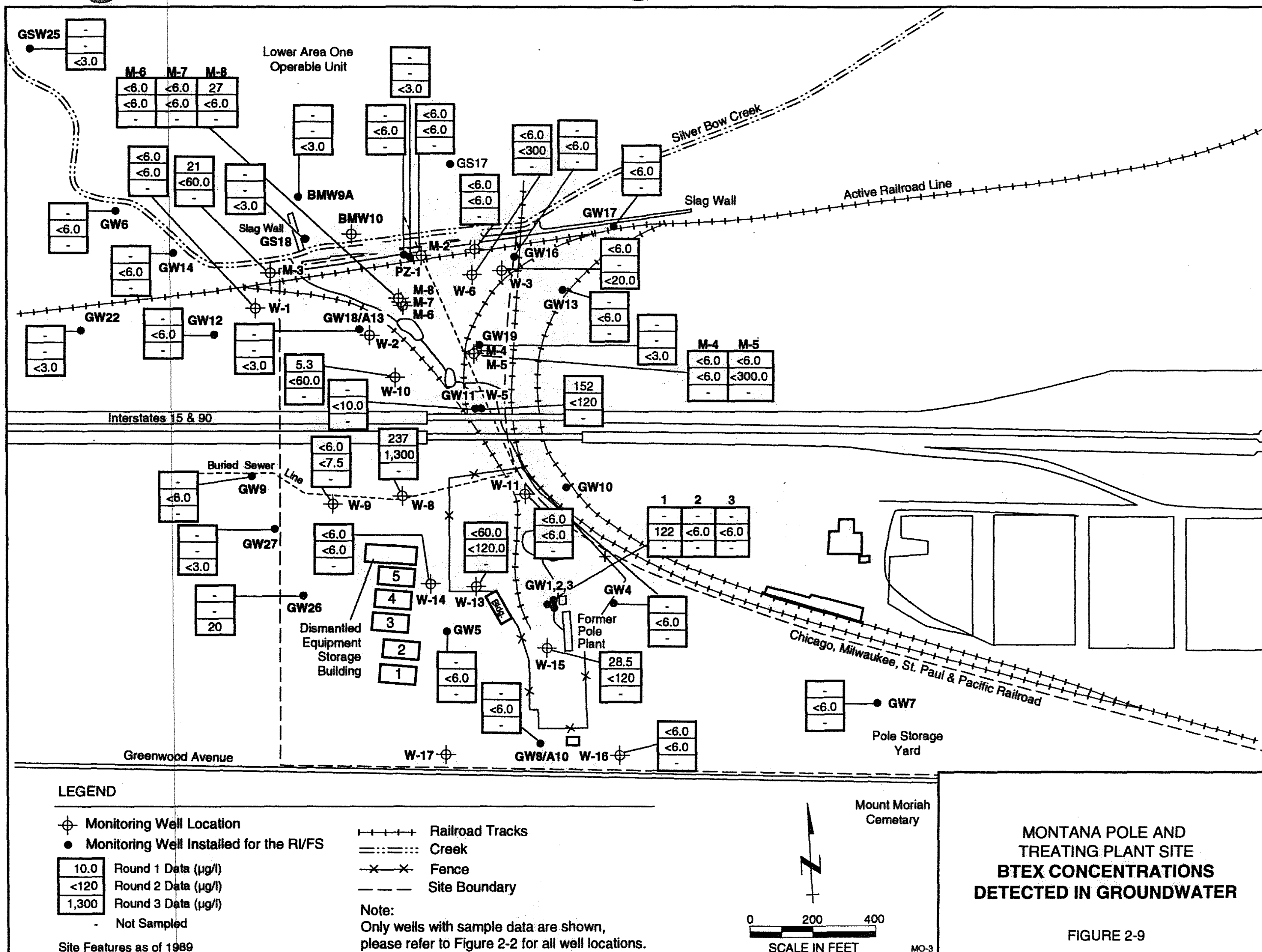
MONTANA POLE AND TREATING PLANT SITE
BTEX CONCENTRATIONS DETECTED IN SUBSURFACE SOIL SAMPLES

FIGURE 2-7



MONTANA POLE AND
TREATING PLANT SITE
ESTIMATED EXTENT OF BTEX PLUME

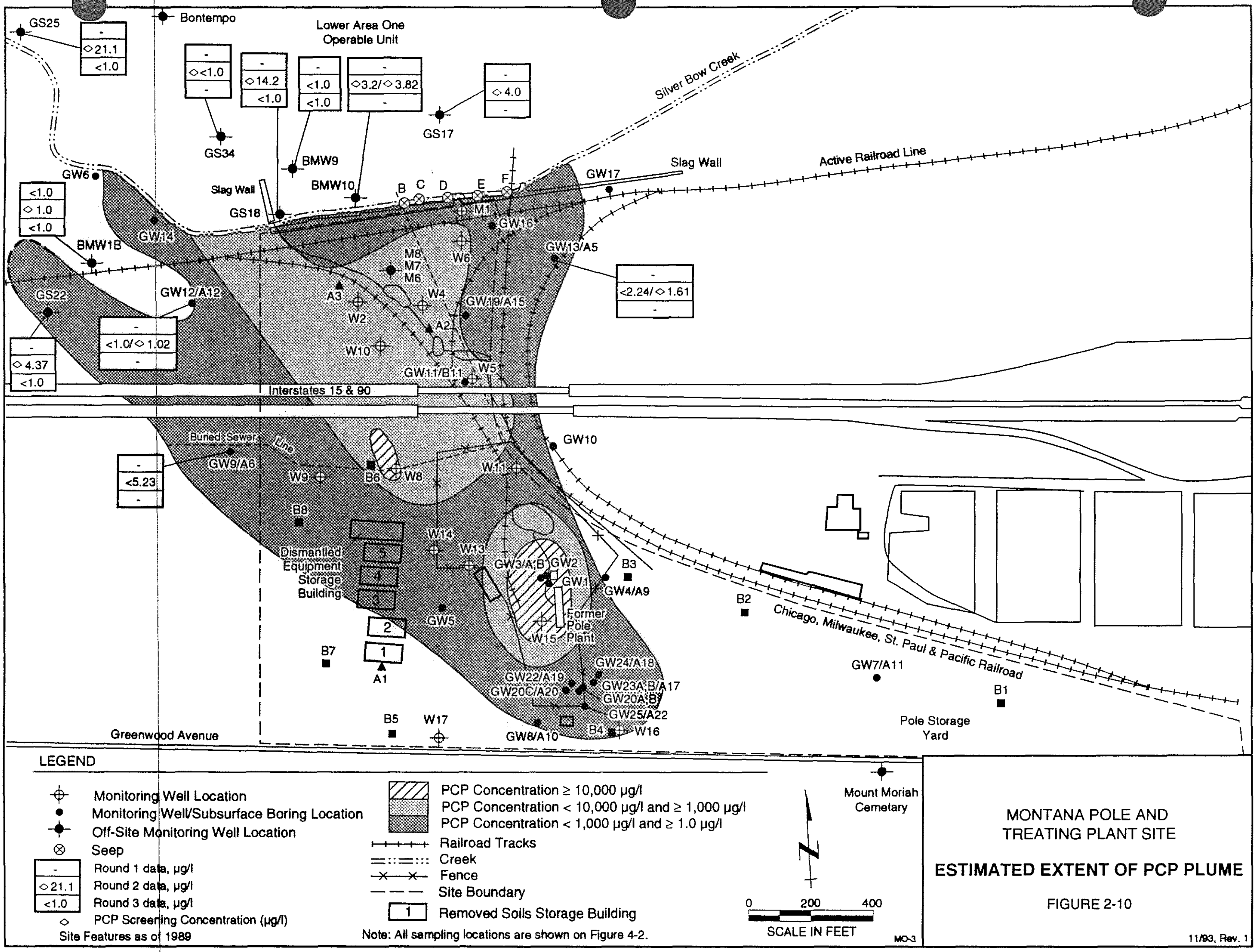
FIGURE 2-8



MONTANA POLE AND TREATING PLANT SITE

BTEX CONCENTRATIONS DETECTED IN GROUNDWATER

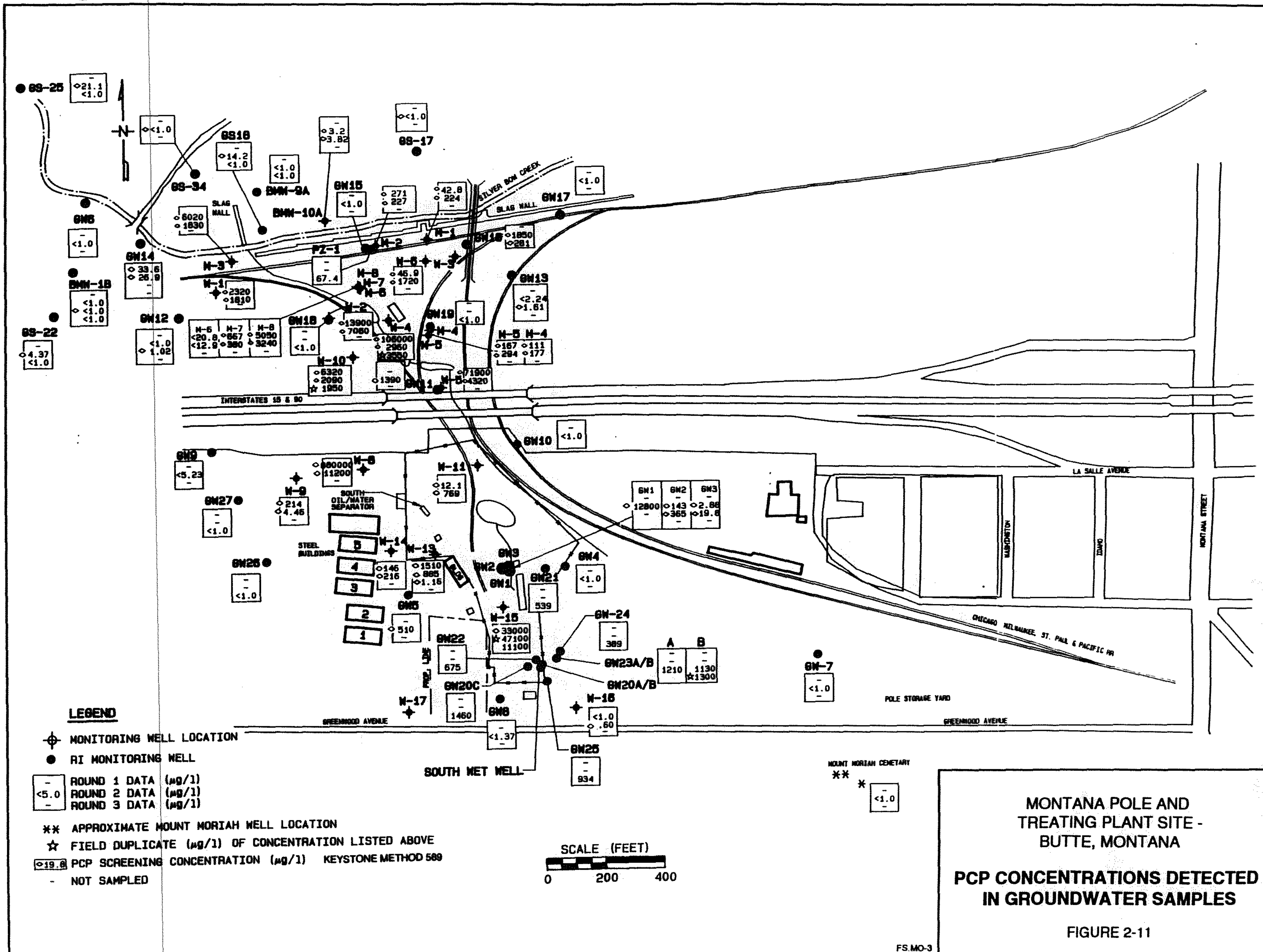
FIGURE 2-9



MONTANA POLE AND TREATING PLANT SITE

ESTIMATED EXTENT OF PCP PLUME

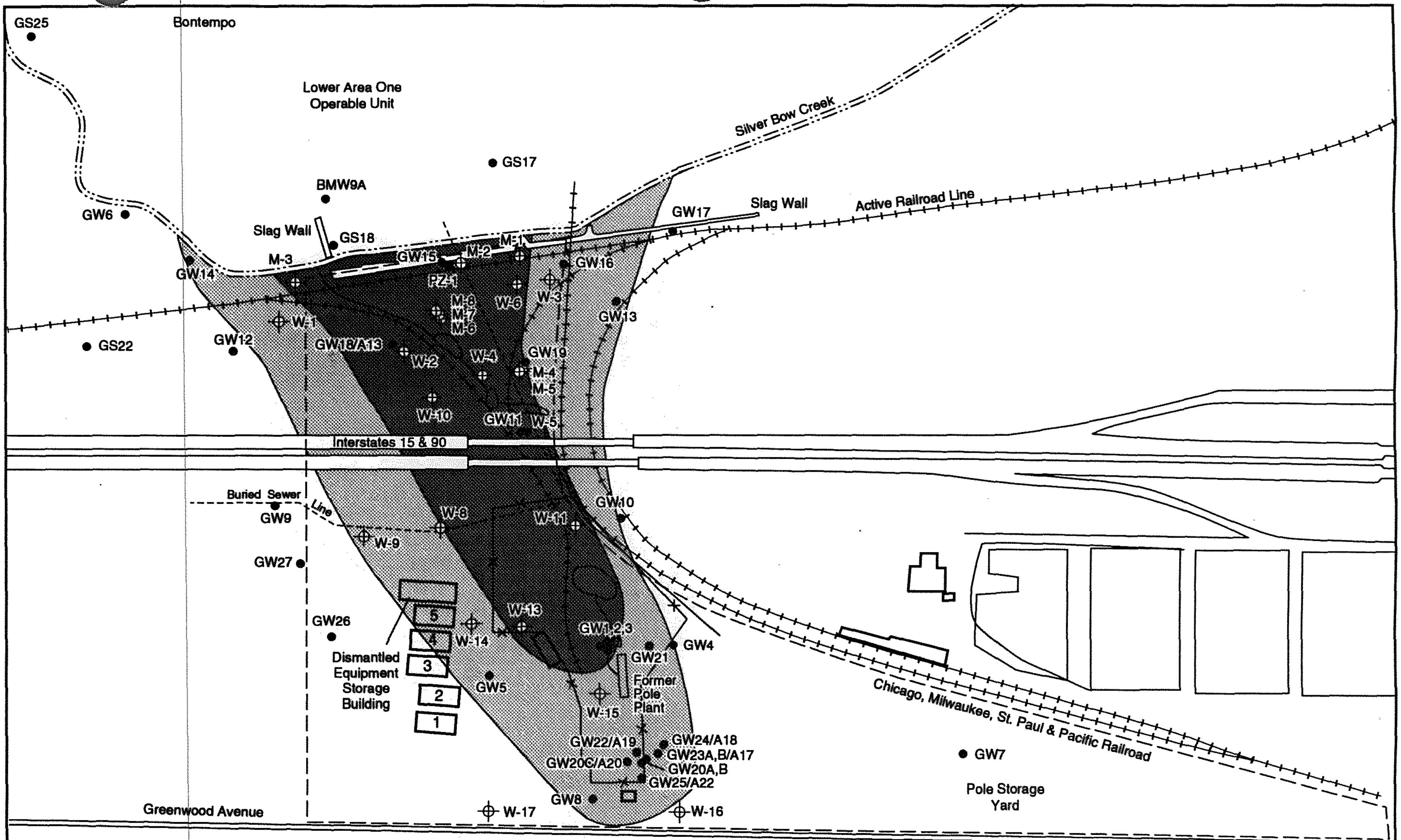
FIGURE 2-10



MONTANA POLE AND TREATING PLANT SITE - BUTTE, MONTANA

PCP CONCENTRATIONS DETECTED IN GROUNDWATER SAMPLES

FIGURE 2-11



LEGEND

- Monitoring Well Location
- Monitoring Well Installed for the RI/FS
- Railroad Tracks
- Creek
- Fence
- Site Boundary

PAH Concentration < 10,000 µg/l and ≥ 1,000 µg/l

PAH Concentration < 1,000 µg/l and ≥ 1.0 µg/l

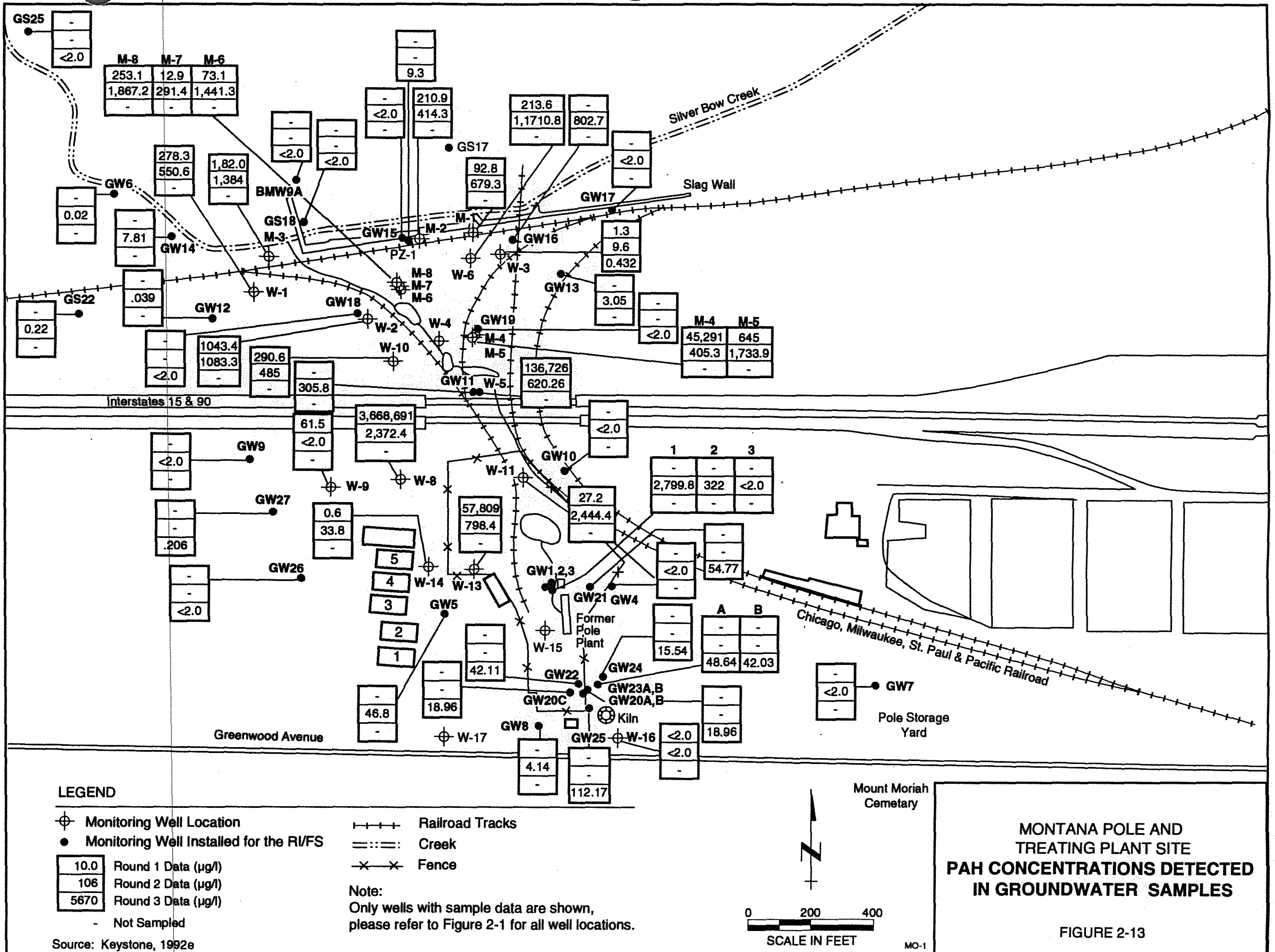
Site Features as of 1989

Note: All sampling locations are shown on Figure 2-2.

MONTANA POLE AND TREATING PLANT SITE

ESTIMATED EXTENT OF PAH PLUME

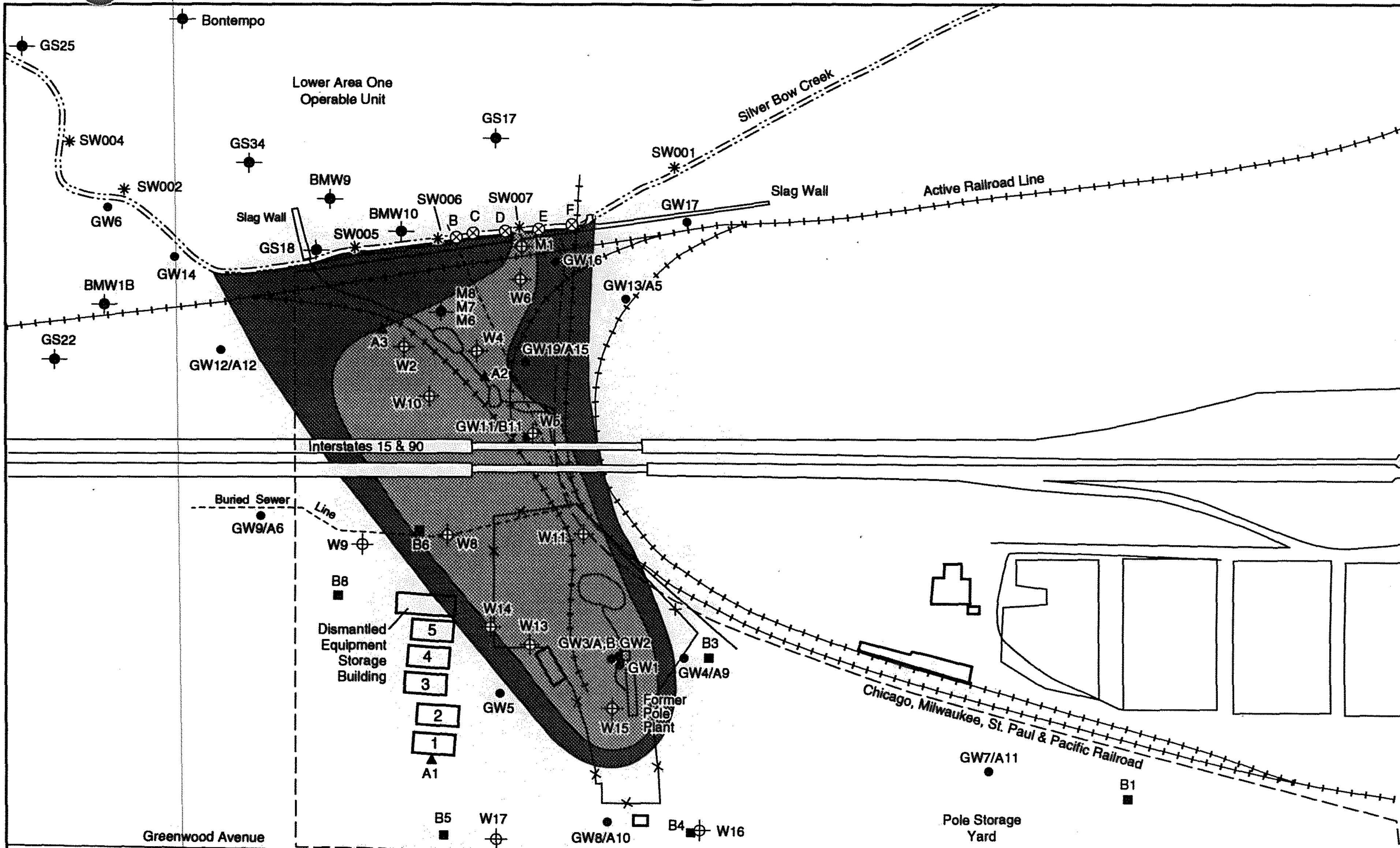
FIGURE 2-12



MONTANA POLE AND TREATING PLANT SITE

PAH CONCENTRATIONS DETECTED IN GROUNDWATER SAMPLES

FIGURE 2-13



LEGEND

- Monitoring Well Location
- Monitoring Well/Subsurface Boring Location
- Off-Site Monitoring Well Location
- Seep
- Surface Water Sampling Locations

Site Features as of 1989

- Total Hydrocarbons ≥1.0 mg/l
- Total Hydrocarbons <1.0 mg/l and ≥ 0.1 mg/l
- Railroad Tracks
- Creek
- Fence
- Site Boundary

Note: All sampling locations are shown on Figure 2-2.

Mount Moriah Cemetary

0 200 400

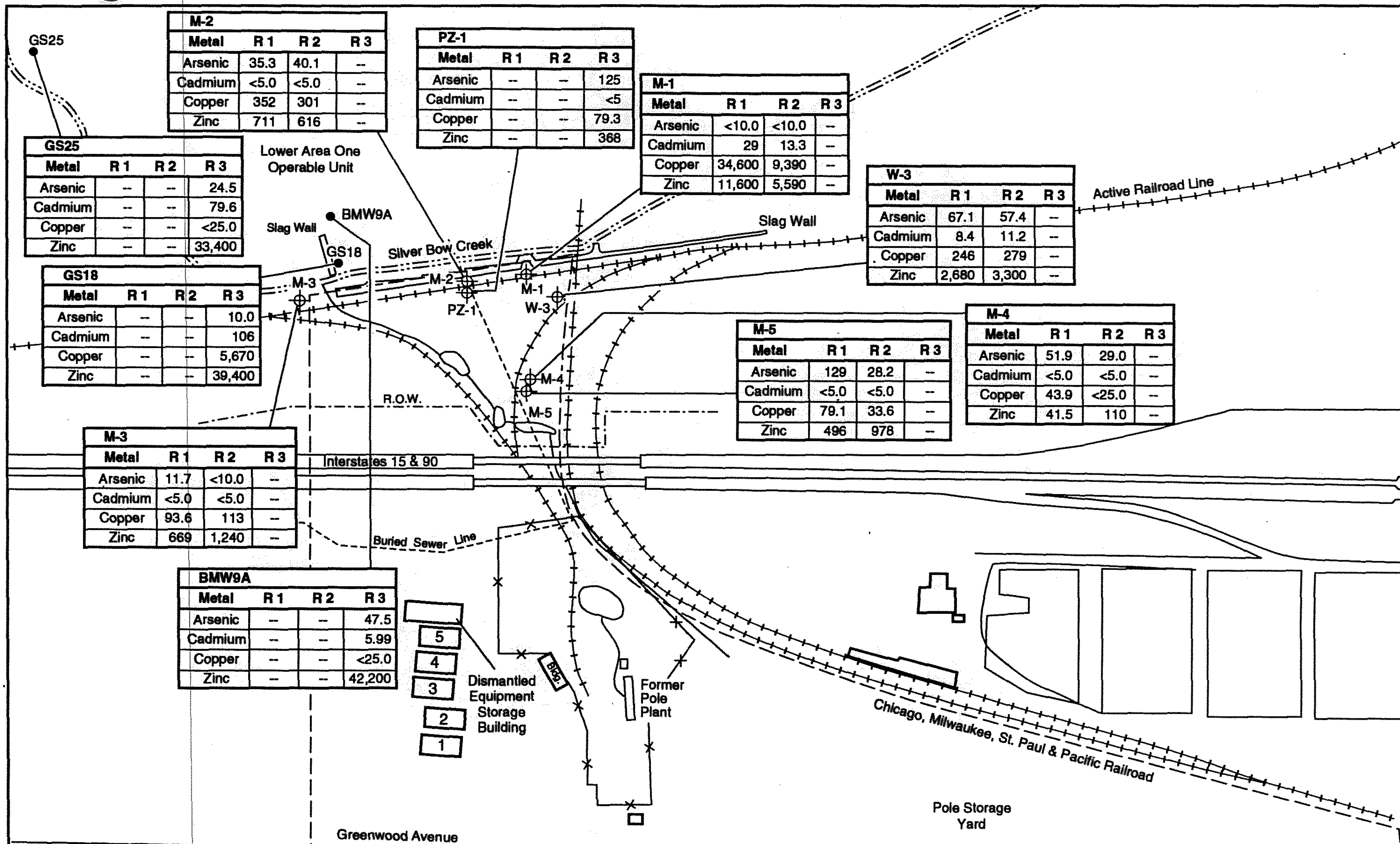
SCALE IN FEET

MO-3

MONTANA POLE AND TREATING PLANT SITE

ESTIMATED EXTENT OF TPH PLUME

FIGURE 2-14



M-2

Metal	R 1	R 2	R 3
Arsenic	35.3	40.1	--
Cadmium	<5.0	<5.0	--
Copper	352	301	--
Zinc	711	616	--

PZ-1

Metal	R 1	R 2	R 3
Arsenic	--	--	125
Cadmium	--	--	<5
Copper	--	--	79.3
Zinc	--	--	368

M-1

Metal	R 1	R 2	R 3
Arsenic	<10.0	<10.0	--
Cadmium	29	13.3	--
Copper	34,600	9,390	--
Zinc	11,600	5,590	--

GS25

Metal	R 1	R 2	R 3
Arsenic	--	--	24.5
Cadmium	--	--	79.6
Copper	--	--	<25.0
Zinc	--	--	33,400

W-3

Metal	R 1	R 2	R 3
Arsenic	67.1	57.4	--
Cadmium	8.4	11.2	--
Copper	246	279	--
Zinc	2,680	3,300	--

GS18

Metal	R 1	R 2	R 3
Arsenic	--	--	10.0
Cadmium	--	--	106
Copper	--	--	5,670
Zinc	--	--	39,400

M-4

Metal	R 1	R 2	R 3
Arsenic	51.9	29.0	--
Cadmium	<5.0	<5.0	--
Copper	43.9	<25.0	--
Zinc	41.5	110	--

M-5

Metal	R 1	R 2	R 3
Arsenic	129	28.2	--
Cadmium	<5.0	<5.0	--
Copper	79.1	33.6	--
Zinc	496	978	--

M-3

Metal	R 1	R 2	R 3
Arsenic	11.7	<10.0	--
Cadmium	<5.0	<5.0	--
Copper	93.6	113	--
Zinc	669	1,240	--

BMW9A

Metal	R 1	R 2	R 3
Arsenic	--	--	47.5
Cadmium	--	--	5.99
Copper	--	--	<25.0
Zinc	--	--	42,200

LEGEND

- ⌖ Monitoring Well Location
- ● Monitoring Well Installed for the RI/FS
- R Sampling Round
- -- Not Sampled
- All Concentrations in µg/l

Site Features as of 1989

- ┼┼┼┼ Railroad Tracks
- ═::═ Creek
- ─×──× Fence
- — — — Site Boundary

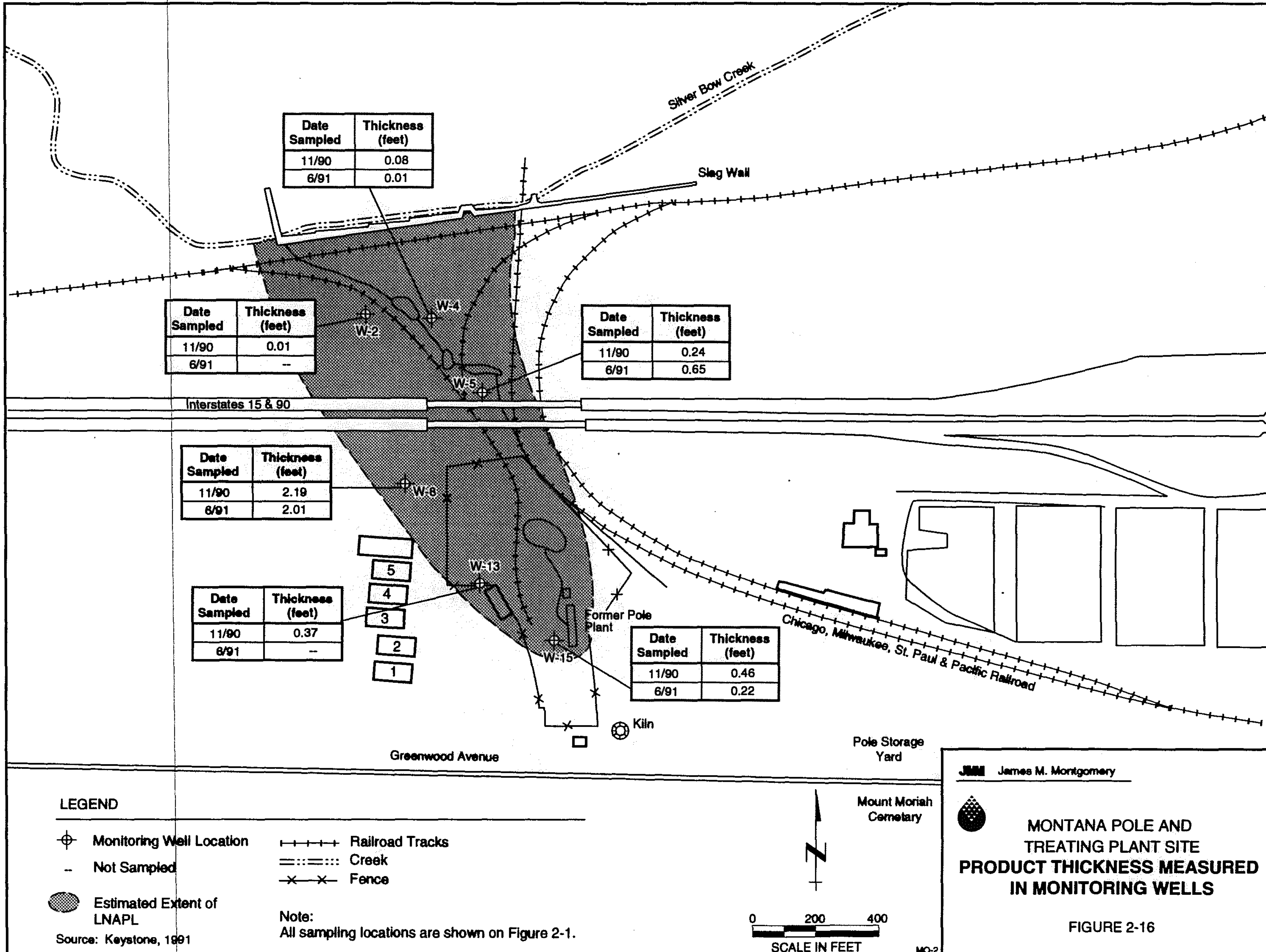
Note:
Only wells with sample data in excess of MCLs are shown, please refer to Figure 2-2 for all well locations.

0 200 400
SCALE IN FEET

MO-3

MONTANA POLE AND TREATING PLANT SITE
ELEVATED METALS CONCENTRATIONS DETECTED IN GROUNDWATER

FIGURE 2-15



LEGEND

- Monitoring Well Location
- -- Not Sampled
- Estimated Extent of LNAPL
- Railroad Tracks
- Creek
- Fence

Source: Keystone, 1991

Note:
All sampling locations are shown on Figure 2-1.

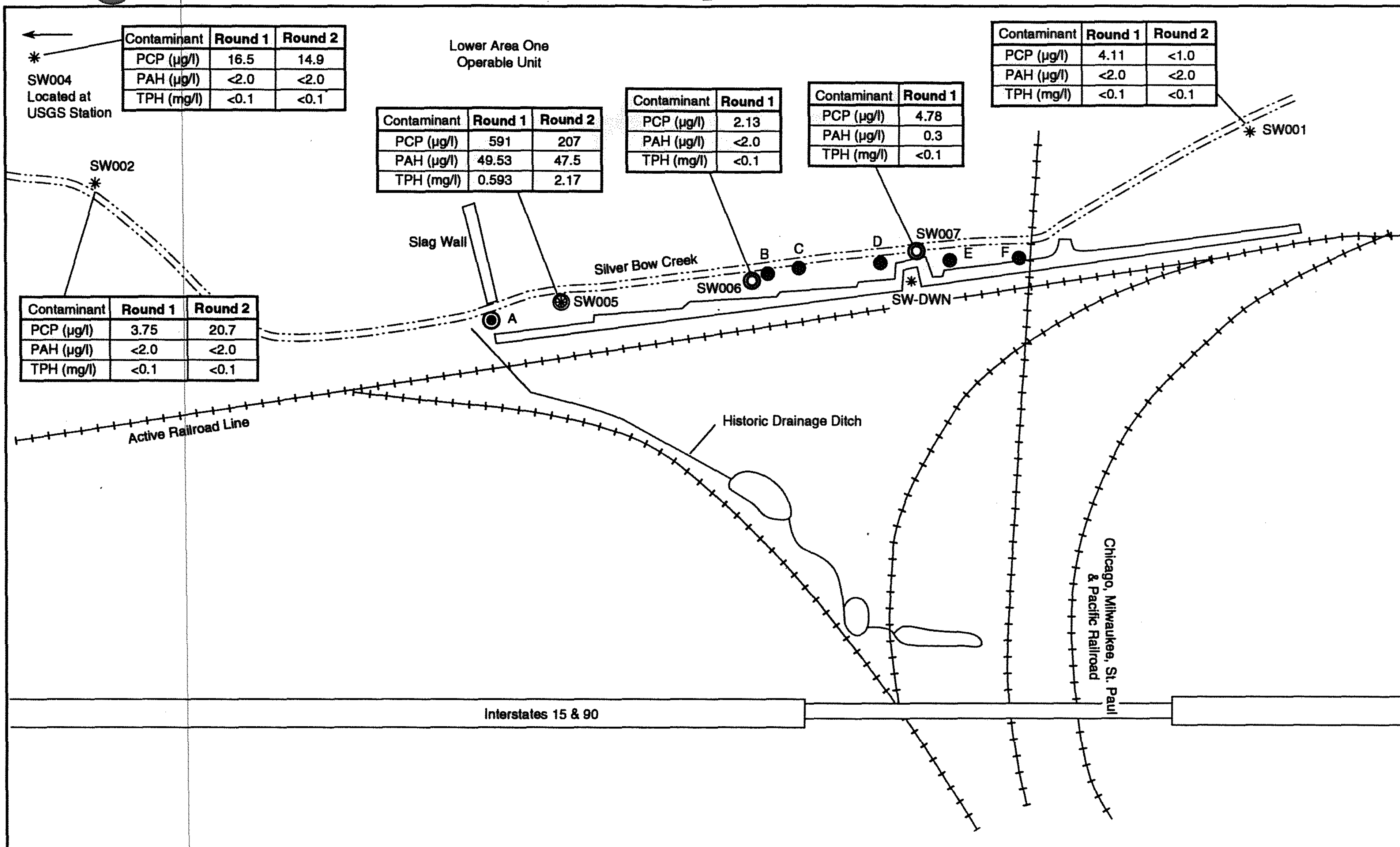
MO-2

JMM James M. Montgomery

MONTANA POLE AND TREATING PLANT SITE

PRODUCT THICKNESS MEASURED IN MONITORING WELLS

FIGURE 2-16



SW004:

Contaminant	Round 1	Round 2
PCP (μg/l)	16.5	14.9
PAH (μg/l)	<2.0	<2.0
TPH (mg/l)	<0.1	<0.1

SW002:

Contaminant	Round 1	Round 2
PCP (μg/l)	3.75	20.7
PAH (μg/l)	<2.0	<2.0
TPH (mg/l)	<0.1	<0.1

SW005:

Contaminant	Round 1	Round 2
PCP (μg/l)	591	207
PAH (μg/l)	49.53	47.5
TPH (mg/l)	0.593	2.17

SW006:

Contaminant	Round 1
PCP (μg/l)	2.13
PAH (μg/l)	<2.0
TPH (mg/l)	<0.1

SW007:

Contaminant	Round 1
PCP (μg/l)	4.78
PAH (μg/l)	0.3
TPH (mg/l)	<0.1

SW001:

Contaminant	Round 1	Round 2
PCP (μg/l)	4.11	<1.0
PAH (μg/l)	<2.0	<2.0
TPH (mg/l)	<0.1	<0.1

LEGEND

- ● Itinerant Seasonal Seep
- ◎ Major Seep
- * Surface water sampling locations for the 1990 RI
- Railroad Tracks
- Creek

Site Features as of 1989

Note:
Seep observations from June through December 1990.
All sampling locations are shown on Figure 2-2.

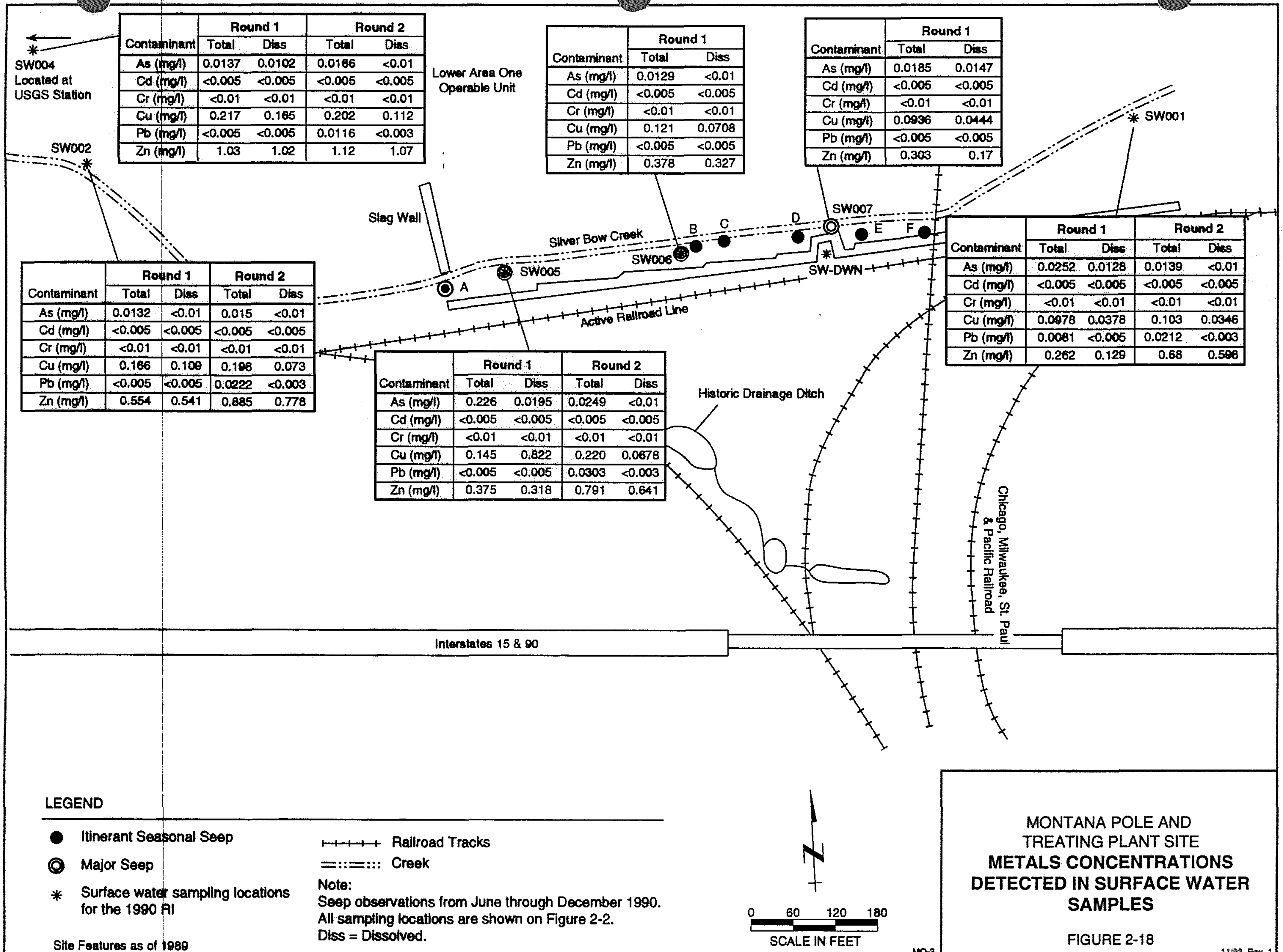
0 60 120 180
SCALE IN FEET

MO-3

MONTANA POLE AND
TREATING PLANT SITE

PCP, PAH AND TPH CONCENTRATIONS DETECTED IN SURFACE WATER SAMPLES

FIGURE 2-17



Contaminant	Round 1 Total	Round 1 Diss	Round 2 Total	Round 2 Diss
As (mg/l)	0.0137	0.0102	0.0166	<0.01
Cd (mg/l)	<0.005	<0.005	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01	<0.01	<0.01
Cu (mg/l)	0.217	0.165	0.202	0.112
Pb (mg/l)	<0.005	<0.005	0.0116	<0.003
Zn (mg/l)	1.03	1.02	1.12	1.07

Contaminant	Round 1 Total	Round 1 Diss
As (mg/l)	0.0129	<0.01
Cd (mg/l)	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01
Cu (mg/l)	0.121	0.0708
Pb (mg/l)	<0.005	<0.005
Zn (mg/l)	0.378	0.327

Contaminant	Round 1 Total	Round 1 Diss
As (mg/l)	0.0185	0.0147
Cd (mg/l)	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01
Cu (mg/l)	0.0936	0.0444
Pb (mg/l)	<0.005	<0.005
Zn (mg/l)	0.303	0.17

Contaminant	Round 1 Total	Round 1 Diss	Round 2 Total	Round 2 Diss
As (mg/l)	0.0132	<0.01	0.015	<0.01
Cd (mg/l)	<0.005	<0.005	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01	<0.01	<0.01
Cu (mg/l)	0.166	0.109	0.198	0.073
Pb (mg/l)	<0.005	<0.005	0.0222	<0.003
Zn (mg/l)	0.554	0.541	0.885	0.778

Contaminant	Round 1 Total	Round 1 Diss	Round 2 Total	Round 2 Diss
As (mg/l)	0.226	0.0195	0.0249	<0.01
Cd (mg/l)	<0.005	<0.005	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01	<0.01	<0.01
Cu (mg/l)	0.145	0.822	0.220	0.0678
Pb (mg/l)	<0.005	<0.005	0.0303	<0.003
Zn (mg/l)	0.375	0.318	0.791	0.641

Contaminant	Round 1 Total	Round 1 Diss	Round 2 Total	Round 2 Diss
As (mg/l)	0.0252	0.0128	0.0139	<0.01
Cd (mg/l)	<0.005	<0.005	<0.005	<0.005
Cr (mg/l)	<0.01	<0.01	<0.01	<0.01
Cu (mg/l)	0.0978	0.0378	0.103	0.0346
Pb (mg/l)	0.0081	<0.005	0.0212	<0.003
Zn (mg/l)	0.262	0.129	0.68	0.596

LEGEND

- ● Itinerant Seasonal Seep
- ◎ Major Seep
- ✳ Surface water sampling locations for the 1990 RI
- Railroad Tracks
- Creek

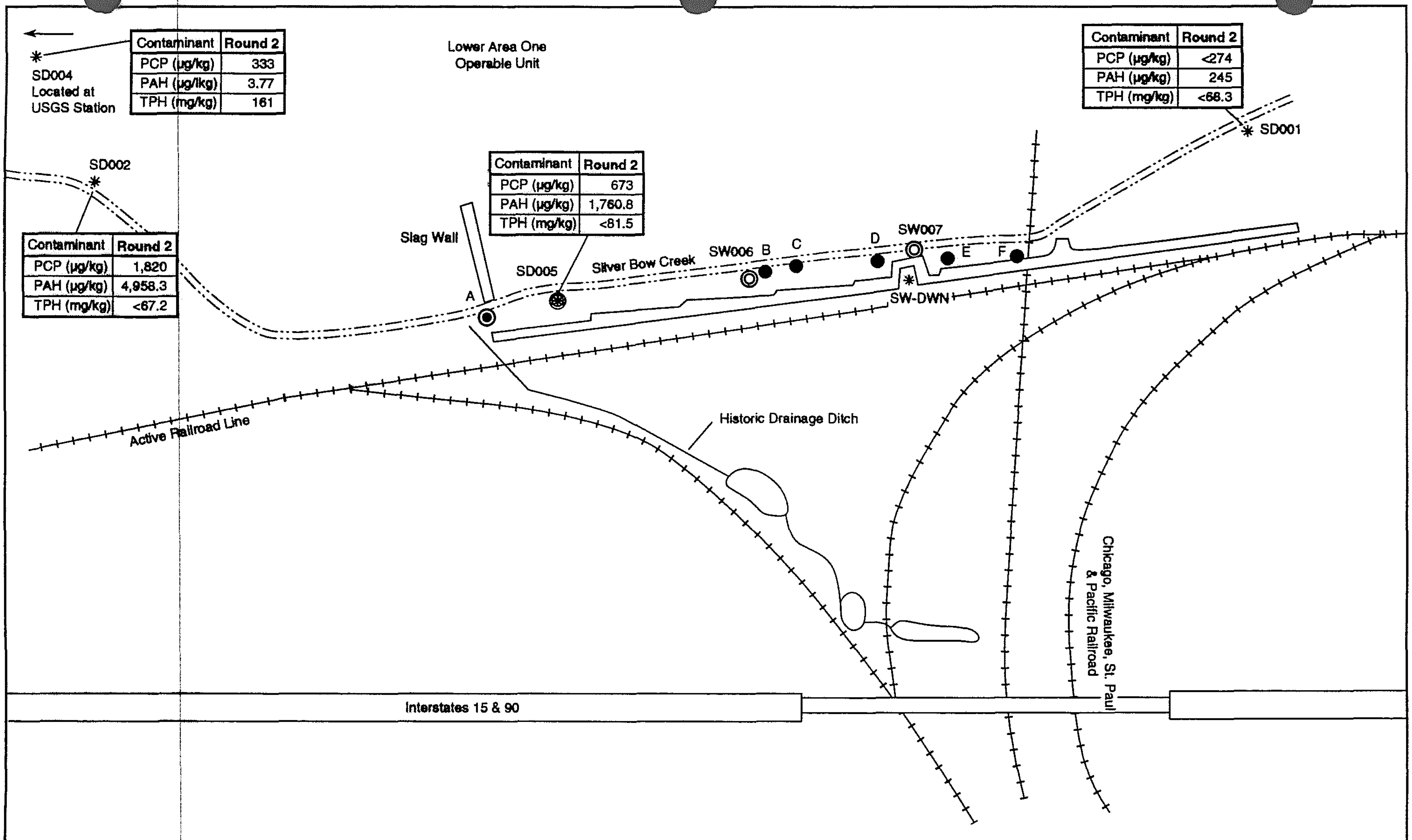
Note:
Seep observations from June through December 1990.
All sampling locations are shown on Figure 2-2.
Diss = Dissolved.

Site Features as of 1989

MONTANA POLE AND TREATING PLANT SITE
METALS CONCENTRATIONS DETECTED IN SURFACE WATER SAMPLES

FIGURE 2-18

11/93, Rev. 1



LEGEND

- Itinerant Seasonal Seep
- Major Seep
- Surface water sampling locations for the 1990 RI
- Railroad Tracks
- Creek

Note:
Seep observations from June through December 1990.
Creek sediments sampled during second round only.
All sampling locations are shown on Figure 4-2.

Site Features as of 1989

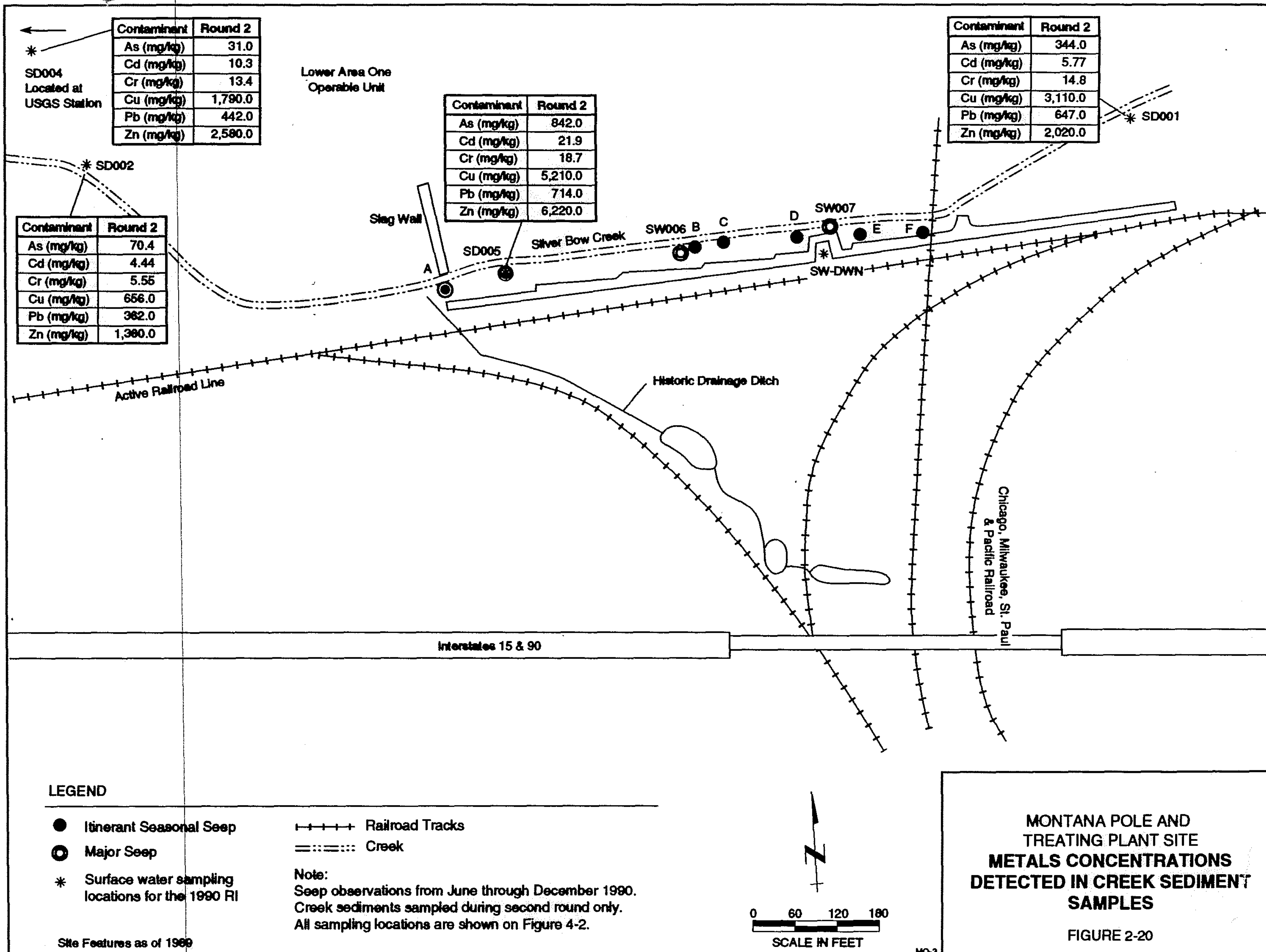
0 60 120 180
SCALE IN FEET

MO-3

MONTANA POLE AND
TREATING PLANT SITE
PCP, PAH AND TPH CONCENTRATIONS DETECTED IN CREEK SEDIMENTS

FIGURE 2-19

11/93, Rev. 1



SD004

Contaminant	Round 2
As (mg/kg)	31.0
Cd (mg/kg)	10.3
Cr (mg/kg)	13.4
Cu (mg/kg)	1,790.0
Pb (mg/kg)	442.0
Zn (mg/kg)	2,580.0

SD005

Contaminant	Round 2
As (mg/kg)	842.0
Cd (mg/kg)	21.9
Cr (mg/kg)	18.7
Cu (mg/kg)	5,210.0
Pb (mg/kg)	714.0
Zn (mg/kg)	6,220.0

SD001

Contaminant	Round 2
As (mg/kg)	344.0
Cd (mg/kg)	5.77
Cr (mg/kg)	14.8
Cu (mg/kg)	3,110.0
Pb (mg/kg)	647.0
Zn (mg/kg)	2,020.0

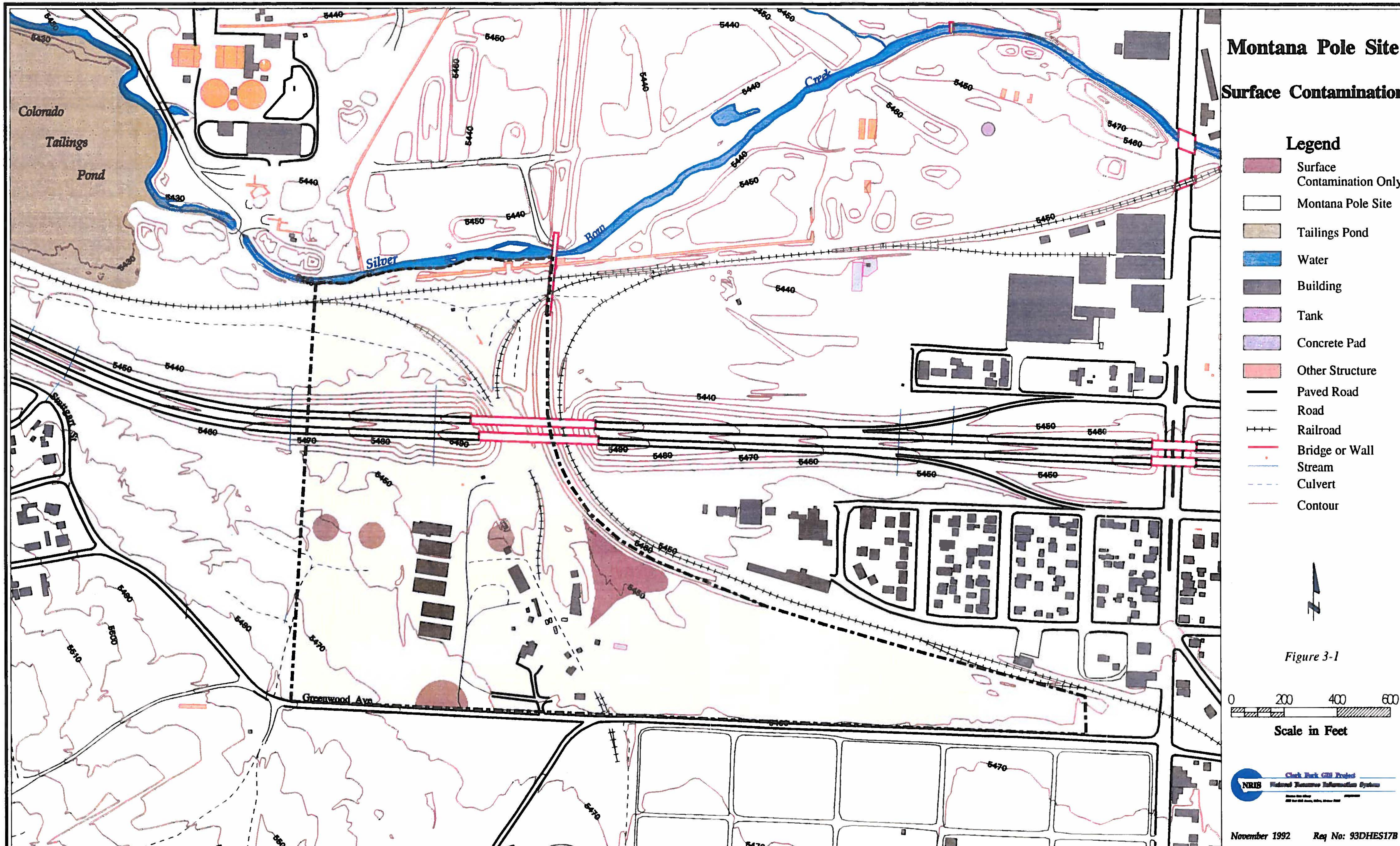
SD002

Contaminant	Round 2
As (mg/kg)	70.4
Cd (mg/kg)	4.44
Cr (mg/kg)	5.55
Cu (mg/kg)	656.0
Pb (mg/kg)	362.0
Zn (mg/kg)	1,360.0

MONTANA POLE AND TREATING PLANT SITE

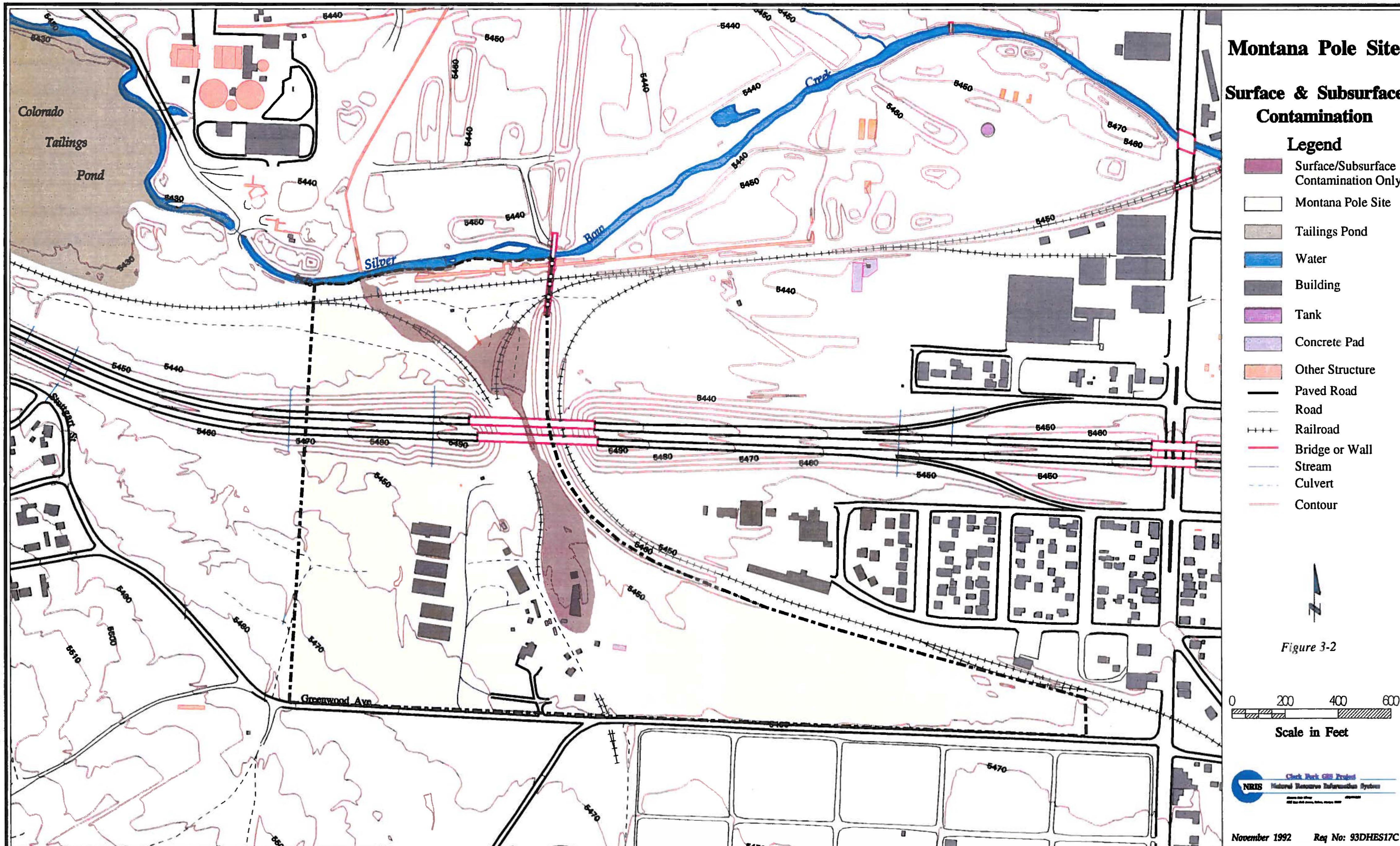
METALS CONCENTRATIONS DETECTED IN CREEK SEDIMENT SAMPLES

FIGURE 2-20

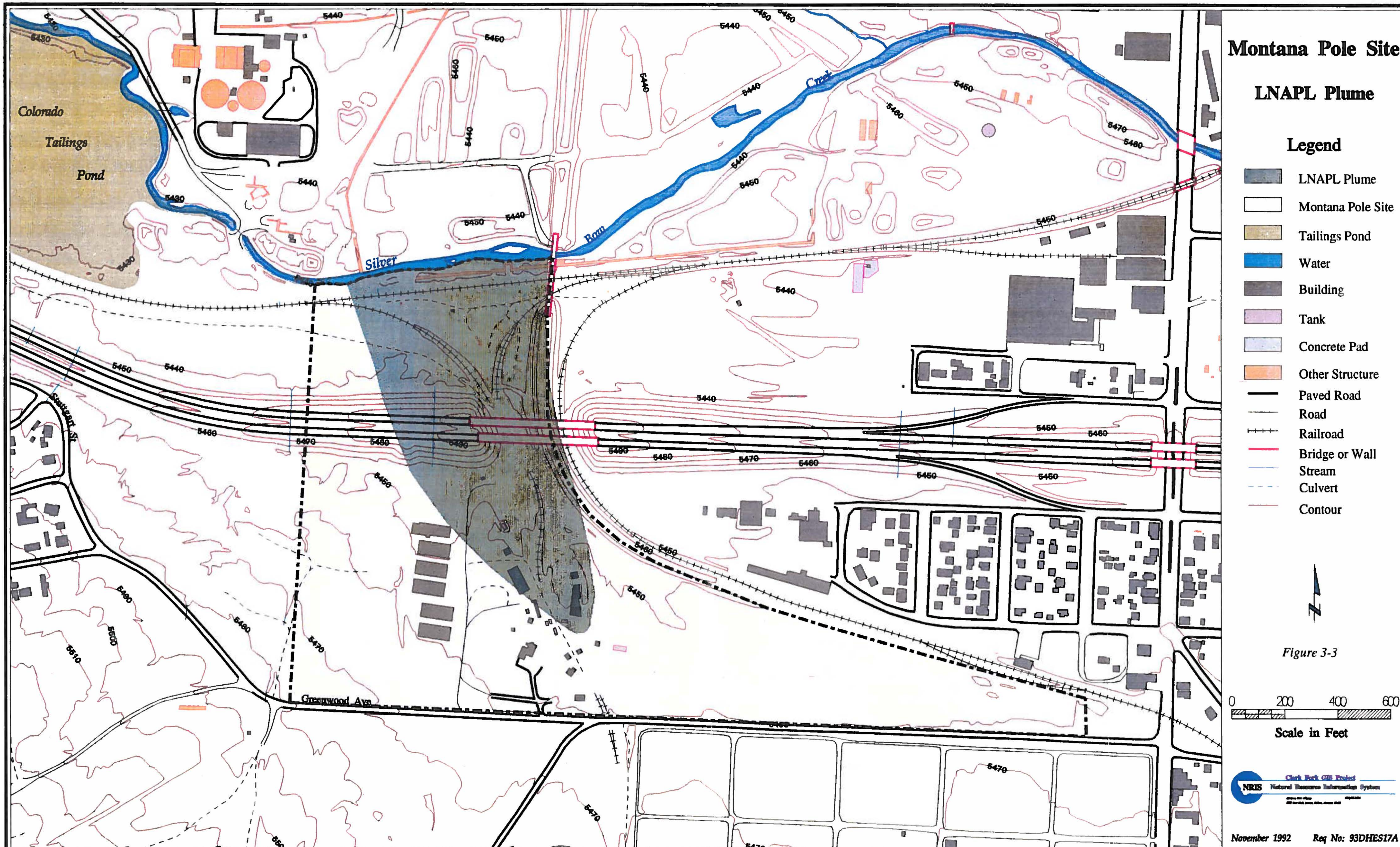


Montana Pole Site
Surface Contamination
Legend
Surface Contamination Only
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
0
200
400
600
Scale in Feet
Clark Fork GIS Project
NRIS
Natural Resource Information System
November 1992
Req No: 93DHES17B
Colorado Tailings Pond
Silver Bow Creek
Greenwood Ave
Stuttgart St.
5430
5440
5450
5460
5470
5480
5490
5500
5510

Figure 3-1

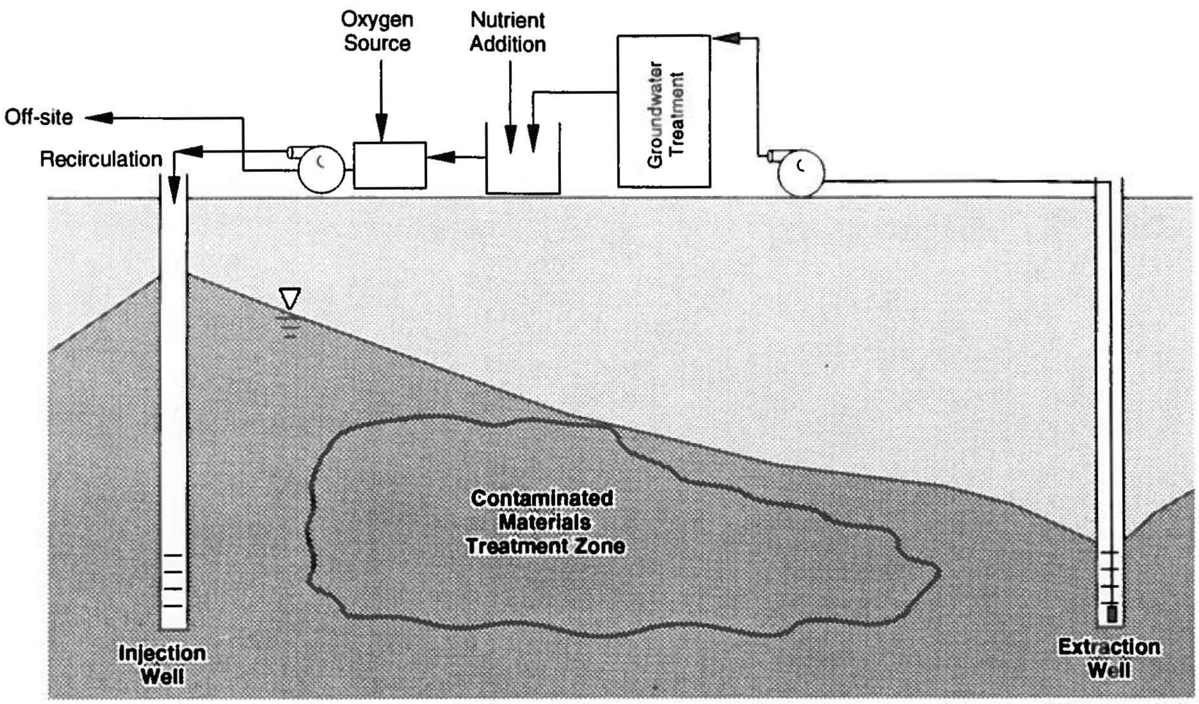


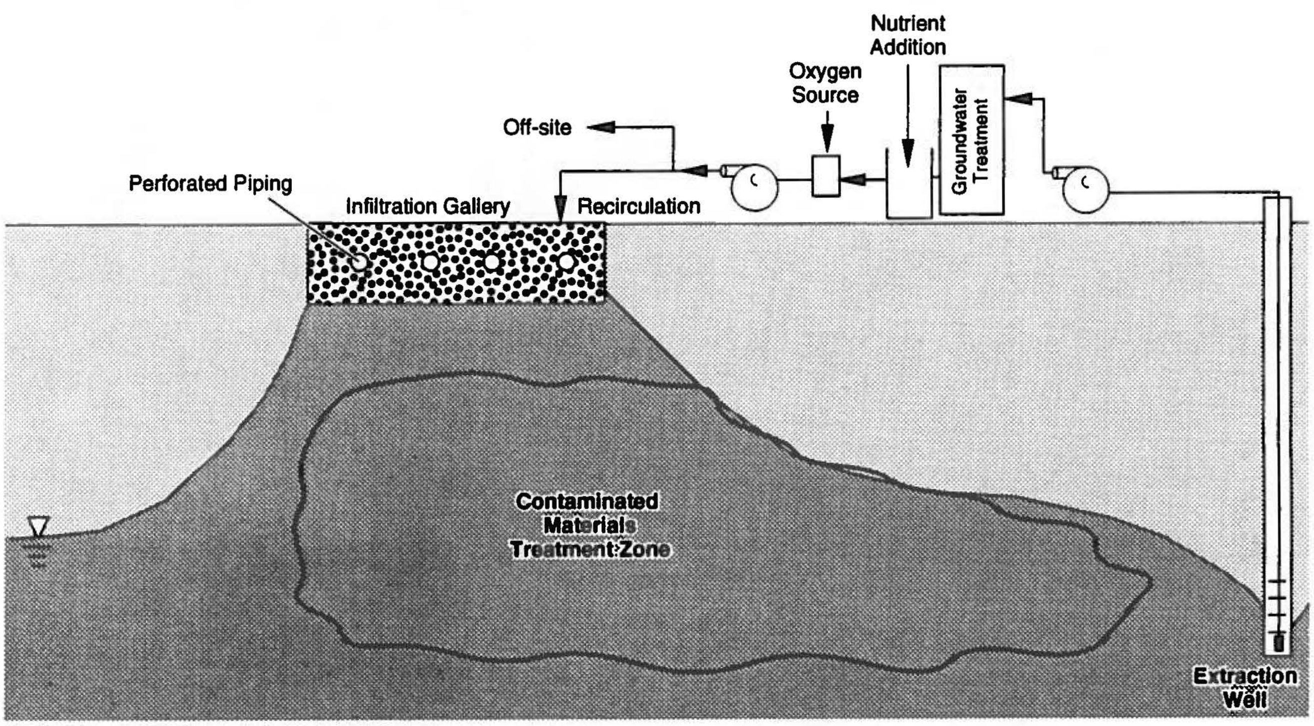
Montana Pole Site
Surface & Subsurface Contamination
Legend
Surface/Subsurface Contamination Only
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
Figure 3-2
0 200 400 600
Scale in Feet
Clark Fork GIS Project
NRIS Natural Resource Information System
November 1992
Req No: 93DHES17C
Colorado Tailings Pond
Silver Bow Creek
Greenwood Ave
Stuttgart St



Montana Pole Site
LNAPL Plume
Legend
LNAPL Plume
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
Colorado Tailings Pond
Silver Bow Creek
Greenwood Ave
0 200 400 600
Scale in Feet
NRIS Natural Resource Information System
November 1992
Req No: 93DHES17A

Figure 3-3



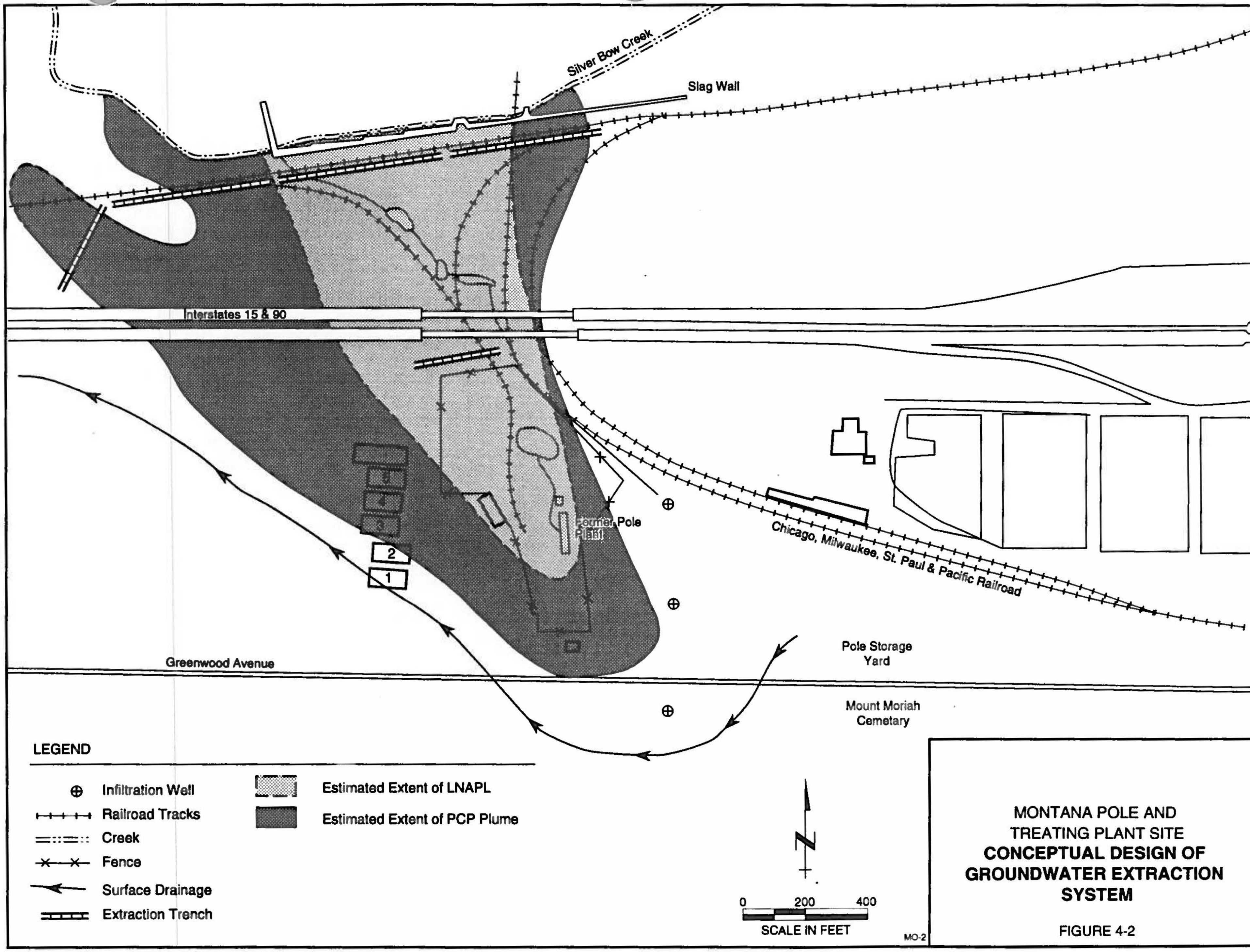


MONTANA POLE AND TREATING PLANT SITE

EXAMPLES OF IN SITU BIOREMEDIATION SYSTEMS

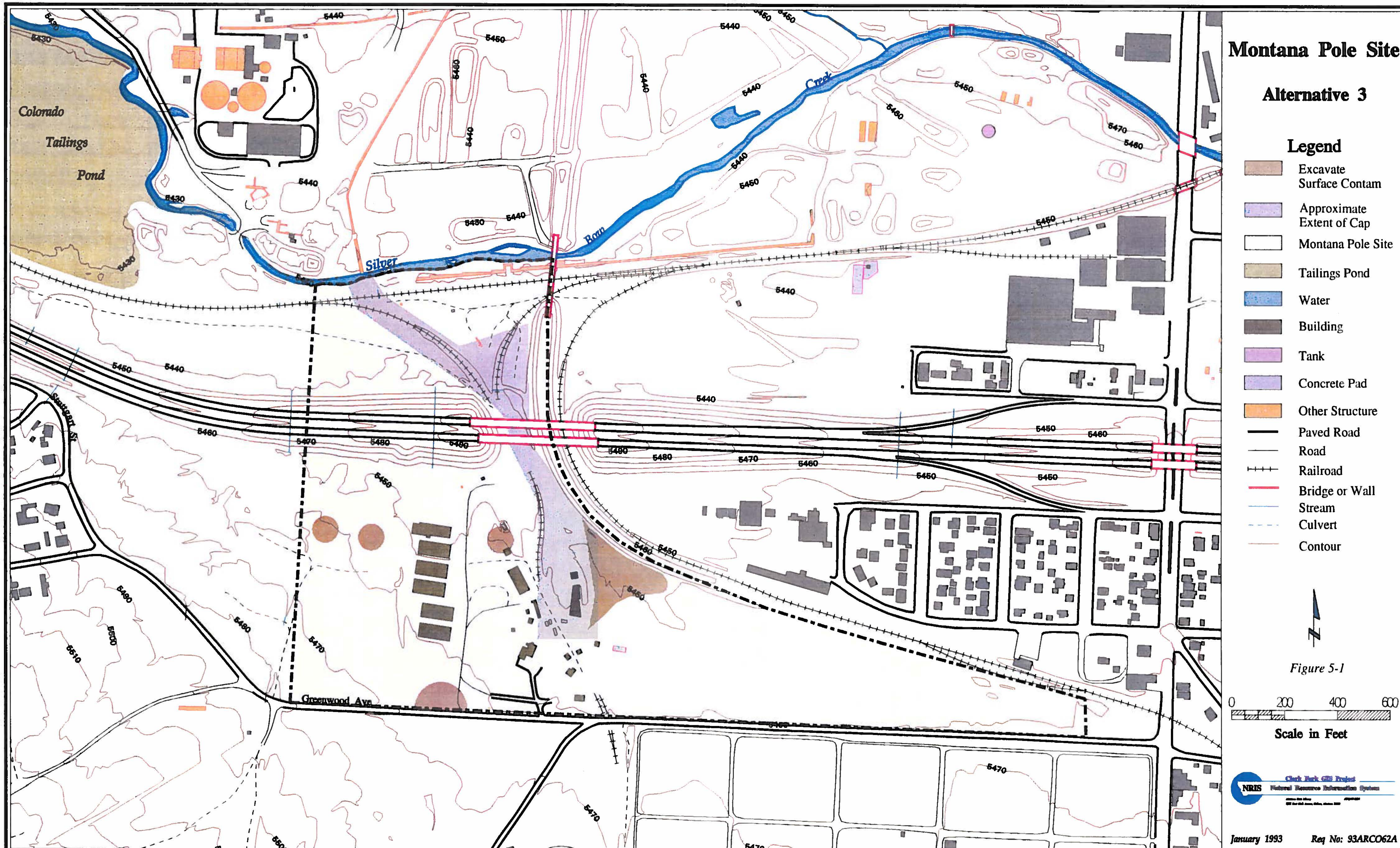
FIGURE 4-1

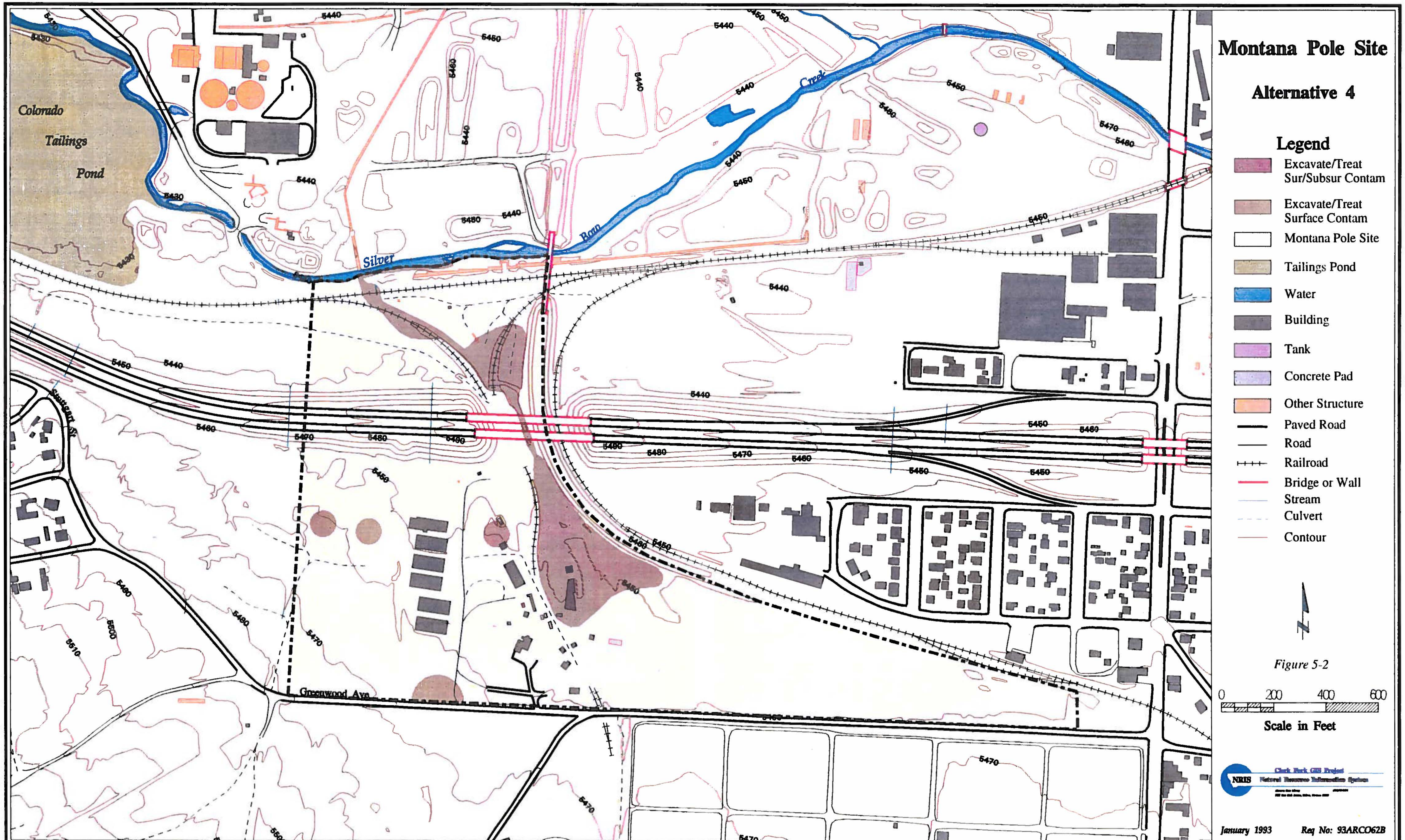
MO-2



MONTANA POLE AND TREATING PLANT SITE
CONCEPTUAL DESIGN OF GROUNDWATER EXTRACTION SYSTEM

FIGURE 4-2


Montana Pole Site
Alternative 3
Legend
Excavate Surface Contam
Approximate Extent of Cap
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
Figure 5-1
0
200
400
600
Scale in Feet
NRIS
January 1993
Req No: 93ARCO62A
Colorado
Tailings
Pond
Silver
Bow
Creek
Greenwood Ave
Stuttgart St



Montana Pole Site
Alternative 4
Legend
Excavate/Treat Sur/Subsur Contam
Excavate/Treat Surface Contam
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
Colorado Tailings Pond
Silver Bow Creek
Greenwood Ave
Stuttgart St.
Figure 5-2
0 200 400 600
Scale in Feet
NRIS
Clark Fork GIS Project
Natural Resource Information System
January 1993
Req No: 93ARCO62B

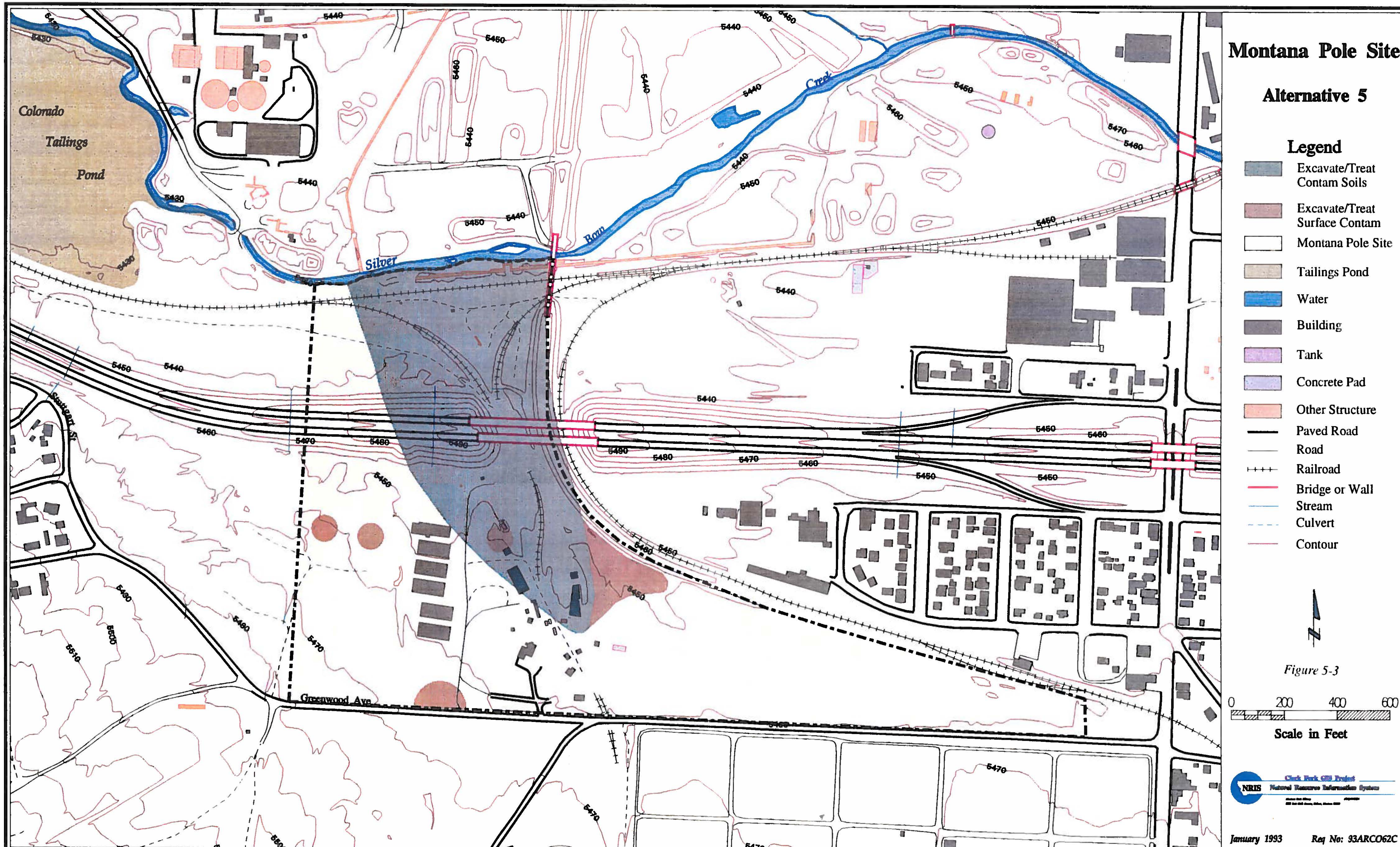

Montana Pole Site
Alternative 5
Legend
Excavate/Treat Contam Soils
Excavate/Treat Surface Contam
Montana Pole Site
Tailings Pond
Water
Building
Tank
Concrete Pad
Other Structure
Paved Road
Road
Railroad
Bridge or Wall
Stream
Culvert
Contour
Colorado Tailings Pond
Silver Bow Creek
Greenwood Ave
Stuttgart St.
0 200 400 600
Scale in Feet
Clark Fork GIS Project
NRIS Natural Resource Information System
January 1993
Req No: 93ARCO62C

Figure 5-3

TABLE 2-1

CONCENTRATION OF CONTAMINANTS IN SURFACE SOIL SAMPLES

Contaminant	Range in Concentration	Average[a] Concentration	Number of Samples
PCP (μg/kg)	5[b] - 1,510,000	102,000	89
TPH (mg/kg)	16.5[b] - 71,500	4,513	89
2,3,7,8-TCDD equivalent (μg/kg)	4.6E-07 - 8.18		12

Reference: Keystone, 1992e

a Concentrations were calculated using an arithmetic mean. These average concentrations are likely higher than the geometric mean.

b Minimum concentration is represented by one-half the detection limit.

TABLE 2-2

CONCENTRATION OF CONTAMINANTS IN SUBSURFACE SOIL SAMPLES

Contaminant	Range in Concentration	Average Concentration	Number of Samples
PCP (μg/kg)	0.0381 - 1,160,000	26,835	150
TPH (mg/kg)	0.07 - 55,600	1,612	133
PAH (μg/kg)	0 - 2,304,320	37,874	128
BTEX (μg/kg)	0.36 - 7,440	254	93
2,3,7,8-TCDD equivalent (μg/kg)	0 - 16		7

Reference: Keystone, 1992e

TABLE 2-3

CONCENTRATION OF CONTAMINANTS IN REMOVED SOILS

Contaminant	Range in Concentration
PCP (μg/kg)	116,000 - 1,450,000
PAH (μg/kg)	16,600 - 441,600
TPH (mg/kg)	ND - 23,600
VOC (μg/kg)	ND
Chlorobenzene (μg/kg)	ND - 2.2
2,3,7,8-TCDD equivalent (μg/kg)	2.12 - 9.77
Metals Total	
As	ND
Cu (mg/kg)	ND - 183
Cd (mg/kg)	0.644 - 0.742
Pb	ND
Zn (mg/kg)	ND - 194
TCLP Extract for Metals	
As (μg/l)	112 - 118
Ba (μg/l)	1,080 - 1,560
Cd (μg/l)	11.7 - 12.5

Reference: Keystone, 1992e

TABLE 2-4

CONCENTRATION OF CONTAMINANTS IN GROUNDWATER SAMPLES

Contaminant	Range in Concentration	Average[a] Concentration	Number of Samples
PCP (μg/l)	0.5[d] - 880,000[a]	3,830[b]	87
TPH (mg/l)	.01[d] - 5,080	210	87
PAH (μg/l)	.02 - 3,668,691	51,770	88
BTEX (μg/l)	.39 - 1,300	40	74
As (μg/l)[c]	.2[d] - 1,570	40	84
Cd (μg/l)[c]	2.5[d] - 232	20	74
Cu (μg/l)[c]	12.5[d] - 34,600	1,470	77
Zn (μg/l)[c]	10[d] - 75,200	5,340	76
2,3,7,8-TCDD equivalent (μg/l)	0.001 - 0.0537		5

Reference: Keystone, 1992e

[a] Average concentrations were calculated using an arithmetic mean. These average concentrations are likely higher than the geometric mean.

[b] Average concentration does not include maximum PCP concentration measured in groundwater samples because it is not representative of the dissolved concentrations.

[c] Metal concentrations represent dissolved metals.

[d] Minimum concentration is represented by one-half the detection limit.

TABLE 2-5

CONCENTRATION OF CONTAMINANTS IN SURFACE WATER

Contaminant	Range in Concentration	Average Concentration	Number of Samples
PCP (μg/l)	0.5[a] - 591	75	12
TPH (mg/l)	.05[a] - 2.17	0.11	12
PAH (μg/l)	0.3 - 49.53	9	12
As (mg/l)	0.0129 - 0.0252	0.018	10
Cd (mg/l)	0.0025[a] - 0.0025	0.0025	10
Cr (mg/l)	0.0050[a] - 0.0050	0.005	10
Cu (mg/l)	0.0936 - 0.220	0.156	10
Pb (mg/l)	0.0025[a] - 0.0303	0.011	10
Zn (mg/l)	0.262 - 1.120	0.614	11

Reference: Keystone, 1992e

[a] Minimum concentration is represented by one-half the detection limit.

TABLE 2-6

CONCENTRATION OF CONTAMINANTS IN CREEK SEDIMENTS SAMPLES

Contaminant	Range in Concentration	Average Concentration	Number of Samples
PCP (μg/kg)	137[a] - 1,820	741	4
PAH (μg/kg)	3.77 - 4,958.3	1,742	4
TPH (mg/kg)	33.6[a] - 161	65	4
As (mg/kg)	31 - 842	321.85	4
Cd (mg/kg)	4.44 - 21.9	10.603	4
Cr (mg/kg)	5.55 - 18.7	13.113	4
Cu (mg/kg)	656 - 5,210	2,691.5	4
Pb (mg/kg)	362 - 714	541.25	4
Zn (mg/kg)	1,360 - 6,220	3,045	4
2,3,7,8-TCDD equivalent (μg/kg)	0.00303 - 0.019		2

Reference: Keystone, 1992e

[a] Minimum concentration is represented by one-half the detection limit.

TABLE 2-7

ESTIMATED VOLUMES OF OILS AND SLUDGES STORED ON SITE

Type	Volume (gals)
Recovered Separator Oil	6,300
KPEG Treated Oil	9,000
KPEG Reagent Sludge	2,200
Miscellaneous Sludge	610
Miscellaneous Liquid	>350
Miscellaneous Liquid with Sludge	940

Reference: Keystone, 1992e

TABLE 2-8

CONCENTRATIONS OF CONTAMINANTS IN MISCELLANEOUS OILS AND SLUDGES
(Page 1 of 2)

Chemical	Separator Oil Recovered (mg/l)	KPEG Treated Oils (mg/l)	KPEG Reagent Sludge (mg/kg)	Misc. Sludge (mg/kg)	Misc. Liquid (mg/l)	Misc. Liquid with Sludge: Oil Phase (mg/l)	Misc. Liquid with Sludge: Sludge Phase (mg/kg)
PCP	1.9 - 2.7	BDL	BDL	7,500	BDL - 160	8.8 - 11	6,500 - 17,000
PAHs	5.7 - 5.9	1.2 - 6.7	2,046 - 14,180	2,350	246.8 - 748	2.8 - 6.2	3,520 - 13,380
VOCs	57.0 - 304.0	34.3 - 43.5	60,000 - 253,000	27,000	42.1 - 321.8	105.2 - 390	BDL - 86
TCL and TCLP Pesticides							
Aldrin	0.001 - 0.0013[a]	0.0034 - 0.0094[a]	BDL	BDL	BDL	0.002 - 0.024[a]	29
4,4-DDT	0.0024 - 0.0031[a]	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	0.3	0.027	NA	NA	NA	NA	NA
Heptachlor epoxy	0.3	0.002	NA	NA	NA	NA	NA
Methoxychlor	NA	0.007	NA	NA	NA	NA	NA
TCLP Herbicide 2,4-TP	0.0098 - 6.5	NA	NA	NA	NA	0.00015	NA
2,3,7,8-TCDD (equiv.)	0.002 - 0.004	0.00	NA	0.195 - 0.206	0.0003 - 0.280	0 - 0.00311	NA
TCLP Metals							
Arsenic	BDL	BDL	NS	BDL	NS	BDL	BDL
Barium	<0.2	BDL	NS	310	NS	BDL	BDL
Cadmium	BDL	BDL	NS	BDL	NS	BDL	BDL
Chromium	BDL	BDL	NS	11.5	NS	1.63	BDL
Lead	BDL	BDL	NS	BDL	NS	BDL	BDL
Mercury	BDL	BDL	NS	BDL	NS	BDL	BDL
Silver	BDL	BDL	NS	BDL	NS	BDL	BDL

TABLE 2-8

CONCENTRATIONS OF CONTAMINANTS IN MISCELLANEOUS OILS AND SLUDGES
(Page 2 of 2)

Chemical	Separator Oil Recovered (mg/l)	KPEG Treated Oils (mg/l)	KPEG Reagent Sludge (mg/kg)	Misc. Sludge (mg/kg)	Misc. Liquid (mg/l)	Misc. Liquid with Sludge: Oil Phase (mg/l)	Misc. Liquid with Sludge: Sludge Phase (mg/kg)
TCLP Semivolatile Organic Compounds							
2,4,6-trichlorophenol	0.497 - 128	BDL	NS	0.964	NS	BDL	BDL
Pentachlorophenol	BDL - 4.92	BDL	NS	14.3	NS	BDL	BDL
Non-TCLP Metals[a]							
Cadmium	BDL	0.014	NS	NA	NS	BDL	BDL
Chromium	- - - - - - - - - - - - - - - Ranged from BDL (6 to 10 mg/kg) - 720 - - - - - - - - - - - - - - -						
Copper	BDL	BDL	NS	290	NS	NA	NA
Lead	1.2	1.2	NS	NA	NS	BDL	NA
Zinc	NA	NA	NS	NA	250	NA	NA
Corrosivity	corrosive	corrosive	NS	non-corrosive	NS	non-corrosive	non-corrosive

[a] Reported as mg/kg in draft RI (Keystone, 1992e)

BDL below detection limit
PAH polycyclic aromatic compounds
VOC volatile organic compounds
PCP pentachlorophenol
NA Information not available
NS Not Sampled

TABLE 2-9

SELECTED CHEMICAL-SPECIFIC ARARs
AND TBCs FOR GROUNDWATER

Chemical	MCLG (mg/l) ARAR	MCL (mg/l) ARAR	Proposed MCL (mg/l) TBC
Inorganics			
Arsenic	N/A	.05[a]	
Cadmium	.005[b]	.005[c]	-
Chromium	.1[d]	.1[e]	
Copper	1.3[f]	1.3[g]	
Lead	N/A[h]	.015[i]	
Organics[j]			
Benzene	N/A[k]	0.005	
Benzo(a)pyrene			0.0002
Benz(a)anthracene			0.0001
Benzo(b)fluoranthene			0.0002
Benzo(k)fluoranthene			0.0002
Chrysene			0.0002
Dibenz(a,h)anthracene			0.0003
Dichlorobenzene (para)	0.075	0.075	
Dichlorobenzene (ortho)	0.6	0.6	
Ethylbenzene	0.7	0.7	
Indeno(1,2,3-CD)pyrene			0.0004
Monochlorobenzene	0.1	0.1	
Pentachlorophenol	N/A[k]	0.001	
Toluene	1	1	
Xylenes (total)	10	10	
2,3,7,8-TCDD (dioxin)			5.0×10^{-8}

[a] 40 CFR § 141.11 (1991). See also ARM 16.20.203.

[b] This MCLG for cadmium will be effective July 30, 1992. See 56 Fed. Reg. 3593 (January 30, 1991).

[c] 40 CFR § 141.51. See 56 Fed. Reg. 3593 (January 30, 1991). The current state MCL is 0.010 mg/l. See ARM 16.20.203.

[d] The chromium MCLG will become effective July 30, 1992. See 40 CFR § 141.51.

[e] This chromium MCL will become effective July 30, 1992. See 40 CFR § 141.62. Until that date the MCL is effectively 0.05 mg/l. See 40 CFR § 141.11.

[f] This level is established as an MCLG for copper through July 30, 1992. See 40 CFR § 141.51.

[g] Effective November 9, 1992, this level will become effective as an "action level" similar to the lead level described in the footnote discussing the lead MCL. See 40 CFR Subpart I.

[h] Lead is among the acutely toxic substances for which the MCLG is zero. However, the zero MCLGs are not generally considered "appropriate" requirements for CERCLA cleanups, primarily for reasons of practicability. See 40 CFR § 300.430(e)(2)(i)(C); see also Preamble to the Final NCP, 55 Fed. Reg. 8750-8753 (March 8, 1990).

[i] The level specified is not an MCL, but rather an "action level." The standard is normally measured at the taps of users of the water to account for additional lead contamination resulting from corrosion in the water supply lines. See 40 CFR Subpart I (40 CFR § § 141.80-141.91). The action level will become effective November 9, 1992 [40 CFR § 141.80(a)(2)]. Until December 7, 1992, an MCL for lead is specified at 0.05 mg/l (40 CFR § 141.11).

[j] See 40 CFR § 141.50 for the MCLGs specified, and 40 CFR § 141.61, for the MCLs specified.

[k] The MCLG for benzene and pentachlorophenol are zero. See 40 CFR § 141.50.

TABLE 2-10

SELECTED CHEMICAL-SPECIFIC ARARs FOR SURFACE WATER

Discharge Limitations	Total Recoverable Concentrations, μg/L				
	Arsenic	Cadmium	Copper	Lead	Zinc
January					
Monthly Average	50[a]	1.6[b]	123.5[d]	5.6[b]	431[d]
Daily Maximum	50[a]	6.4[c]	185[e]	142[c]	647[e]
February					
Monthly Average	50[a]	1.6[b]	98[d]	5.6[b]	416[d]
Daily Maximum	50[a]	6.4[c]	147[e]	142[c]	624[e]
March					
Monthly Average	50[a]	1.6[b]	131.5[d]	5.6[b]	448.5[d]
Daily Maximum	50[a]	6.4[c]	197[e]	142[c]	673[e]
April					
Monthly Average	50[a]	1.6[b]	129[d]	5.6[b]	444[d]
Daily Maximum	50[a]	6.4[c]	194[e]	142[c]	666[e]
May					
Monthly Average	50[a]	1.6[b]	115[d]	5.6[b]	443.5[d]
Daily Maximum	50[a]	6.4[c]	173[e]	142[c]	650[e]
June					
Monthly Average	50[a]	1.6[b]	112[d]	5.6[b]	482[d]
Daily Maximum	50[a]	6.4[c]	168[e]	142[c]	723[e]
July					
Monthly Average	50[a]	1.6[b]	117.5[d]	5.6[b]	492.5[d]
Daily Maximum	50[a]	6.4[c]	176[e]	142[c]	739[e]
August					
Monthly Average	50[a]	1.6[b]	95[d]	5.6[b]	476.5[d]
Daily Maximum	50[a]	6.4[c]	143[e]	142[c]	7155
September					
Monthly Average	50[a]	2.9[b]	150[f]	11.8[b]	750[f]
Daily Maximum	50[a]	6.4[c]	225[e]	142[c]	1125[e]
October					
Monthly Average	50[a]	1.6[b]	98.5[d]	5.6[b]	445[d]
Daily Maximum	50[a]	6.4[c]	148[e]	142[c]	668[e]
November					
Monthly Average	50[a]	1.65[b]	131.5[d]	7.25[b]	465[d]
Daily Maximum	50[a]	6.4[c]	197[e]	142[c]	698[e]
December					
Monthly Average	50[a]	1.6[b]	130[d]	7.5[b]	442[d]
Daily Maximum	50[a]	6.4[c]	195[d]	142[c]	663[e]

Reference: Memorandum to James J. Scherer, Regional Administrator, from Steven D. Hawthorne, Emergency Response Branch, USEPA Region VIII; 8HWM-ER; dated July 21, 1992.

a Primary Drinking Water Standard (Safe Drinking Water Act). This limitation may be adjusted based on treatability study results.
b Chronic Water Quality Criteria
c Acute Water Quality Criteria
d On-half Monthly Mean
e 150 percent of the Monthly Average Discharge Limitation
f Effluent Limitation (40 CFR 440.102)

Note: MCLs are considered applicable by DHES for organic compounds.

TABLE 2-11

COCs FOR HUMAN HEALTH AT THE MONTANA POLE SITE

Groundwater	Soil
Arsenic	Arsenic
Chromium VI	4-chloro-3-methylphenol
Copper	Dioxins/Furans
Lead	2-methyl-4,6-dinitrophenol
Manganese	Anthracene
2-chlorophenol	Benzo(a)anthracene
4-chloro-3-methylphenol	Benzo(a)pyrene
2,4-dichlorophenol	Benzo(a)fluoranthene
2,4-dinitrophenol	Benzo(k)fluoranthene
2,4-dinitrotoluene	Indeno(1,2,3-cd)pyrene
Dioxins/Furans	Pentachlorophenol
2-methyl-4,6-dinitrophenol	2,4,6-trichlorophenol
Acenaphthene	
Anthracene	**Surface Water**
Benzo(a)anthracene	
Benzo(a)pyrene	Arsenic
Benzo(b)fluoranthene	Copper
Benzo(g,h,i)perylene	Lead
Benzo(k)fluoranthene	Benzo(a)anthracene
Chrysene	Benzo(a)pyrene
Dibenzo(a,h)anthracene	Benzo(b)fluoranthene
Fluoranthene	Chrysene
Fluorene	Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene	Pyrene
2-methyl naphthalene	Pentachlorophenol
Naphthalene	Zinc
Phenanthrene	
Pyrene	**Sediments**
Pentachlorophenol	
2,3,5,6-tetrachlorophenol	Arsenic
2,4,6-trichlorophenol	Dioxins/Furans
	Lead

Reference: CDM, 1993

TABLE 2-12

SUMMARY OF ESTIMATED TOTAL RISKS FOR
CURRENT ON-SITE TRESPASSERS

Chemical	Soil Ingestion	Dermal Contact with Soil	Sediment Ingestion	Surface Water Ingestion	Dermal Contact with Surface Water
Carcinogenic Exposure		**Incremental Lifetime Cancer Risk**			
Pentachlorophenol	1.25E-06	9.40E-06	NA	3.33E-06	3.65E-07
Dioxins/Furans (TEFs)	6.44E-07	4.82E-07	2.47E-09	NA	NA
2,4,6-Trichlorophenol	5.38E-10	4.03E-09	NA	NA	NA
Benzo(a)Pyrene (TEFs)	7.27E-09	NA	NA	4.35E-07	NA
Arsenic	1.88E-06	1.76E-06	NA	NA	NA
Total Cancer Risk	3.78E-06	1.16E-05	2.47E-09	3.77E-06	3.65E-07
		Total Cancer Risk for all Media			1.96E-05
Noncarcinogenic Exposure		**Hazard Index**			
Pentachlorophenol	2.03E-03	1.52E-02	NA	5.40E-03	5.90E-04
Dioxins/Furans (TEFs)	2.50E-02	1.88E-02	9.59E-05	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA
2-methyl-4,6-dinitrophenol	NA	NA	NA	NA	NA
Anthracene	3.25E-08	NA	NA	NA	NA
Arsenic	2.09E-02	1.96E-02	NA	NA	NA
Cadmium	3.02E-04	2.26E-04	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	1.24E-05	NA
Total Hazard Index	4.82E-02	5.38E-02	9.59E-05	5.41E-03	5.90E-04
		Total Hazard Index for all Media			1.08E-01

Reference: CDM, 1993
NA = Not Applicable

TABLE 2-13

SUMMARY OF ESTIMATED TOTAL RISKS FOR FUTURE ON-SITE WORKERS

Chemical	Soil Ingestion	Dermal Contact with Soil	Sediment Ingestion	Surface Water Ingestion	Dermal Contact with Surface Water
Carcinogenic Exposure		**Incremental Lifetime Cancer Risk**			
Pentachlorophenol	8.03E-06	3.63E-05	NA	NA	NA
Dioxins/Furans (TEFs)	4.12E-06	1.86E-06	NA	NA	NA
2,4,6-Trichlorophenol	3.44E-09	1.56E-08	NA	NA	NA
Benzo(a)pyrene (TEFs)	4.65E-08	NA	NA	NA	NA
Arsenic	1.20E-05	6.80E-06	NA	NA	NA
Total Cancer Risk	2.42E-05	4.50E-05	0.00E+00	0.00E+00	0.00E+00
		Total Cancer Risk for all Media			6.92E-05
Noncarcinogenic Exposure			**Hazard Index**		
Pentachlorophenol	6.24E-03	2.82E-02	NA	NA	NA
Dioxins/Furans (TEFs)	7.69E-02	3.48E-02	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA
2-methyl-4,6-dinitrophenol	NA	NA	NA	NA	NA
Anthracene	9.99E-08	NA	NA	NA	NA
Arsenic	6.42E-02	3.63E-02	NA	NA	NA
Cadmium	9.72E-04	4.19E-04	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA
Total Hazard Index	1.48E-01	9.97E-02	0.00E+00	0.00E+00	0.00E+00
		Total Hazard Index for all Media			2.48E-01

Reference: CDM, 1993
NA = Not Applicable

TABLE 2-14

SUMMARY OF ESTIMATED TOTAL RISKS FOR FUTURE ON-SITE RESIDENTS FOR THE SOUTHERN AREA

Chemical	Soil Ingestion	Dermal Contact with Soil	Ingestion of Home-Grown Vegetables	Groundwater Ingestion
Carcinogenic Exposure				
Pentachlorophenol	2.23E-05	9.41E-05	8.92E-04	1.09E-02
Dioxins/Furans (TEFs)	1.15E-05	4.83E-06	1.08E-04	1.10E-01
2,4,6-Trichlorophenol	9.57E-09	4.03E-08	2.10E-05	3.55E-05
Benzo(a)pyrene (TEFs)	1.29E-07		4.63E-06	3.09E-02
Arsenic	3.35E-05	1.76E-05	4.64E-04	5.64E-04
Total Cancer Risk	6.74E-05	1.17E-04	1.49E-03	1.53E-01
Noncarcinogenic Exposure				
Pentachlorophenol	6.01E-02	2.28E-01	5.39E+01	2.19E+01
Dioxins/Furans (TEFs)	7.40E-01	2.81E-01	5.21E+00	5.33E+03
2,4,6-Trichlorophenol	NA	NA	NA	NA
PAH (Total noncarcinogen)	NA	NA	NA	7.54E+02
2-chlorophenol	NA	NA	NA	8.17E-01
Arsenic	6.18E-01	2.93E-01	6.40E+00	7.86E+00
Copper	NA	NA	NA	3.52E-01
Manganese	NA	NA	NA	2.52E+00
Lead	NA	NA	NA	NA
Chromium	NA	NA	NA	5.73E-01
2,4-Dichlorophenol	NA	NA	NA	3.31E+01
2,4-Dinitrotoluene	NA	NA	NA	3.27E-02
4-Chloro-3-methylphenol	NA	NA	NA	NA
Anthracene	9.62E-07	NA	2.66E-05	NA
Cadmium	8.92E-03	3.39E-03	1.41E+00	NA
2-methyl-4,6-dinitrophenol	NA	NA	NA	NA
2,3,5,6-Tetrachlorophenol	NA	NA	NA	1.04E+01
Total Hazard Index	1.43E+00	8.05E-01	6.69E+01	6.16E+03

Reference: CDM, 1993
NA = Not Applicable

TABLE 3-1

PRELIMINARY REMEDIAL ACTION GOALS FOR SOILS AT THE MONTANA POLE SITE (concentrations in mg/kg)

Chemical	Residential Land Use	Industrial Land Use	Trespasser or Recreational Land Use
Pentachlorophenol[a]	3	9	34
Dioxins/Furans[b]	0.00001	0.00003	0.0002
PAH (Carcinogenic)[bc]	0.2	0.7	4.0

[a] Levels correspond to an excess cancer risk of 1×10^{-6} and are based on data for the dermal exposure pathway as presented in the Baseline Risk Assessment report (CDM, 1993).

[b] Levels correspond to an excess cancer risk of 1×10^{-4} and are based on data for the soil ingestion exposure pathway as presented in the Baseline Risk Assessment report (CDM, 1993).

[c] Levels are based on benzo(a)pyrene equivalents using the toxicity equivalency factors (TEFs) as described in the Baseline Risk Assessment report (CDM, 1993).

TABLE 3-2

CONCENTRATION OF CONTAMINANTS OF CONCERN CORRESPONDING TO 10^{-4}, 10^{-5}, AND 10^{-6} EXCESS CANCER RISK

	Residential Land Use			Industrial Land Use			Trespasser or Recreational Land Use		
Chemical	**10^{-4}**	**10^{-5}**	**10^{-6}**	**10^{-4}**	**10^{-5}**	**10^{-6}**	**10^{-4}**	**10^{-5}**	**10^{-6}**
Pentachlorophenol	300	30	3	900	90	9	3,400	340	34
Dioxins/Furans	0.001	0.0001	0.00001	0.003	0.0003	0.00003	0.02	0.002	0.0002
PAH (Carcinogenic)	20	2.0	0.2	70	7.0	0.7	400	40	4.0

TABLE 3-3

PRELIMINARY REMEDIAL ACTION GOALS FOR GROUNDWATER AT THE MONTANA POLE SITE
(concentrations in $\mu g/l$)

Chemical	MCL	Risk Based
Pentachlorophenol	1.0	0.6[a]
Dioxins/Furans	0.00005[b]	0.0000005[a]
PAH (Carcinogenic)	0.2[c]	0.01[a]
PAH (Total noncarcinogenic)	NA[d]	400[e]
Arsenic	50	0.04[a]
Chromium	100	50
Copper	1,300[f]	400
Manganese	NA[g]	1,000
Lead	15[f]	NA[h]

a Level corresponds to an excess cancer risk of $1x10^{-6}$ and is based on data for the ingestion exposure pathway as presented in the Baseline Risk Assessment report (CDM, 1993).

b Proposed MCL for 2,3,7,8-TCDD.

c Level is based on MCL proposed for benzo(a)pyrene.

d Not available. No MCLs are promulgated for these compounds.

e Level corresponds to a hazard index of 1 and is based on data for the ingestion exposure pathway as presented in the Baseline Risk Assessment report (CDM, 1993).

f Level is based on Action Level (USEPA, 1991).

g Not available. No MCL promulgated for manganese.

h Not available.

TABLE 3-4

PRELIMINARY REMEDIAL ACTION GOALS FOR DISCHARGES TO SURFACE WATER AT THE MONTANA POLE SITE
(concentrations in $\mu g/l$)

Chemical	Human Health Based Criteria	Aquatic Criteria[a] Acute Chronic
Pentachlorophenol	1.0[b]	13-20
Dioxins/Furans	0.00005[c]	0.00001 - 0.01
PAH (Carcinogenic)	0.2[d]	NA[e]
PAH (Total noncarcinogenic)	20[f]	620 - 2,300[g]
Arsenic	50[b]	48 - 850
Cadmium	5[b]	1.1 - 3.9
Chromium	100[b]	11 - 16
Copper	1,300[h]	12 - 18
Lead	15[h]	3.2 - 82
Zinc	NA[i]	110 - 120

a Levels may be hardness dependent and are based on Ambient Water Quality (Gold Book) Criteria for chronic and acute toxicity to freshwater aquatic life. Levels for toxic and deleterious substances in new discharges to I class waters the larger of either Gold Book levels or one-half the mean in stream concentration immediately upstream of the discharge point.
b Final MCL.
c Proposed MCL for 2,3,7,8-TCDD.
d Level is based on benzo(a)pyrene proposed MCL.
e Not available. No aquatic criteria specified for these compounds.
f Level is based on Lifetime Health Advisory (USEPA, 1991).
g Level is based on aquatic criteria for Naphthalene.
h Level is based on Action Level (USEPA, 1991).
i Not available. No MCL specified for zinc.

TABLE 3-5

VOLUME ESTIMATES OF CONTAMINATED SOILS AT THE MONTANA POLE AND TREATING PLANT SITE

Soils	Volume, yd^3
1. Bagged Soils[a]	10,000
2. Near Creek Soils[b]	6,000
3. Soils excavated for groundwater extraction system	7,000
4. Contaminated Surface soils[c]	10,000
5. Contaminated Surface and Subsurface soils[d]	82,000
6. Accessible LNAPL "smear zone" soils[e]	93,000
7. Soils overlying accessible LNAPL "smear zone" soils[f]	
Northern portion of site	28,000
Southern portion of site	66,000
8. Inaccessible contaminated soils[g]	41,000

[a] Soils previously excavated and stored on-site.

[b] Near-creek soils are those soils north of the Gundwall constructed during the latest USEPA removal action at MPTP site and covers an area of about 750 feet long by 50 feet wide.

[c] Areas marked on Figure 3-1 from surface to 3 feet below ground surface.

[d] Areas marked on Figure 3-2 where contamination is continuous from 3 feet below ground surface to 4 feet below groundwater surface.

[e] Areas marked on Figure 3-3 where contaminated soils are associated with the LNAPL plume. Volume includes soils from 2 feet above groundwater surface to 4 feet below groundwater surface. Volume excludes the area accounted by surface/subsurface soils in #3 above and soils beneath the highway.

[f] Areas of uncontaminated soils which overlie accessible LNAPL "smear zone" soils shown on Figure 3-3.

[g] Inaccessible soils beneath the interstate highway include approximately 37,000 yd^3 associated with the LNAPL "smear zone" as shown on Figure 3-3 and approximately 4,000 yd^3 of surface and subsurface soils shown in Figure 3-2.

TABLE 3-6

GENERAL RESPONSE ACTIONS

Media	General Response Action
Soil	Institutional Controls Containment Removal Ex Situ Treatment In Situ Treatment Disposal
Groundwater	Institutional Controls Containment Extraction Ex Situ Treatment In Situ Treatment Disposal
Equipment	Removal Treatment Disposal
Oils and Sludges	Containment Treatment Disposal

TABLE 4-1

EVALUATION OF POTENTIALLY APPLICABLE INSTITUTIONAL CONTROLS

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Institutional Controls	Local Government Land Use Controls	Zoning	Restricts residential development at the site.	Zoning laws currently exist. Modifications to laws require a formal process of public notice and hearings.	Low	Consider
		Floodplain Regulations	Restrict building in portions of site which are within the 100-year flood boundary.	Currently implemented.	None	Consider
		Subdivision Regulations	Restricts further subdivision of the site.	Not needed.	None	Eliminate
		Building Codes	Restricts construction activities.	Currently implemented. Modifications require formal process of public notice and public hearings.	Low	Consider
	Private Property Rights	Deed Restrictions	Restricts access and future uses of site.	Agreement between land owners required. May be difficult to enforce.	Low	Consider
	Public Groundwater Controls	Well Ban	Prohibits use of new wells for drinking water. Reduces human exposure to groundwater.	Currently implemented.	None	Consider
	Dedicated Development	Parks, Trails, Golf Course	Restricts uses of the site.	Implementable, but land is not desirable for dedicated development.	High	Eliminate

Adapted from: Murray Lamont, 1992

TABLE 4-2

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Containment	Surface Controls	Grading	Effective in managing surface water flow and reducing infiltration.	Readily implementable.	Low	Consider
		Revegetation	Effective in reducing surface water infiltration and reducing exposure.	Readily implementable.	Low	Consider
	Capping	Soil	Effective in preventing exposure.	Readily implementable.	Low	Consider
		Clay	Effective in preventing exposure and reducing surface water infiltration.	Readily implementable.	Moderate	Consider
		Multimedia	Effective in preventing exposure and surface water infiltration.	Readily implementable.	High	Consider
		Concrete/Asphalt	Effective in preventing exposure and surface water infiltration.	Readily implementable but not as aesthetically pleasing as other caps.	Moderate	Eliminate
Removal	Excavation	Excavation	Effective in removing soil.	Readily implementable to shallow depth below water table except beneath interstate highway.	Moderate	Consider
In Situ Treatment	Thermal	Radio Frequency Heating	Effective for removing compounds that volatilize between 80 to 300°C.	Method is in demonstration phase and is difficult to implement.	High	Eliminate
		Vitrification	Not proven effective for treating organic compounds.	Implementable.	High	Eliminate

TABLE 4-2

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
In Situ Treatment (Continued)	Physical/Chemical	Soil Flushing	Treatability studies (Keystone, 1992d) indicate that soil flushing is somewhat effective in enhancing removal of contaminants. Soil heterogeneities can reduce effectiveness.	Implementable. Difficult to control, could spread contamination.	Moderate	Consider for areas where excavation is not feasible.
		Stabilization	Not effective in reducing migration of organic contaminants.	Implementable.	Moderate	Eliminate
		Vacuum Extraction	Not effective for SVOCs.	Readily implementable.	Moderate	Eliminate
		Steam Extraction	Effective for VOCs and SVOCs. Heterogeneities reduce effectiveness.	Difficult to control movement of steam front and prevent steam condensation in the subsurface. Not demonstrated on large scale applications.	Moderate/ High	Eliminate
	Biological	Bioremediation	Treatability studies (Keystone, 1992a) indicate that bioremediation would be effective in reducing TPH, PCP, and PAHs. Not effective for dioxins and furans. Soil heterogeneities can reduce effectiveness.	Readily implementable. Field test required to determine feasibility of hydraulic control and implementability in winter.	Moderate	Consider
		Bioventing	Effective for enhancing bioremediation which destroys TPH, PCP, and PAHs. Not effective for dioxins.	Field testing and treatability testing would be required. Slow process.	Moderate	Eliminate
Aboveground Treatment	Thermal	Low Temperature Thermal Desorption	Effective in treating organic wastes. Oily residuals require further treatment.	Implementable. May not reach 99.9999 percent destruction efficiency for dioxins. Produces oily waste stream.	Moderate	Eliminate

TABLE 4-2

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Aboveground Treatment (Continued)	Thermal (Continued)	On-Site Incineration	Effective in destroying TPH, PCP, PAHs, and dioxins.	Implementable. May be difficult to obtain approval from community.	Moderate	Consider
		Off-Site Incineration	Effective in destroying TPH, PCP, PAHs, and dioxins. Transportation costs make on-site incineration more cost effective for large volumes of soil.	May be difficult to implement because of presence of dioxins.	High	Eliminate
	Physical/Chemical	Soil Washing/ Extraction with Recovery	Treatability studies (Keystone, 1991d) indicate that soil washing is effective in removing TPH, PCP, and PAHs from soil fractions >#170 mesh. Residuals require further treatment.	Implementable. Residuals including fines and sludges may require further treatment.	Moderate	Consider
		Solidification/ Stabilization	Effectiveness for treating organics is unproven. Best suited for inorganics.	Implementable.	Moderate	Eliminate
		Dechlorination	Effective for detoxifying PCP and dioxins. Does not treat TPH or PAHs.	Process no longer commercially available.	High	Eliminate
		Supercritical Extraction	Effective in removing some organics. Residuals require further treatment.	Innovative. Recovered oil sold or incinerated.	High	Eliminate
	Biological	Biological Slurry Reactor	Treatability studies (Keystone, 1991c) indicate that this process is effective for treating TPH, PCP, and PAH. May not be effective for dioxins.	Implementable.	Moderate	Consider for treatment of soil washing residuals.
		Composting	Effective for treating TPH, PCP, and PAH. May not be effective for dioxins.	Implementable.	Moderate	Consider
		Engineered Landfarming	Treatability studies (Keystone, 1991c) indicate that this process is effective for treating TPH, PCP, and PAHs. Dioxins may degrade by photoxidation.	Implementable.	Moderate	Consider

TABLE 4-2

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Aboveground Treatment (Continued)	Biological (Continued)	White Rot Fungus	Treatability studies (Keystone, 1991c) indicate that this process is less effective for treating TPH, PCP, and PAHs than microbial bioremediation.	Implementable.	Moderate	Eliminate
Disposal	On-Site Disposal	Backfill	Effective for disposal of treated soils which do not contain inorganic contamination.	Implementable.	Low	Consider
	Off-Site Disposal	Landfill	Effective for disposal of soils, however, no treatment is attained.	Implementable.	High	Consider for metals contaminated soils

TABLE 4-3

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR OILY WASTES AND SLUDGES
(Page 1 of 2)

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Treatment	Thermal	Thermal Desorption	Not effective in treating high strength oily wastes.	Implementable.	Moderate	Eliminate
		On-site Incineration	Effective in treating organic wastes. More expensive than off-site incineration for low volumes.	Implementable. May be difficult to obtain community approval.	High	Consider only if selected for site soils
		Off-Site Incineration	Effective in treating organic wastes.	Limited availability of permitted facilities.	Moderate	Consider
	Physical/Chemical	Solidification/ Stabilization	Not proven effective for organic wastes.	Implementable.	Moderate	Eliminate
		Wet Air Oxidation	Not proven effective for high strength, oily wastes. Generally used for high strength aqueous waste streams.	Off-gases, liquid, and sludge waste typically require further treatment.	High	Eliminate
		Dechlorination	Treatability studies (GRC, 1991) and other studies conducted on the MPTP site indicate that dechlorination is effective in destroying PCP, dioxins, and furans in oily wastes. Residuals can be incinerated off-site or recycled.	Process is no longer commercially available.	Moderate	Eliminate
		Supercritical Extraction	Not proven effective for high strength, oily wastes. Generally used for high strength aqueous waste streams.	Innovative. May not be implementable.	High	Eliminate
		Solvent Extraction	Typically used to concentrate waste streams. Not effective for oily wastes.	Innovative. May not be implementable.	High	Eliminate

TABLE 4-3

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES
AND PROCESS OPTIONS FOR OILY WASTES AND SLUDGE
(Page 2 of 2)

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Treatment (Continued)	Biological	Biological Slurry	Not effective for treating high strength wastes.	Implementable.	Moderate	Eliminate
		Composting	Not effective for treating high strength wastes.	Implementable.	Moderate	Eliminate
		Engineered Landfarming	Not effective for treating high strength wastes.	Implementable.	Moderate	Eliminate
		White Rot Fungus	Not effective for treating high strength wastes.	Implementable.	Moderate	Eliminate
Disposal	On-Site Disposal	Backfill	Not effective for disposal of oily wastes.	Not acceptable to state or USEPA.	Low	Eliminate
	Off-Site Disposal	Landfill	Not effective for disposal of oily wastes.	Permit required.	High	Eliminate
	Reuse/Recycling	Recycle Recovered Product	Effective in treating organic wastes.	Recycle as a hazardous fuel at a permitted facility is not implementable within Montana.	Low	Consider

TABLE 4-4

EVALUATION OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES
AND PROCESS OPTIONS FOR GROUNDWATER

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Management/ Institution	Monitoring	Groundwater Monitoring	Effective in monitoring migration of contaminants in groundwater.	Readily implementable.	Moderate	Consider
Extraction	Groundwater Collection	Pumping Wells	Generally effective in removing LNAPL and contaminated groundwater depending on site conditions.	Implementable.	Moderate	Consider
		Interceptor Trenches	Generally effective in removing LNAPL and shallow contaminated groundwater depending on site conditions.	Implementable. EPA has encountered difficulty constructing trenches due to flowing sand conditions.	Low	Consider
Containment	Impermeable Barriers	Sheet Piling	Generally effective in preventing LNAPL migration. May be less effective in preventing dissolved contaminant migration due to lack of competent bedrock zone to anchor piling.	Implementable.	Low	Consider
		Slurry Trench/Wall	Generally effective in preventing LNAPL migration. May be less effective in preventing dissolved contaminant migration due to lack of competent bedrock zone to anchor wall or trench.	Implementable.	Moderate	Consider
	Hydraulic Barriers	Pumping wells/ interception trenches	Effective in preventing LNAPL and dissolved phase contaminant migration.	Implementable.	Moderate	Consider

TABLE 4-4

EVALUATION OF POTENTIALLY APPLICABLE TECHNOLOGIES
AND PROCESS OPTIONS FOR GROUNDWATER

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
In Situ Treatment	Biological	Bioremediation	Treatability studies (Keystone, 1992a) indicate that in situ bioremediation may be effective in reducing PCP, TPH, and PAH levels in groundwater.	Further treatability testing might be required. Innovative.	Low	Consider
Aboveground Treatment	Biological	Activated Sludge	Not as efficient with low hydrocarbon concentrations.	Implementable.	Moderate	Consider
		Fixed Bed Bioreactor	This type of bioreactor has been effective at treating groundwater at sites with similar contaminants as MPTP.	Readily implementable.	Moderate	Consider
		Fluidized Bed Bioreactor	Treatability studies (Keystone, 1991e) indicate that this process is effective in treating PCP, TPH, and PAH.	Readily implementable.	Moderate	Consider
	Physical/Chemical	Air Stripping	Not effective in removing SVOCs.	Readily implementable.	Moderate	Eliminate
		Steam Stripping	Effective in removing SVOCs.	Implementable.	High	Eliminate
		Carbon Adsorption	Accelerated column study (Calgon, 1991) indicated that carbon adsorption is effective in removing PCP, BTEX, TPH, PAH, and dioxins.	Readily implementable.	High	Consider
		UV and/or Chemical Oxidation (H_2O_2, O_3)	Treatability studies (Keystone, 1992c) indicate that UV oxidation with O_3 or H_2O_2 is effective in removing PCP, PAH, BTEX, dioxins, and furans.	Readily implementable.	High	Consider

TABLE 4-4

EVALUATION OF POTENTIALLY APPLICABLE TECHNOLOGIES
AND PROCESS OPTIONS FOR GROUNDWATER
(Page 3 of 3)

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Initial Screen Results
Aboveground Treatment (Continued)	Physical/Chemical (Continued)	Oil/Water Separation	Treatability studies (Keystone, 1991b) indicate that enhanced oil/water separation which includes coagulation/flocculation is effective as a pretreatment process in removing oil and grease, insoluble organics, and sediments.	Readily implementable.	Moderate	Consider
		Solvent Extraction	Effective in removing PCP, PAH, and TPH.	Best suited for high concentration aqueous streams.	High	Eliminate
		Wet Air Oxidation	Effective in removing inorganics. Best suited for higher concentrations of hydrocarbons.	Implementable. Uses high pressure and temperature.	High	Eliminate
Disposal	On-Site Disposal	Surface Water Discharge	Effective for discharge of treated groundwater.	Implementable.	Low	Consider
		Groundwater Recharge	Effective for disposal of treated groundwater.	Implementable.	Low/ Moderate	Consider
		Industrial Treatment Facility	Effective in conjunction with LAO water treatment facility if constructed.	Implementable.	Moderate	Consider for treatment of inorganics only
	Off-Site Disposal	POTW Discharge	Effective groundwater disposal.	May be implementable, however pretreatment requirements have not been set.	Moderate	Eliminate

TABLE 4-5

EVALUATION OF POTENTIALLY APPLICABLE DECONTAMINATION TECHNOLOGIES
(Page 1 of 3)

General Response Actions	Remedial Technology	Type of Equipment or Debris	Effectiveness	Implementability	Initial Screen Results
Treatment	Wet Washing	Buildings	Effective in removing contaminants deep within the surface pores.	Readily implementable. Process water requires further treatment.	Consider
		Plant Process Equipment	Effective in removing contaminants from the surface and hard to reach areas, such as inside tanks, process lines, and pumps.	Readily implementable. Process water requires further treatment.	Consider
		Storage Vessels	Effective in removing contaminants from the insides of tanks and drums after the contents have been extracted.	Readily implementable. Process water requires further treatment.	Consider
		Debris	Effective in removing contaminants on large metal surfaces once separated. Not effective on wood or small surface area debris.	Implementable. Must separate larger debris from soil and smaller debris and treat rinsate.	Consider
	Wipe Methods	Buildings	Effective in removing surficial contaminants.	Readily implementable. Cloths must be cleaned and/or disposed.	Consider
		Plant Process Equipment	Not effective in removing contaminants from hard to reach areas such as within plant process lines and pumps.	Readily implementable. Cloths must be cleaned and/or disposed.	Eliminate
		Storage Vessels	Effective in removing surficial contaminants; however, if surfaces are wet from contacting oily wastes and sludge, large volumes of cloths may be required.	Readily implementable. Cloths must be cleaned and/or disposed.	Eliminate

TABLE 4-5

EVALUATION OF POTENTIALLY APPLICABLE DECONTAMINATION TECHNOLOGIES
(Page 2 of 3)

General Response Actions	Remedial Technology	Type of Equipment or Debris	Effectiveness	Implementability	Initial Screen Results
Treatment (Continued)	Wipe Methods (Continued)	Debris	Not effective in removing contaminants in mixed piles of debris.	Not implementable.	Eliminate
	HEPA Vacuuming	Buildings	Effective in removing surficial contaminants.	Readily implementable. HEPA filters must be cleaned and/or disposed.	Consider
		Plant Process Equipment	Not effective in removing contaminants from hard to reach areas such as within plant process lines and pumps.	Readily implementable. HEPA filters must be cleaned and/or disposed.	Eliminate
		Storage Vessels	Effective in removing surficial contaminants; however, if surfaces are wet from contacting oily wastes and sludge, many HEPS filters may be required.	Readily implementable. HEPA filters must be cleaned and/or disposed.	Eliminate
		Debris	Not effective in removing contaminants in mixed piles of debris.	Not implementable.	Eliminate
	Scarification	Buildings	Effective in removing contaminants from porous surfaces such as walls, floors, and ceilings.	Readily implemented. Removed surface material requires further treatment and/or disposal.	Consider
		Plant Process Equipment	Not effective in removing contaminants from metal or rubber surfaces characteristic of plant process equipment.	Not implementable.	Eliminate

TABLE 4-5

EVALUATION OF POTENTIALLY APPLICABLE DECONTAMINATION TECHNOLOGIES
(Page 3 of 3)

General Response Actions	Remedial Technology	Type of Equipment or Debris	Effectiveness	Implementability	Initial Screen Results
Treatment (Continued)	Scarification (Continued)	Storage Vessels	Not effective in removing contaminants from metal surfaces characteristic of drums and tanks.	Not implementable.	Eliminate
		Debris	Not effective in removing contaminants in mixed piles of debris.	Not implementable.	Eliminate
	On-Site	Backfill	Uncontaminated debris can be backfilled on site.	Implementable. Land is available.	Consider
	Off-Site	RCRA Landfill	Equipment and debris that are not treated must be disposed of in a Subtitle C facility.	Implementable.	Consider
		Municipal	Equipment and debris treated by USEPA approved methods can be disposed in a Subtitle D facility.	Implementable.	Consider

TABLE 4-6

SUMMARY OF SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
(Page 1 of 2)

General Response Action	Retained Remedial Technologies and Process Options
No Action	
Groundwater Monitoring	
Institutional Controls	Zoning Flood Plain Regulations Building Codes Deed Restrictions Well Ban
Containment Actions	Soils - Capping - Grading - Revegetation Groundwater - Physical Barriers - Hydraulic Methods
Removal/Extraction Actions	Soils - Excavation Groundwater - Trenches - Extraction Wells
In Situ Treatment	Soils - Bioremediation - Soil flushing (only in areas not feasible for excavation) Groundwater - Bioremediation

TABLE 4-6

SUMMARY OF SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
(Page 2 of 2)

General Response Action	Retained Remedial Technologies and Process Options
Aboveground Treatment	Soils - On-Site Incineration - Biological Land Treatment - Soil Washing - Bioslurry Reactor (soil washing residuals treatment)
	Oily Wastes and Sludges - Off-Site Incineration - On-Site Incineration (if on-site incineration is chosen for site soils)
	Groundwater - UV Oxidation - Carbon Adsorption - Bioreactor
	Equipment and Debris - Wet Washing - Wipe Methods - HEPA Vacuuming - Scarification
Disposal	Treated Soils - Backfill - Off-site Landfill (inorganic contaminated soils only)
	Treated Groundwater - Recharge to the Aquifer - Discharge to Silver Bow Creek
	Equipment and Debris - On-site Landfill - Off-site Landfill
	Oily Wastes and Sludges - Off-Site Incineration

TABLE 5-1

DEVELOPMENT OF REMEDIAL ALTERNATIVES

General Response Action	Media	Process Option	Alternative 1	Alternative 2	Alternative 3 A	Alternative 3 B	Alternative 3 C	Alternative 4 A	Alternative 4 B	Alternative 4 C	Alternative 5 A	Alternative 5 B	Alternative 5 C
No Action			•										
Monitoring				•	•	•	•	•	•	•	•	•	•
Institutional Controls		Deed Restrictions		•	•	•	•	•	•	•	•	•	•
		Zoning	•	•	•	•	•	•	•	•	•	•	•
		Floodplain Regulations	•	•	•	•	•	•	•	•	•	•	•
		Building Codes	•	•	•	•	•	•	•	•	•	•	•
		Well Ban	•	•	•	•	•	•	•	•	•	•	•
Containment	Soil	Grading			•	•	•	•	•	•	•	•	•
		Revegetation			•	•	•	•	•	•	•	•	•
		Clay Cap			•	•	•						
	Groundwater	Physical/Hydraulic Barriers			•	•	•	•	•	•	•	•	•
Removal/Extraction	Soil	Minimal Excavation			•	•	•						
		Limited Excavation						•	•	•			
		Total Excavation									•	•	•
	Groundwater	Extraction Wells & Trenches			•	•	•	•	•	•	•	•	•
In Situ Treatment	Soil and Groundwater	Bioremediation			•	•	•	•	•	•	•	•	•
	LNAPL	Soil Flushing									•	•	•

TABLE 5-1 (Continued)

DEVELOPMENT OF REMEDIAL ALTERNATIVES

General Response Action	Media	Process Option	Alternative 1	Alternative 2	Alternative 3			Alternative 4			Alternative 5		
					A	B	C	A	B	C	A	B	C
Ex Situ Treatment	Soil	On-site Incineration			•			•			•		
		Landfarming				•			•			•	
		Soil Washing					•			•			•
	Groundwater	Oil/Water Separator			•	•	•	•	•	•	•	•	•
		Bioreactor			•	•	•	•	•	•	•	•	•
		Carbon Polishing			•	•	•	•	•	•	•	•	•
	Oily Wastes and Sludges	On-site Incineration			•			•			•		
		Off-site Incineration			•	•	•	•	•	•	•	•	•
	Equipment and Debris	Wet Washing			•	•	•	•	•	•	•	•	•
		HEPA Vacuuming			•	•	•	•	•	•	•	•	•
		Wipe Methods			•	•	•	•	•	•	•	•	•
		Scarification			•	•	•	•	•	•	•	•	•
Disposal	Treated Soil	Backfill			•	•	•	•	•	•	•	•	•
	Treated Groundwater	Surface Water Discharge			•	•	•	•	•	•	•	•	•
		Recharge			•	•	•	•	•	•	•	•	•
	Decontaminated Equipment & Debris	Off-site Landfill			•	•	•	•	•	•	•	•	•

TABLE 5-2

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 1

No Action: Maintain Current Site Operations

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Administrative Costs @ 15%						$11,250	$11,250
TOTAL CAPITAL REQUIREMENT						$90,000	$90,000
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	year	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Current Site Operations	Year 1 - 30	1	lump sum	$150,000	$150,000	$150,000	$150,000
Annual costs for years 1 - 30						$168,000	$172,000
PRESENT WORTH							
Duration	30 years						
Discount rate	7 percent					$2,310,000	$2,350,000

TABLE 5-3

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 2

Institutional Controls and Groundwater Monitoring

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
SUBTOTAL						$80,000	$83,000
Contractors Overhead and Profit @ 20%						$16,000	$16,600
Contractors Mobilization and Demobilization @ 15%						$12,000	$12,450
Engineering Design @ 5%						$4,000	$4,200
Administrative Costs @ 15%						$12,000	$12,450
TOTAL CAPITAL REQUIREMENT						$124,000	$129,000

TABLE 5-3 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 2

Institutional Controls and Groundwater Monitoring

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	year	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Current Site Operations	Year 1 - 30	1	lump sum	$150,000	$150,000	$150,000	$150,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Annual costs for years 1 - 30						$238,000	$323,000
PRESENT WORTH							
Duration	30 years						
Discount rate	7 percent					$3,270,000	$4,400,000

TABLE 5-4

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3A

Soil: On-Site Incineration (1 year)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Clay Cover	2nd year	170,000	sq. ft.	$12	$19	$1,987,000	$3,194,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Excavation/Backfill	1st year	23,000	cu. yd.	$17	$30	$391,000	$690,000
On-Site Incineration	1st year	23,000	cu. yd.	$408	$750	$9,380,000	$17,250,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$15,070,000	$25,040,000
Contractors Overhead and Profit @ 20%						$3,014,000	$5,008,000
Contractors Mobilization and Demobilization @ 15%						$2,260,500	$3,756,000
Engineering Design @ 20%						$3,014,000	$5,008,000
Administrative Costs @ 15%						$2,260,500	$3,756,000
TOTAL CAPITAL REQUIREMENT						$25,620,000	$42,570,000

TABLE 5-4 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3A

Soil: On-Site Incineration (1 year)
Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing
Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Clay Cover Maintenance	Year 3 - 30	1	lump sum	$50,000	$70,000	$50,000	$70,000
Treatment and Disposal							
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,030,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$598,000	$1,203,000
Annual cost for year 2						$657,000	$1,295,000
Annual cost for years 3 - 30						$707,000	$1,365,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$34,620,000	$60,130,000

TABLE 5-5

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3B

Soil: Bioremediation (2 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Clay Cover	3rd year	170,000	sq. ft.	$12	$19	$1,987,000	$3,194,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$695,000	$2,482,000	$695,000	$2,482,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$6,500,000	$10,370,000
Contractors Overhead and Profit @ 20%						$1,300,000	$2,070,000
Contractors Mobilization and Demobilization @ 15%						$975,000	$1,560,000
Engineering Design @ 20%						$1,300,000	$2,070,000
Administrative Costs @ 15%						$975,000	$1,560,000
TOTAL CAPITAL REQUIREMENT						$11,050,000	$17,630,000

TABLE 5-5 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3B

Soil: Bioremediation (2 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Clay Cover Maintenance	Year 4 - 30	1	lump sum	$50,000	$70,000	$50,000	$70,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 2	11,500	cu. yd.	$17	$30	$196,000	$345,000
Bioremediation	Year 1 - 2	11,500	cu. yd.	$38	$50	$434,000	$572,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,030,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$1,230,000	$2,120,000
Annual cost for year 2						$1,290,000	$2,210,000
Annual cost for year 3						$657,000	$1,300,000
Annual cost for years 4 - 30						$707,000	$1,370,000
PRESENT WORTH							
Duration	30 years						
Discount rate	7 percent					$21,060,000	$36,640,000

TABLE 5-6

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3C

Soil: Soil Washing/Bioslurry (1 year)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Clay Cover	2nd year	170,000	sq. ft.	$12	$19	$1,987,000	$3,194,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Excavation/Backfill	1st year	23,000	cu. yd.	$17	$30	$391,000	$690,000
Soil Washing	1st year	23,000	cu. yd.	$195	$275	$4,495,000	$6,315,000
Bioslurry	1st year	1,200	cu. yd.	$263	$438	$316,000	$526,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$11,010,000	$15,420,000
Contractors Overhead and Profit @ 20%						$2,200,000	$3,080,000
Contractors Mobilization and Demobilization @ 15%						$1,650,000	$2,310,000
Engineering Design @ 20%						$2,200,000	$3,080,000
Administrative Costs @ 15%						$1,650,000	$2,310,000
TOTAL CAPITAL REQUIREMENT						$18,710,000	$26,200,000

TABLE 5-6 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 3C

Soil: Soil Washing/Bioslurry (1 year)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Clay Cover Maintenance	Year 3 - 30	1	lump sum	$50,000	$70,000	$50,000	$70,000
Treatment and Disposal							
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,033,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$598,000	$1,206,000
Annual cost for year 2						$657,000	$1,298,000
Annual cost for years 3 - 30						$707,000	$1,368,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$27,720,000	$43,780,000

TABLE 5-7

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4A

Soil: On-Site Incineration (4 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Soil Cover	5th year	11,300	cu. yd.	$10	$20	$113,000	$226,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$14,870,000	$14,870,000	$14,870,000	$14,870,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$18,300,000	$19,000,000
Contractors Overhead and Profit @ 20%						$3,660,000	$3,800,000
Contractors Mobilization and Demobilization @ 15%						$2,750,000	$2,850,000
Engineering Design @ 20%						$3,660,000	$3,800,000
Administrative Costs @ 15%						$2,750,000	$2,850,000
TOTAL CAPITAL REQUIREMENT						$31,120,000	$32,300,000

TABLE 5-7 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4A

Soil: On-Site Incineration (4 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 6 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 4	28,750	cu. yd.	$17	$60	$489,000	$1,730,000
Dewatering removed soils	Year 1 - 4	6,250	cu. yd.	$16	$72	$100,000	$450,000
On-Site Incineration	Year 1 - 4	28,750	cu. yd.	$335	$512	$9,630,000	$14,730,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,030,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 5 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for years 1 - 4						$10,720,000	$17,663,000
Annual cost for year 5						$657,000	$1,295,000
Annual cost for years 6 - 30						$687,000	$1,345,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$77,880,000	$110,840,000

TABLE 5-8

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4B

Soil: Bioremediation (5 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

				Unit Cost		Total Cost	
Item/Description	**Duration**	**Quantity**	**Unit**	**Min.**	**Max.**	**Min.**	**Max.**
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Soil Cover	6th year	11,300	cu. yd.	$10	$20	$113,000	$226,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$2,660,000	$6,040,000	$2,660,000	$6,040,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$6,590,000	$10,960,000
Contractors Overhead and Profit @ 20%						$1,318,000	$2,190,000
Contractors Mobilization and Demobilization @ 15%						$988,500	$1,640,000
Engineering Design @ 20%						$1,318,000	$2,190,000
Administrative Costs @ 15%						$989,000	$1,640,000
TOTAL CAPITAL REQUIREMENT						$11,200,000	$18,620,000

TABLE 5-8 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4B

Soil: Bioremediation (5 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 7 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 5	23,000	cu. yd.	$17	$60	$391,000	$1,380,000
Dewatering removed soils	Year 1 - 5	5,000	cu. yd.	$12	$88	$60,000	$440,000
Bioremediation	Year 1 - 5	23,000	cu. yd.	$27	$35	$629,000	$803,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,030,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$1,680,000	$3,830,000
Annual cost for years 2 - 5						$1,730,000	$3,910,000
Annual cost for year 6						$657,000	$1,300,000
Annual cost for years 7 - 30						$687,000	$1,345,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$24,780,000	$47,570,000

TABLE 5-9

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4C

Soil: Soil Washing/Bioslurry (2 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Containment							
Soil Cover	3rd year	11,300	cu. yd.	$10	$20	$113,000	$226,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$2,420,000	$2,570,000	$2,420,000	$2,570,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$6,350,000	$7,490,000
Contractors Overhead and Profit @ 20%						$1,270,000	$1,500,000
Contractors Mobilization and Demobilization @ 15%						$953,000	$1,120,000
Engineering Design @ 20%						$1,270,000	$1,500,000
Administrative Costs @ 15%						$953,000	$1,120,000
TOTAL CAPITAL REQUIREMENT						$10,800,000	$12,730,000

TABLE 5-9 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 4C

Soil: Soil Washing/Bioslurry (2 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 4 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 2	57,500	cu. yd.	$17	$60	$980,000	$3,450,000
Soil Washing	Year 1 - 2	57,500	cu. yd.	$111	$122	$6,380,000	$7,010,000
Bioslurry	Year 1 - 2	2,900	cu. yd.	$263	$438	$760,000	$1,270,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,033,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$8,720,000	$12,940,000
Annual cost for year 2						$8,780,000	$13,030,000
Annual cost for year 3						$657,000	$1,300,000
Annual cost for years 4 - 30						$687,000	$1,350,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$35,450,000	$52,660,000

TABLE 5-10

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5A

Soil: On-Site Incineration (7 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Site Preparation							
Excavate and Reconstruct Railroad	1st year	1,000	feet	$100	$150	$100,000	$150,000
Containment							
Soil Cover	8th year	51,100	cu. yd.	$10	$20	$511,000	$1,022,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$14,870,000	$14,870,000	$14,870,000	$14,870,000
Transportation	1st year	6,000	cu.yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$18,800,000	$19,950,000
Contractors Overhead and Profit @ 20%						$3,760,000	$3,990,000
Contractors Mobilization and Demobilization @ 15%						$2,820,000	$2,990,000
Engineering Design @ 20%						$3,760,000	$3,990,000
Administrative Costs @ 15%						$2,820,000	$2,990,000
TOTAL CAPITAL REQUIREMENT						$31,960,000	$33,910,000

TABLE 5-10 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5A

Soil: On-Site Incineration (7 years)
Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing
Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Annual Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	5 years	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 9 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 7	41,700	cu. yd.	$17	$75	$710,000	$3,130,000
Dewatering removed soils	Year 1 - 7	16,280	cu. yd.	$3	$26	$49,000	$420,000
On-Site Incineration	Year 1 - 7	29,570	cu. yd.	$334	$511	$9,880,000	$15,120,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,033,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 8 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for years 1 - 7						$11,240,000	$19,880,000
Annual cost for year 8						$657,000	$1,298,000
Annual cost for years 9 - 30						$687,000	$1,348,000

PRESENT WORTH

Duration	30 years		
Discount rate	7 percent	$99,870,000	$156,220,000

TABLE 5-11

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5B

Soil: Bioremediation (10 years)
Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing
Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Site Preparation							
Excavate and Reconstruct Railroad	1st year	1,000	feet	$100	$150	$100,000	$150,000
Containment							
Soil Cover	11th year	51,100	cu. yd.	$10	$20	$511,000	$1,020,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$2,660,000	$6,040,000	$2,660,000	$6,040,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$7,090,000	$11,910,000
Contractors Overhead and Profit @ 20%						$1,420,000	$2,380,000
Contractors Mobilization and Demobilization @ 15%						$1,060,000	$1,790,000
Engineering Design @ 20%						$1,420,000	$2,380,000
Administrative Costs @ 15%						$1,063,500	$1,786,500
TOTAL CAPITAL REQUIREMENT						$12,050,000	$20,250,000

TABLE 5-11 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5B

Soil: Bioremediation (10 years)
Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing
Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 12 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 10	29,200	cu. yd.	$17	$75	$500,000	$2,190,000
Dewatering removed soils	Year 1 - 10	11,400	cu. yd.	$3	$20	$34,000	$228,000
Bioremediation	Year 1 - 10	20,700	cu. yd.	$26	$34	$534,000	$708,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,033,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$1,670,000	$4,330,000
Annual cost for years 2 - 10						$1,720,000	$4,420,000
Annual cost for year 11						$657,000	$1,298,000
Annual cost for years 12 - 30						$687,000	$1,348,000
PRESENT WORTH							
Duration	30 years						
Discount rate	7 percent					$27,530,000	$55,200,000

TABLE 5-12

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5C

Soil: Soil Washing/Bioslurry (4 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
CAPITAL COSTS							
Institutional Controls							
Implementation	1st year	1	lump sum	$75,000	$75,000	$75,000	$75,000
Groundwater Monitoring							
Well Installation	1st year	4	each	$1,200	$2,000	$4,800	$8,000
Site Preparation							
Excavate and Reconstruct Railroad	1st year	1,000	feet	$100	$150	$100,000	$150,000
Containment							
Soil Cover	5th year	51,100	cu. yd.	$10	$20	$511,000	$1,020,000
Common Borrow	1st year	16,000	cu. yd.	$8	$15	$128,000	$240,000
Treatment and Disposal							
Soil							
Fixed Costs	1st year	1	lump sum	$2,420,000	$2,570,000	$2,420,000	$2,570,000
Transportation	1st year	6,000	cu. yd.	$4	$8	$24,000	$48,000
Groundwater							
Treatment Facility	1st year	1	lump sum	$981,000	$1,090,000	$981,000	$1,090,000
Extraction Facility	1st year	1	lump sum	$371,000	$557,000	$371,000	$557,000
Infiltration Facility	1st year	1	lump sum	$133,000	$168,000	$133,000	$168,000
Oily Wastes and Sludge							
Off-Site Incineration	1st year	30,000	gallon	$17	$26	$504,000	$792,000
Equipment and Debris							
Mob/Decon/Disposal	1st year	1	lump sum	$1,600,000	$1,720,000	$1,600,000	$1,720,000
SUBTOTAL						$6,850,000	$8,440,000
Contractors Overhead and Profit @ 20%						$1,370,000	$1,690,000
Contractors Mobilization and Demobilization @ 15%						$1,030,000	$1,270,000
Engineering Design @ 20%						$1,370,000	$1,690,000
Administrative Costs @ 15%						$1,030,000	$1,270,000
TOTAL CAPITAL REQUIREMENT						$11,650,000	$14,360,000

TABLE 5-12 (continued)

ESTIMATED COST FOR REMEDIAL ALTERNATIVE 5C

Soil: Soil Washing/Bioslurry (4 years)

Groundwater: Oil/Water Separation Followed by Biotreatment and Carbon Polishing

Oily Wastes and Sludge: Off-Site Incineration

Item/Description	Duration	Quantity	Unit	Unit Cost Min.	Unit Cost Max.	Total Cost Min.	Total Cost Max.
OPERATION AND MAINTENANCE COSTS							
Institutional Controls							
Annual Institutional Controls	Year 1 - 30	1	lump sum	$10,000	$10,000	$10,000	$10,000
Five Year Site Review	Every 5 years	1	lump sum	$40,000	$60,000	$40,000	$60,000
Groundwater Monitoring							
Analytical/Reporting	Year 1 - 30	1	year	$70,000	$151,000	$70,000	$151,000
Containment							
Cover Maintenance	Year 6 - 30	1	lump sum	$30,000	$50,000	$30,000	$50,000
Treatment and Disposal							
Soil							
Excavation/Backfill	Year 1 - 4	73,000	cu. yd.	$17	$75	$1,241,000	$5,480,000
Soil Washing	Year 1 - 4	51,750	cu. yd.	$111	$121	$5,730,000	$6,260,000
Bioslurry	Year 1 - 4	2,600	cu. yd.	$263	$438	$680,000	$1,140,000
Groundwater							
Bioreactor	Year 1 - 30	72,580	1,000 gallons	$7	$14	$510,000	$1,030,000
Oily Wastes and Sludge							
Off-Site Incineration	Year 2 - 30	3,500	gallon	$17	$26	$58,800	$92,400
Annual cost for year 1						$8,250,000	$14,080,000
Annual cost for years 2 - 4						$8,310,000	$14,180,000
Annual cost for year 5						$657,000	$1,300,000
Annual cost for years 6 - 30						$687,000	$1,350,000
PRESENT WORTH							
Duration	30 years						
Discount rate	7 percent					$48,080,000	$78,180,000

TABLE 5-13

SUMMARY OF REMEDIAL ALTERNATIVES FOR THE MPTP SITE

Evaluation Criteria	Alternative 1 No Action	Alternative 2	Alternatives 3A, B, and C	Alternatives 4A, B, and C	Alternatives 5A, B, and C
Effectiveness	(i) Existing institutional controls would provide some protection to human health by restricting development at the site. (ii) Not effective in containing the LNAPL or dissolved groundwater contaminant plume from further migration. (iii) Does not prevent exposure to contaminated soils, oily wastes and sludges, and debris.	(i) Additional institutional controls would be effective in reducing human exposure by further restricting development at the site. (ii) Same as 1. (iii) Same as 1.	(i) Same as 2. (ii) Capping limits exposure to contaminated surface and subsurface soils. (iii) Effective in containing the contaminated groundwater plume and preventing seepage of LNAPLs into the creek. (ivA) On-site incineration would permanently destroy contaminants in soils significantly reducing MTV[a]. (ivB) Treatability studies indicate that bioligical treatment is effective in reducing PCP and PAH concentration. Dioxins and furans would not be affected. (ivC) Treatability studies indicate that soil washing would be effective in reducing the concentration of PCP, PAH and dioxin/furans. Further treatment is required for the process water and residual soils. (v) Off-site incineration would permanently destroy contaminants in oily wastes and sludges. (vi) Surface water discharge would maintain water balance.	(i) Same as 2. (ii) Effective in containing the groundwater contaminant plume from further downgradient migration. Effective in enhancing the removal of LNAPL and contaminated groundwater. (iii) Excavation is effective in removing about 44 percent of the contaminated subsurface soils. Excavation and extraction is expected to be effective in removing about 60 percent of LNAPL. (ivA) Same as 3A. (ivB) Same as 3B. (ivC) Same as 3C. (v) Same as 3. (vi) Same as 3.	(i) Same as 2. (ii) Same as 4 (iii) Effective in removing 83 percent of the contaminated soils and about 87 percent of the LNAPL from the subsurface. (ivA) Same as 3A. (ivB) Same as 3B. (ivC) Same as 3C. (v) Same as 3. (vi) Same as 3.

TABLE 5-13

SUMMARY OF REMEDIAL ALTERNATIVES FOR THE MPTP SITE
(Page 2 of 2)

Evaluation Criteria	Alternative 1 No Action	Alternative 2	Alternatives 3A, B, and C	Alternatives 4A, B, and C	Alternatives 5A, B, and C
Implementability	(i) Readily technically implementable.	(i) Private property rights can be negotiated among the land owners. Changes to zoning laws and building codes are performed by the local legislative bodies.	(i) Same as 2. (ii) In general, soil technologies are readily implementable. Although, on-site incineration may not be acceptable to the community. (iii) Disposal of sludge from fluidized bed bioreactor, spent carbon, and oily wastes may not be implementable if they contains elevated levels of dioxins and furans.	(i) Same as 2. (ii) Same as 3. (iii) Same as 3. (iv) Excavation below the water table is more difficult than conventional excavation and could smear the contamination.	(i) Same as 2. (ii) Same as 3. (iii) Same as 3. (iv) Same as 3.
30-Year Present Worth at 7% Discount Rate	$2.3 million	$3.3 - $4.4 million	3A $34.7 - 60.1 million	4A $77.9 - 110.8 million	5A $99.9 - $156.2 million
			3B $21.0 - 36.6 million	4B $24.8 - $47.6 million	5B $27.5 - $55.2 million
			3C $27.7 - 43.8 million	4C $35.5 - $52.7 million	5C $48.1 - $78.2 million

* MTV - mobility, toxicity, and volume