REMEDIAL PLANNING ACTIVITIES AT SELECTED UNCONTROLLED HAZARDOUS SUBSTANCES DISPOSAL SITES IN A ZONE FOR EPA REGIONS VI, VII, & VIII

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FOR
AMERICAN CREOSOTE WORKS, INC.
WINNFIELD, LOUISIANA

Volume 1 of 5 - Remedial Investigation

Work Assignment No.: 33-6LG3
Document Control No.: 7760-033-RI-CFJX

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CONTRACT NO. 68-W9-0021

CDM FEDERAL PROGRAMS CORPORATION
■ SVERDRUP ■ LATA ■ KELLOGG ■ CCJM ■ GRADIENT ■

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VOLUME V - APPENDICES (F - G)

F FS SAMPLING METHODS, RESULTS, AND RAW LABORATORY ANALYTICAL DATA
G FS COST SPREADSHEETS

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LIST OF ACRONYMS

ACRONYM	DEFINITION
ACGIH	American Conference of Governmental and Industrial Hygienists
AHPA	Archaeological and Historic Preservation Act
ARAR	Applicable or Relevant and Appropriate Requirement
ARCS	Alternative Remedial Contracting Strategy
ATTIC	Alternative Treatment Technology Information Center
B(a)P	Benzo(a)pyrene
BDAT	Best Demonstrated Available Technology
BNA	Base Neutral/Acid Extractable Compounds
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CAA	Clean Air Act
CBI	Confidential Business Information
CDI	Chronic Daily Intake
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERI	Center for Environmental Research Information
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chemical (Contaminants) of Concern
COD	Chemical Oxygen Demand
COE	Corps of Engineers
CSF	Critical Success Factor
CWA	Clean Water Act

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LIST OF ACRONYMS (cont)

ACRONYM	DEFINITION
DMP	Data Management Plan
DNAPL	Dense Non-Aqueas Phase Liquid
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ERB	Emergency Response Branch
ERCS	Emergency Response Cleanup Services
ERT	Environmental Response Team
ESHAP	National Emissions Standards for Hazardous Air Pollutants
FIT	Field Investigation Team
FS	Feasibility Study
FWCA	Fish and Wildlife Coordination Act
FWPCA	Federal Water Pollution Control Act
FY	Fiscal Year
GPS	Global Positioning System
HA	Health Advisory
HI	Hazard Index
HSBAA	Historic Sites, Buildings, and Antiquities Act
HSP	Health and Safety Plan
IRIS	Integrated Risk Information System
K	Hydraulic Conductivity
LAER	Lowest Achievable Emission Rates
LDEQ	Louisiana Department of Environmental Quality
LDR	Land Disposal Restriction
LOEL	Low Observed Effect Level
LSI	Listing Site Inspection

LIST OF ACRONYMS (cont)

ACRONYM	DEFINITION
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NAAQS	National Ambient Air Quality Standards
NAPL	Nonaqueous Phase Liquids
NCP	National Contingency Plan
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NOEL	No Observed Effect Level
NSPS	New Source Performance Standards
O&M	Operation and Maintenance
OERR	Office of Emergency and Remedial Response
OP	Operating Procedure
OSC	Onscene Coordinator
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OTS	Office of Toxic Substances
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbon
PAT	Processes, Activities, and Tasks
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated dibenzo-dioxins
PCDF	Polychlorinated dibenzo-furans
PCP	Pentachlorophenol
POTW	Publicly Owned Treatment Works
PQM	Projected Quality Management

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LIST OF ACRONYMS (cont)

ACRONYM	DEFINITION
PRG	Preliminary Remediation Goal
PRP	Potential Responsible Party
PVC	Polyvinyl Chloride
PSD	Prevention of Significant Deterioration
QA	Quality Assurance
QAMP	QA Management Plan
QAPjP	Quality Assurance Project Plan
QC	Quality Control
QTM	Quick Turnaround Method
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Referenced Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SARA	Superfund Amendment and Reauthorization Act
SAS	Special Analytical Services
SDWA	Safe Drinking Water Act
SF	Slope Factors
SIP	State Implementation Plan
SITE	Superfund Innonative Technology Evaluation
S/S	Stabilization/Solidification

LIST OF ACRONYMS (cont)

ACRONYM	DEFINITION
SSDMS	Superfund Soil Data Management System
TAT	Technical Assistance Team
TBC	To Be Considered
TCDD	Tetrachlorodibenzo(p)dioxin
TEF	Toxic Equivalency Factors
TIO	Technology Innovation Office
TSC	Toxicology Support Center
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WAM	Work Assignment Manager
WCAP	Waste Characteristics Affecting Performance
WQC	Water Quality Criteria

Section 1.0

1.0 INTRODUCTION

1.1 SITE BACKGROUND

The U.S. Environmental Protection Agency (EPA) Region VI has requested that CDM Federal Programs Corporation (CDM) conduct a Remedial Investigation and Feasibility Study (RI/FS) of the American Creosote Works, Inc. site located in Winnfield, Louisiana. The facility, an inactive wood-preserving operation, utilized creosote, pentachlorophenol (PCP), and petroleum distillates in its processes. Product and waste handling practices resulted in contamination by these materials to surface and subsurface soils, groundwater, surface water, and sediments. This report presents a discussion of site history and features, investigation methods and results, and identification and evaluation of remedial alternatives.

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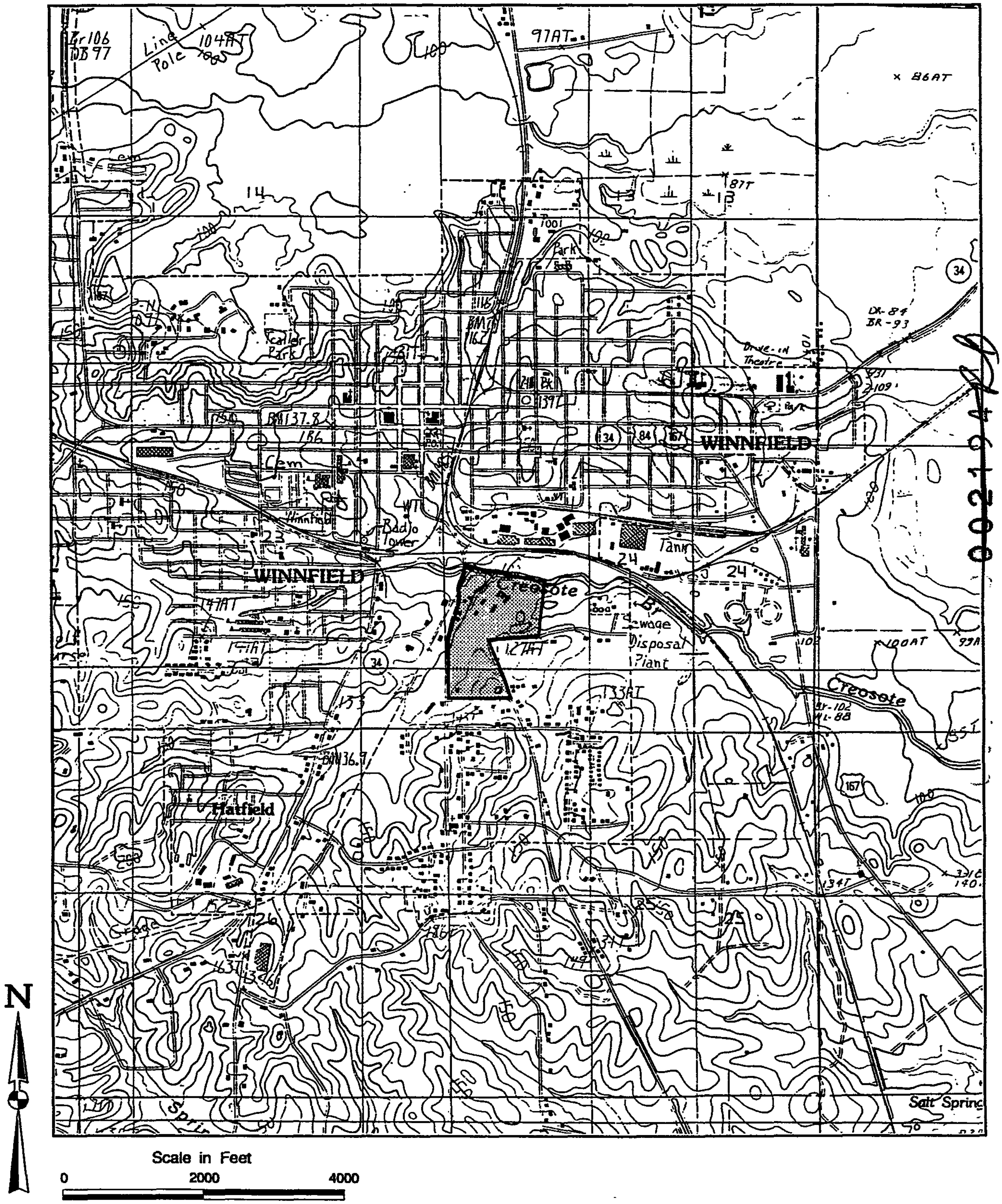
1.1.1 SITE DESCRIPTION

The American Creosote site occupies approximately 34 acres immediately south of the City of Winnfield, in Winn Parish, Louisiana. The site is bounded on two sides by Creosote Branch, a perennial creek (Figure 1-1) which flows in a 10-12 foot deep valley. Site drainage is predominantly via three man-made ditches and a single natural drainage. The plant area formerly consisted of 15 tanks, four pressure vessels or retorts, a boiler building, a tool and die shop, offices and other administrative buildings, and several unlined waste impoundments. East of the former facility is a denuded area containing a mat of tar-like material, and further east is a densely vegetated area.

1.1.2 SITE HISTORY

The American Creosote site began operations in 1901 under the direction of the Bodcaw Lumber Company. This firm owned 61 acres of land in the area of the site. Records explaining site operations during ownership by the Bodcaw Lumber Company have not been identified.



Source: USGS 7.5 min. Winnfield East & West, La. Quadrangles

Project No.: 7760-033	American Creosote Winnfield, Louisiana CDM FEDERAL PROGRAMS CORPORATION a subsidiary of Camp Dresser & McKee Inc.	Site Location Map	Figure No.: 1-1 4/92

In 1910, Bodcaw Lumber sold 22.14 acres of the property to the Louisiana Creosoting Company. Records of site operations for this period of ownership are similarly unavailable. American Creosote Works of Louisiana, Inc. purchased the property from Louisiana Creosoting in 1938. American Creosote also acquired an additional 12 acres of adjoining property during ownership. In 1977, American Creosote Works, Inc. was bought by Dickson Lumber Company. Dickson Lumber Company was later declared bankrupt and seized by the City of Winnfield for taxes. The property was then purchased by Stallworth Timber Company in 1980.

Aerial photographs depicting site conditions are available for several dates beginning in 1940. These photographs allow interpretation of site conditions over time, as reported below. A list of the historical aerial photographs used in interpreting site conditions over time and the sources of these photographs are provided in Table 1-1.

Aerial photographs provide evidence that the facility was well established by 1940 (Figure 1-2). An office building was present west of Creosote Branch and just south of the main entrance. Wood-treating operations were concentrated in the north-central portion of the site (the process area). The process area consisted of a boiler building flanked by two or more pressure chambers or retorts. A tank farm consisting of several vertical tanks lacking secondary containment was present immediately east of the boiler building. Several other buildings whose functions are unknown are present in the process area. Based on evidence in the aerial photographs, the southern half of the property was used primarily for debarking, cutting, and staging timbers prior to treatment. Several sets of railroad tracks, used to transport treated and untreated lumber around the facility, ran from the southwest corner of the site north and northeast through the process area to the northeast portion of the site. The railroad tracks crossed Creosote Branch on three trestles north of the process area. Stacks of untreated lumber were present in the southwest and western portions of the site. Stacks of treated lumber are evident in the central and north-central (north of Creosote Branch) portions of the site.

TABLE 1-1

HISTORICAL AERIAL PHOTOGRAPHS USED TO INTERPRET AMERICAN CREOSOTE SITE HISTORY

Photo Date	Photo Source[1]	Film Type[2]	Original Scale
06/26/40	NARS	BW	?
11/26/47	USGS	BW	1:43,200
04/21/50	ASCS	BW	1:20,000
05/07/52	AEROS	BW	1:69,000
01/25/55	ASCS	BW	1:20,000
01/18/59	ASCS	BW	1:20,000
02/11/66	TOBIN	BW	1:40,000
12/12/67	ASCS	BW	1:20,000
01/15/70	LADOTD	BW	1:14,400
03/07/73	LADOTD	BW	1:36,000
01/14/76	LADOTD	BW	1:14,400
03/01/79	TOBIN	BW	1:15,840
04/15/80	ASCS	BW	1:40,000
12/04/81	USGS	CIR	1:58,000
12/30/83	LADOTD	BW	1:36,000
01/21/84	TOBIN	BW	1:15,840
06/06/87	EMSL-LV	COL	?
10/20/89	LADOTD	BW	1:36,000
02/24/90	USGS	CIR	1:40,000
01/20/92	AERO-DATA	COL	1:6,000

[1] AERO-DATA - AERO-Data Corp., Baton Rouge, LA
AEROS - Aeros Data Center, Sioux Falls, SD
ASCS - Agricultural Soil Conservation Service, Salt Lake City, NV
EMSL-LV - Environmental Monitoring Systems Laboratory, Las Vegas, NV
LADOTD-Louisiana Department of Transportation and Development, Baton Rouge, LA
NARS - National Archives Research Service, Washington, DC
TOBIN - Tobin Inc., San Antonio, TX
USGS - U.S. Geological Survey, Sioux Falls, SD

[2] BW - Black and White
CIR - Color infrared
COL - Color

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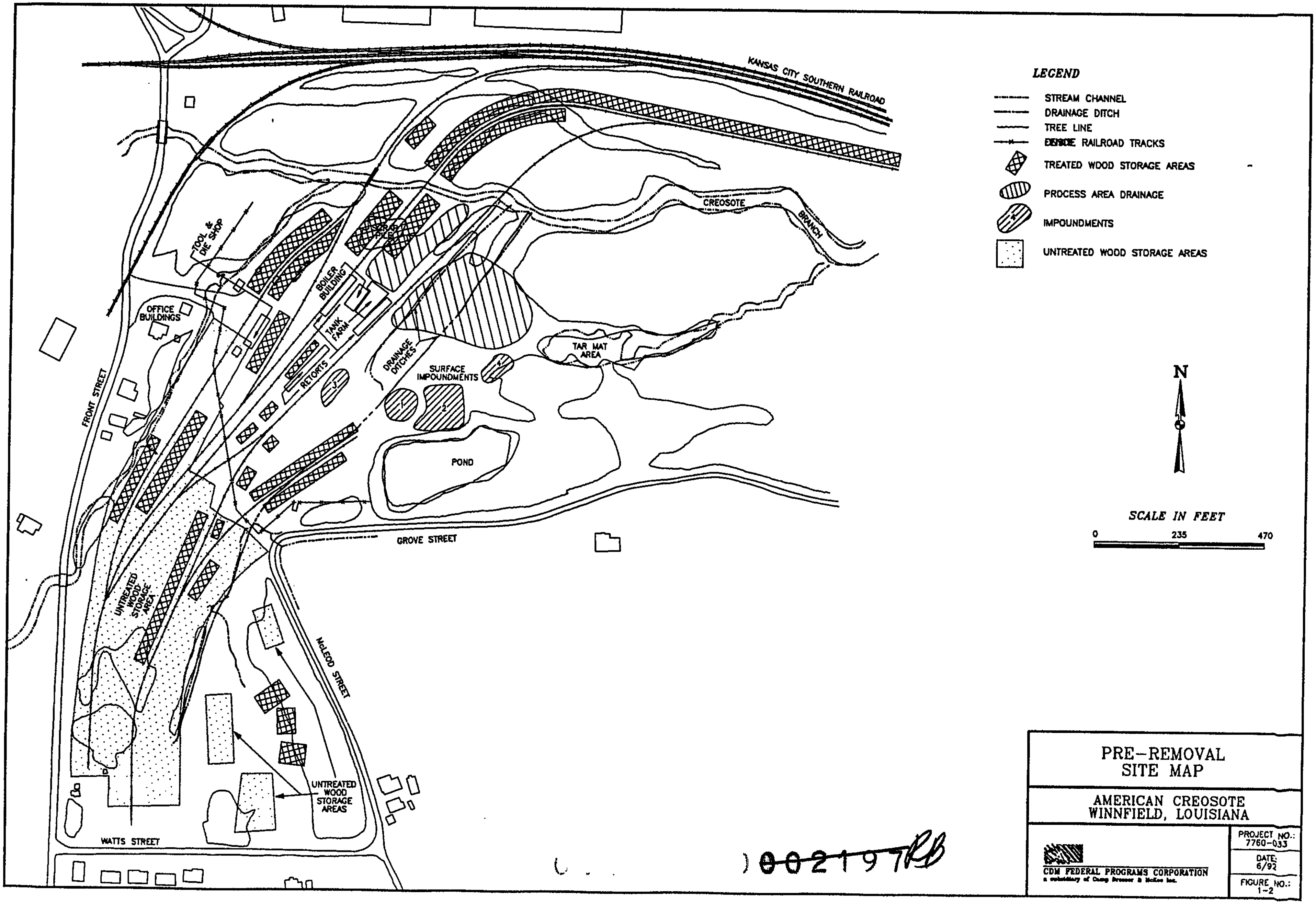

PRE-REMOVAL
SITE MAP

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
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PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 1-2

Also in the 1940 photographs, an unnamed drainage in the northeast portion of the site follows a meandering path from the process area north and east (through an area later referred to as the "tar mat") to a confluence with Creosote Branch. Darkly stained soils and stressed vegetation are evident along this drainage in all subsequent aerial photographs. A portion of runoff from the process area followed a path north to enter Creosote Branch between the east and central railroad bridges. Areas of darkly stained soil are apparent in and north of the process area.

Aerial photographs indicate that by 1947 increased quantities of treated and untreated wood were stored onsite, suggesting an increase in wood-treating activities. Drainage and possibly wastes from the process area continued to flow unimpeded into Creosote Branch. The extent of stained soils north and east of the process area had increased.

Between April 1950 and May 1952, two impoundments were constructed east of the process area (Impoundments 1 and 2 on Figure 1-2). These impoundments probably received liquid wastes from the wood-treating process including water, tree sap, creosote, petroleum distillates, and PCP. Several shallow ditches had been constructed east of the process area and along the eastern set of railroad tracks to facilitate drainage of site runoff into Creosote Branch. Photos from this period show evidence of increasing activity.

An aerial photograph from 1959 shows evidence of a pool of standing liquid immediately northeast of the tank farm between the eastern and central railroad tracks. Evidence of standing liquid and/or darkly stained soils in this area are present in all subsequent photographs until 1973.

Prior to 1966, another retort was added south of the existing process area. A third impoundment was constructed east of the new retort (Impoundment 3 on Figure 1-2). Based on the aerial photographs listed in Table 1-1, the mid- to late-1960s appear to be the period of maximum activity or production at the American Creosote site. Records discovered in a shed onsite provide information regarding the magnitude of the American Creosote operation during that time. According to these records, for a seven-month period ending July 31, 1966, more than 750,000 gallons of petroleum distillate, 40,000 gallons of creosote, and 54,000 pounds of PCP were used to treat approximately 7.5 million board-feet of wood.

Impoundment 1 was apparently backfilled with soil or wood chips prior to 1970. By 1973, retaining walls of this impoundment had been partially removed by earthmoving equipment. Also apparent in the 1973 photographs is the development of the tar mat, perhaps resulting from a single spill event. Located approximately 500 feet east of the process area, the tar mat is a large, flat, asphalt-like layer which extends over a marshy portion of the site. A number of mature pine trees located within the tar mat appear to have died shortly before the 1973 photographs were taken.

Between 1973 and 1976, extensive earth-moving operations north and east of the process area covered up most of the darkly stained soils and obliterated the remains of Impoundment 1. Impoundment 4 (Figure 1-2) was built immediately north of Impoundment 2 and may have been used to contain drainage from it. A pond was constructed just south of Impoundment 2 to collect and store water for emergency fire-fighting purposes. A fence was constructed completely enclosing the pond. Based on the volume of treated and untreated wood present onsite, wood-treating operations may have been declining during this period.

By 1979, wood-treating operations at the American Creosote site appear to have ceased. No untreated wood and very little treated wood are present in aerial photographs taken at that time. All railroad tracks had been removed from the site. This roughly coincides with the time at which site owner Dickson Lumber Company was declared bankrupt and seized by the City of Winnfield.

Aerial photographs taken in 1981, shortly after the site was purchased by Stallworth Timber Company, provide evidence of the resumption of wood-treating activities at the site. A large drainage ditch was excavated from the south-central portion of the site north and east between the process area and Impoundment 2 presumably to improve driving conditions onsite. Judging from the quantity of treated and untreated wood stockpiled onsite, operations were taking place on a much smaller scale after 1980 than during ownership by American Creosote Works, Inc.

The Louisiana Department of Environmental Quality (LDEQ) inspected the site in July 1982 and issued a letter of warning to Stallworth Timber Company in January 1983 in response to releases of contaminants to the environment. In December 1984, LDEQ found no environmental improvements and issued a Compliance Order the next month.

By 1983, Impoundments 2 and 4 had been backfilled, presumably with wood chips, and the impoundment retaining walls had been demolished. Impoundment 3 was apparently still active. Evidence of continuing wood-treating operations is present in photographs from 1983 and 1984.

In June 1985, LDEQ inspectors found the site abandoned. In March 1987, the case was referred to the EPA. At the EPA's direction, several investigations of the site were conducted in 1987 and 1988. In 1989, the EPA Emergency Removal Branch conducted a removal action at the American Creosote site which included source control and contaminant migration control actions. The EPA investigations and removal actions are described in Section 3.0 of this report.

1.2 PURPOSE AND SCOPE OF THE RI/FS

The primary focus of the RI is to utilize findings of previous investigations in conjunction with collection of additional information, to characterize current and future risks, and to develop and evaluate long-term and permanent remedial action alternatives. The purpose of the FS is to provide a structured means to identify and evaluate remedial alternatives to address human health and/or environmental risks posed by site-related contaminants.

The American Creosote RI/FS has been performed in accordance with EPA's National Contingency Plan under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Superfund Amendments and Reauthorization Act (SARA). RI/FS activities have progressed concurrently in an effort to expedite remedial work at this site.

The American Creosote RI has included the following tasks:

- Compile and evaluate existing data regarding the nature and extent of contamination present at the site.
- Collect and evaluate data to determine the extent of surficial contamination present at the site following the EPA's removal action.
- Collect and evaluate data to determine the extent of contamination in subsurface soils and groundwater.
- Collect and evaluate data to characterize the shallow subsurface geology and hydrogeologic conditions.
- Collect and evaluate data to determine the extent of contamination in surface water and sediments of Creosote Branch near the site.
- Evaluate human health and environmental risks posed by site-related contamination.
- Collect samples of wastes and contaminated groundwater and soils for analysis of waste characteristics affecting performance (WCAPs). These samples provide important information for the selection of remedial technologies in the FS.

The FS process for the American Creosote site includes the following tasks:

- Evaluate data generated during the RI and risk assessment to determine potential remedial action goals for the site.
- Utilize historical information in the FS reports and Records of Decision (RODs) from other wood-preserving sites to identify similar site characteristics and areas. Build upon existing EPA experience for the evaluation of potential remedial technologies to achieve remedial action goals.

- Identify applicable or relevant and appropriate requirements (ARARs) for possible remedial actions.

- Screen selected media-specific technologies and develop site-specific alternatives based on previous Records of Decision at wood-treating facilities.

- Conduct a detailed analysis of a limited group of alternatives to identify preferred alternatives.

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Section 2.0

2.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

2.1 CLIMATE AND VEGETATION

The following description of climate and vegetation is based on the U.S. Soil Conservation Service (1983).

The Winnfield, Louisiana area is characterized by a subtropical climate with relatively long, hot, humid summers and mild winters. The average temperatures in the Winnfield area range from 47° in January to 81° in July and August. The annual precipitation averages 50 inches. The heaviest rainfall occurs in April and May and the lightest in October. Thunderstorms can occur at any time of the year and average about 54 days per year. The prevailing winds are from the south. Average windspeed is highest in the spring at about 11 miles per hour. Severe local storms, including tropical hurricanes and tornadoes, occasionally strike in or near the area.

The vegetation in the Winnfield area consists of plants and trees found on crop and range land and in coniferous and deciduous forests. The crop lands are largely used to produce cotton and soybeans, but are also used to grow corn, wheat, oats, and grain sorghum to a lesser extent. Perennial grasses, legumes, or mixtures of these are grown on pasture land. Examples of grasses and legumes are fescue, bermuda grass, clover, and vetch. Wild herbaceous plants are native or naturally established grasses and forbs that grow within pasture land or crop land. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, paspalum, and uniola.

Coniferous trees grow in numerous forests throughout the Winnfield area. These trees can produce forests with exclusively coniferous plants or mixed with other deciduous plants. Examples of coniferous trees common to the area include the white pine, cedar, and cypress. Cypress trees tend to grow in large swampy forests. Examples of hardwood trees in the Winnfield area include oak, poplar, cherry, sweetgum, persimmon, hawthorn, dogwood, hickory, blackberry, greenbrier, and muscadine.

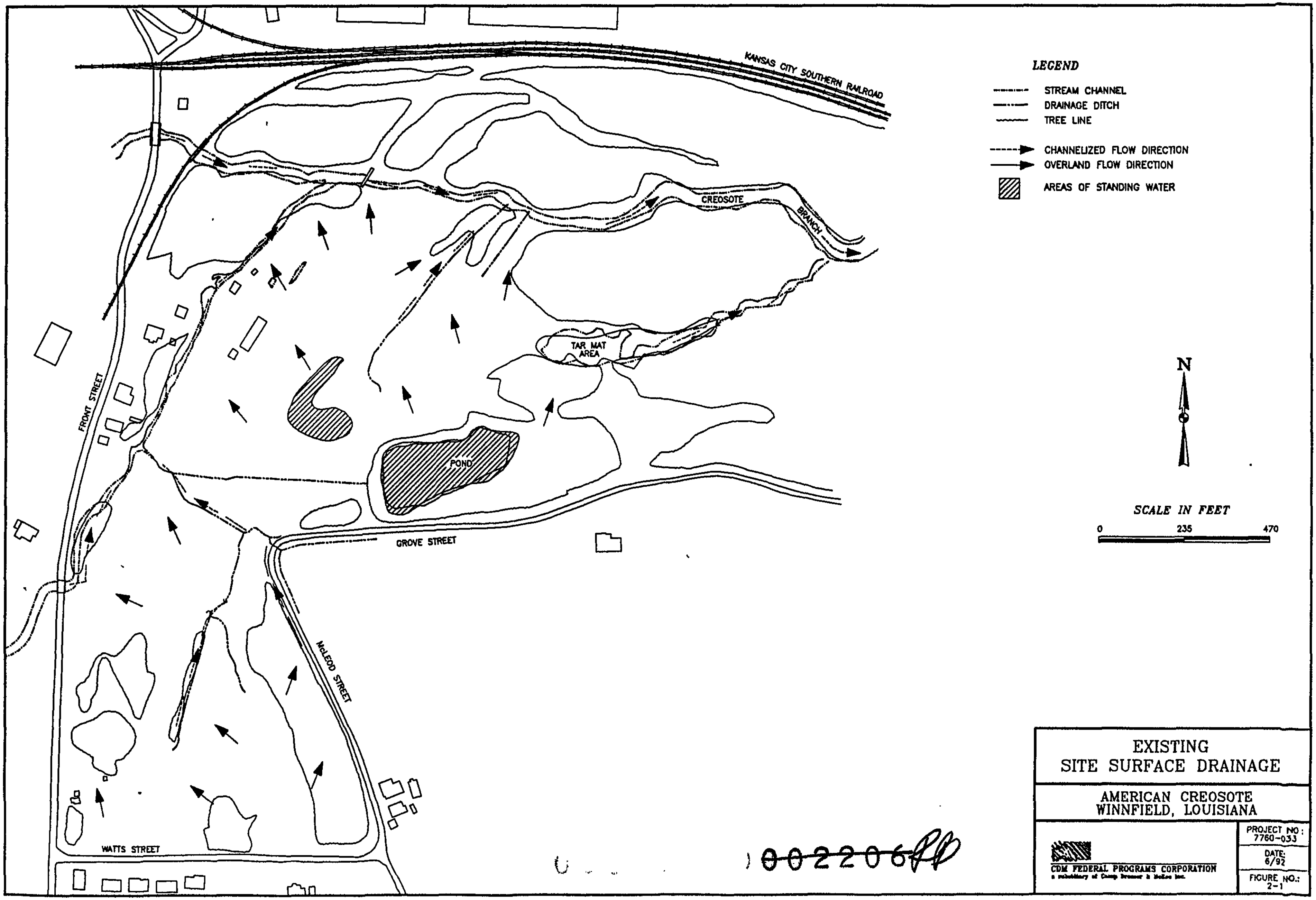
Numerous shrub plants grow within the forests and the pasture lands. These plants tend to form under foliage within the forests and include the American beautyberry, waxmyrtle, American elder, sumac, and elderberry. Wetland plants are annual or perennial wild herbaceous plants that grow on moist sites. Examples of wetland plants are the smartweed, wild millet, wild rice, rushes, sedges, and reeds.

2.2 SURFACE WATER HYDROLOGY

Surface water from the American Creosote site drains into Creosote Branch, which bounds the site to the west and crosses the northern portion of the site. Creosote Branch is a small creek with banks 10 to 12 feet high. Approximately two miles east to southeast of the site, the Creosote Branch joins with the Port de Luce Creek, which flows for another three miles to the southeast then joins Cedar Creek before emptying into the Dugdemona River. This river is one of the larger waterways in the Winnfield area and ultimately drains into the Little River in the southeastern section of Winn Parish.

The surface drainage patterns at the American Creosote site are illustrated in Figure 2-1. The site is drained by both overland flow and by several natural and manmade drainages. The southern part of the site is topographically higher than the northern part of the site due to outcrops of bedrock in this area. A manmade drainage runs north-south through the middle of the southern portion of the site. Prior to the EPA Removal Action at the site in 1989, this drainage continued north through the site, flowing into Creosote Branch. During the removal action, two east-west drainages were excavated across the center of the site intercepting surface water flow from the southern portion of the site. The northern portion of the pre-existing drainage was backfilled. A less well-defined topographic low still exists between the process area and the impoundment area along the backfilled portion of this feature.

In the southeast portion of the site, the land is dissected to about one to three feet deep in many places providing good exposure of the bedrock. Rapid runoff in this area was observed several



EXISTING SITE SURFACE DRAINAGE

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

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PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 2-1

times during the remedial investigation. The southwestern portion of the site is characterized by more recent alluvial sediments of low relief draining by overland flow to the north. This portion of the site drains very slowly and is commonly the site of large standing pools of water. Drainage from the southern part of the site is intercepted by the east-west drainages excavated by the EPA in 1989. These drainages are approximately five feet deep and drain west towards Creosote Branch.

Surface water flow in the northern half of the site is best described by dividing this portion into three areas. The northwestern third is drained primarily by overland flow. This water enters Creosote Branch west and northwest of the process area. The topography in this portion of the site has very little relief and water tends to pool or stand following heavy rains. One large area where water tends to pond is located at the south end of the waste cell constructed by the EPA. During the Remedial Investigation water in this area was approximately two to three feet deep. The north-central portion of the site is drained by several manmade ditches. These drainages run northward into Creosote Branch. Surface waters in the north-east portion of the site flow into an unnamed natural drainage running eastward and northward entering Creosote Branch just upstream of the sewage treatment plant. This creek is the site of a large tar mat which formed as a result of site runoff and/or discharges from the process area. Flow in this creek starts on the northeastern portion of the site.

A surface water holding pond near Grove Street is the only body of water with any significant size or depth. This pond, which is manmade with a berm approximately six to seven feet high appeared onsite between 1973 and 1976. The pond was reportedly constructed to store water for fire- fighting purposes. This pond is approximately one to eight feet deep and occupies 1.5 acres.

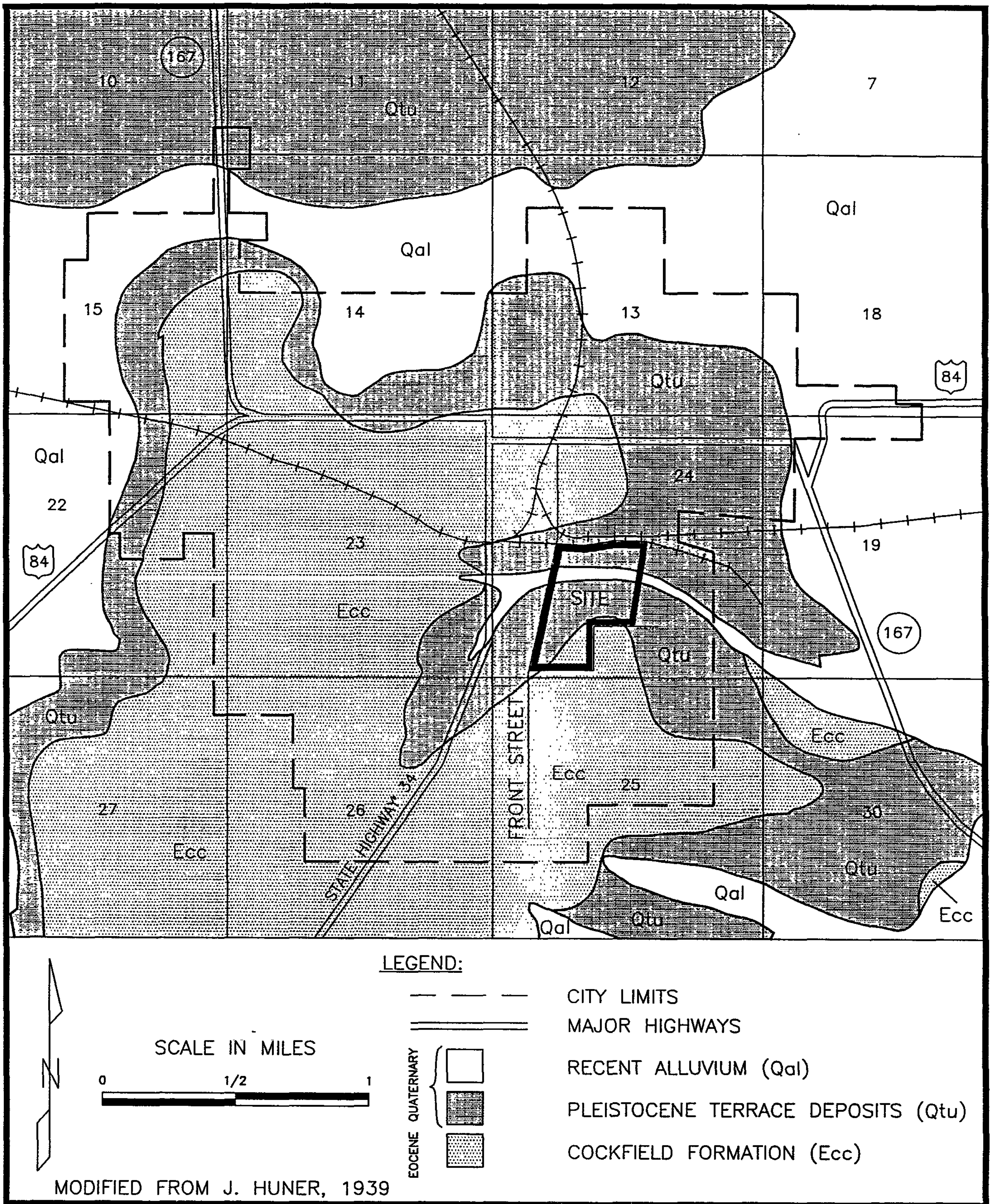
2.3 GEOLOGY

The description of the regional geology presented in this section is based on Huner (1939). Discussion of site geology represents interpretations of surface and subsurface geologic information collected during the current RI. Lithologic logs for borings drilled during the RI are presented in Appendix C.

Northern Louisiana is characterized by dissected hills composed of Cenozoic sedimentary bedrock and Quaternary alluvial valley and floodplain deposits associated with the numerous rivers and bayous. Bedrock units exposed in this portion of the state consist of the Eocene Claiborne Group, specifically the Sparta Sand, the Cook Mountain Formation, and the Cockfield Formation. These units are exposed as low hills forming continuous, sinuous, ridges of low relief. The alluvial valleys contain a variable thickness of graded, unconsolidated sediments deposited by past and present meandering rivers and bayous. Quaternary studies performed by the Louisiana Geological Survey (Huner, 1939) have shown these rivers to have changed course several times in the past blanketing much of northern Louisiana with deposits of gravel, silt, and sand.

Figure 2-2 is a geologic map of the Winnfield area. As can be seen from the map, only Recent channel deposits, Prairie Terrace deposits, and the Cockfield Formation outcrop in the Winnfield area. Figure 2-3 is a schematic cross-section illustrating the subsurface geology in a north-south orientation. The subsurface is typified by nearly horizontal bedrock units overlain by thin deposits of Recent and Late Pleistocene sediments.

The Cane River Formation is the oldest unit within the Eocene Claiborne Group and consists of strata of sandy shale to thick sequences of clay shale, while the lower part of the formation consists of a glauconitic marl and limestone. The Sparta Sand consists of nonmarine sands and intermittent sandy shales and has a thickness of about 250-300 feet in Winn Parish. The Sparta Sand is a major water-bearing unit in northern Louisiana. However, the sequence of sands are not consistent in their production of water. Some beds produce large volumes of water while others may be dry.



PROJECT NO. 7760–033	AMERICAN CRESOSOTE WINNFIELD, LOUISIANA CDM FEDERAL PROGRAMS CORPORATION a subsidiary of Camp Dresser & McKee Inc.	**REGIONAL GEOLOGIC MAP**	FIGURE NO. 2–2 6/92

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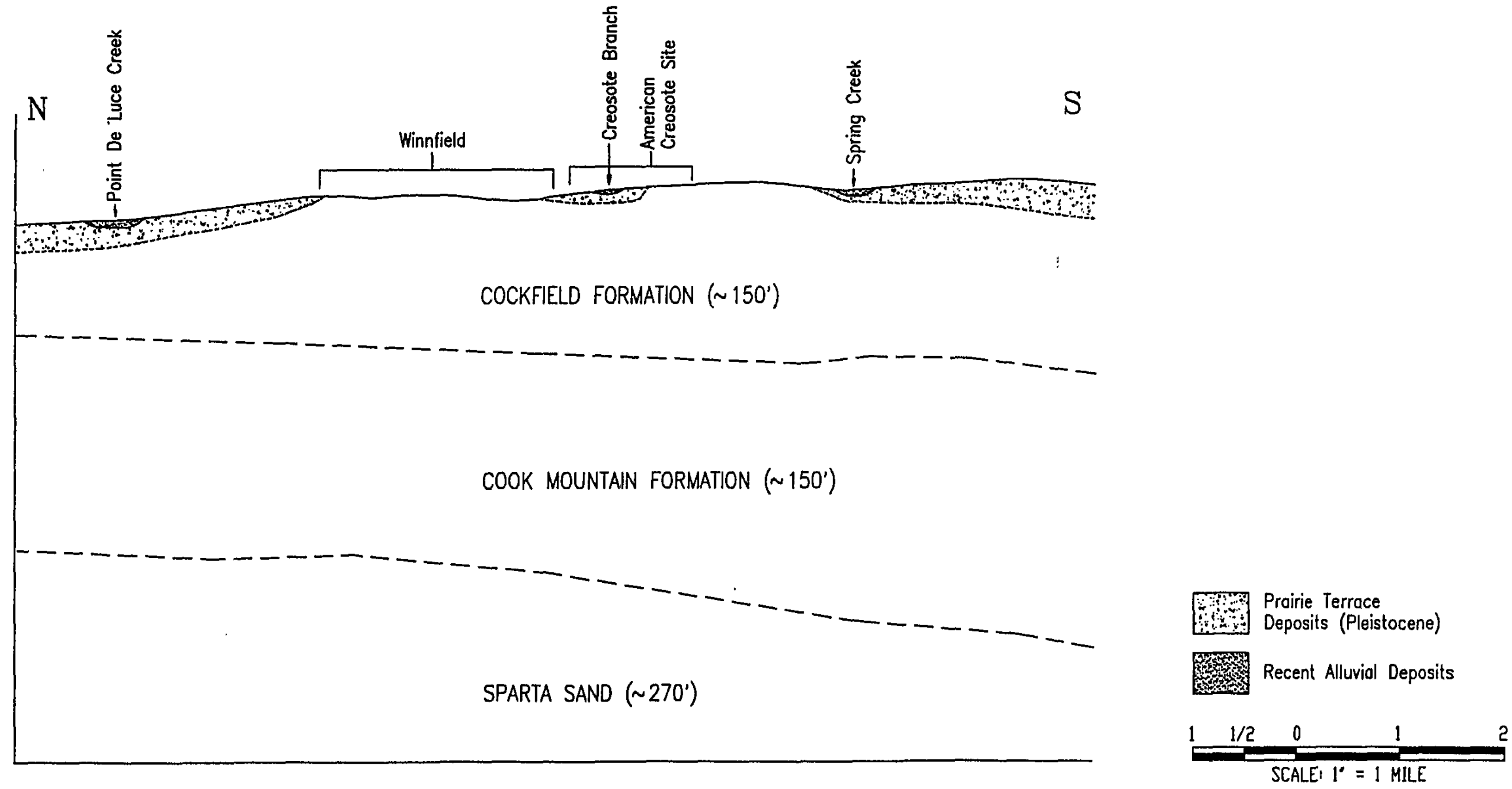

Project No.: 7760-033	American Creosote Winnfield, Louisiana CDM FEDERAL PROGRAMS CORPORATION a subsidiary of Camp Dresser & McKee Inc.	Schematic Regional Geologic Cross-Section	Figure No.: 2-3 6/92

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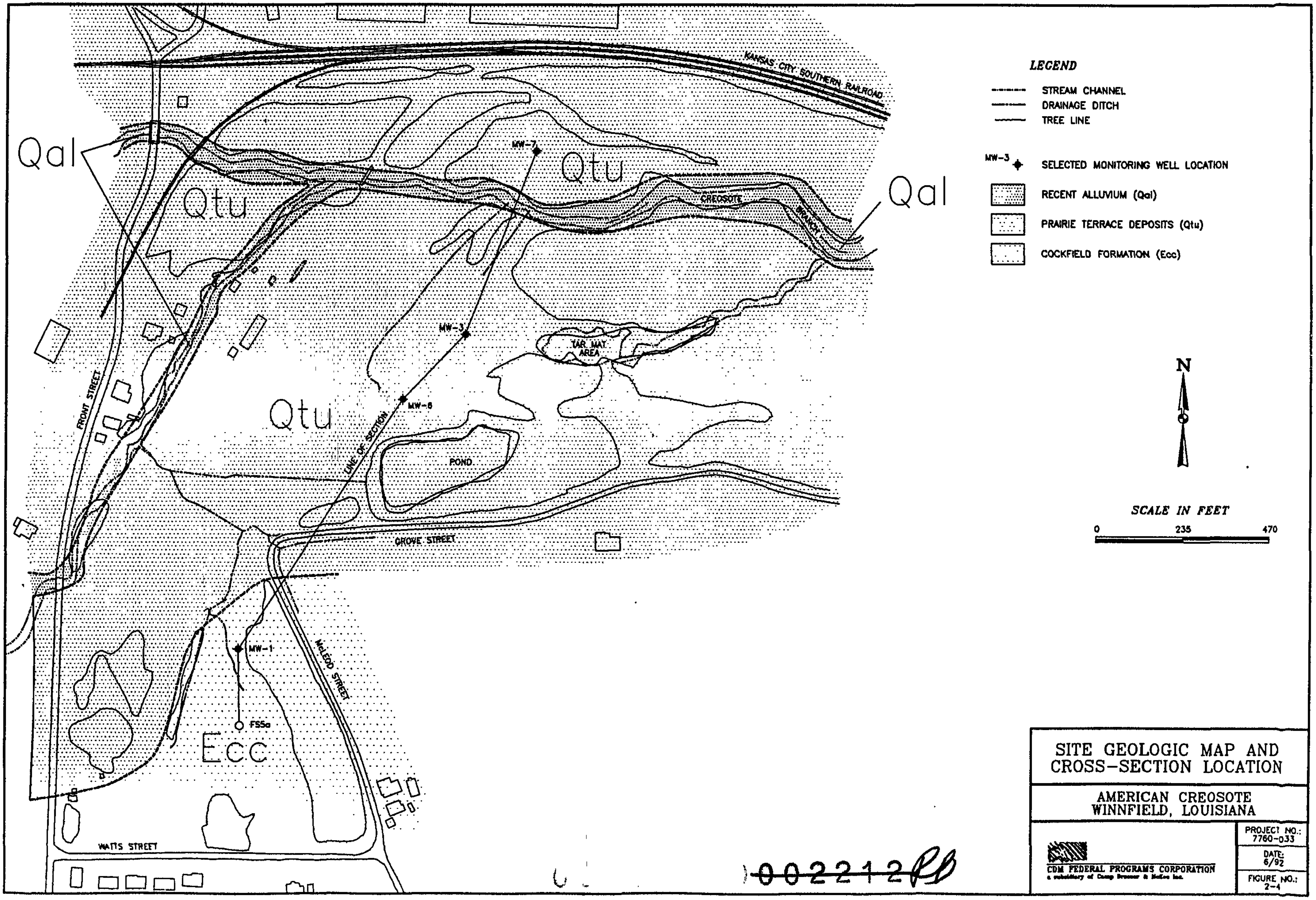
The Cook Mountain Formation is composed of a variety of lithologies including interbedded sands and shales, sometimes containing glauconitic or lignitic material, or ironstones and fossiliferous concretions. The overall thickness of the Cook Mountain Formation in the Winnfield area is approximately 150 feet.

The Cockfield Formation is the only bedrock unit outcropping at the American Creosote site (Figure 2-2). It is nonmarine in origin, derived from predominantly continental sediments, and consists of interbedded silty sands and lignitic shales. The presence of lignite within the formation is an identifying characteristic. The individual beds are very thin, ranging from less than an inch to a few feet thick. The Cockfield Formation is approximately 150 feet thick in the Winnfield area.

The primary alluvial deposits in the Winnfield area consist of Pleistocene terraces. These terrace deposits show a typical fluvial origin consisting of an upward-fining, matrix-containing sand, silt, clay, and gravel lenses. Pleistocene terrace deposits in the Winnfield area have been divided into four groups with the youngest being the Prairie Terrace. Of the four deposits, the Prairie Terrace is the most extensive.

Most of the American Creosote site is underlain by Prairie Terrace deposits (Figure 2-4). These unconsolidated and poorly bedded deposits are up to 100 feet thick and are composed of gravels, sands, and silts. The grading within the terrace deposits show a fining upward sequence with gravels common at the base. The Pleistocene deposits lie unconformable on the Cockfield Formation in the northern portion of the site, and form a wedge which thins to the south. This relationship is illustrated on a cross-section located on Figure 2-4 and presented in Figure 2-5.

Boreholes completed on the southeast portion of the site (MW 1, BH 15, FS-5a, FS-5b) penetrated only the Cockfield Formation. Lithologies encountered consisted of interbedded olive gray to brown silty sands and clayey silts. This formation is finely laminated with beds ranging from 1/4- to 1-inch and shows some signs of oxidation. The beds are easily distinguished and



SITE GEOLOGIC MAP AND CROSS-SECTION LOCATION

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
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PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 2-4

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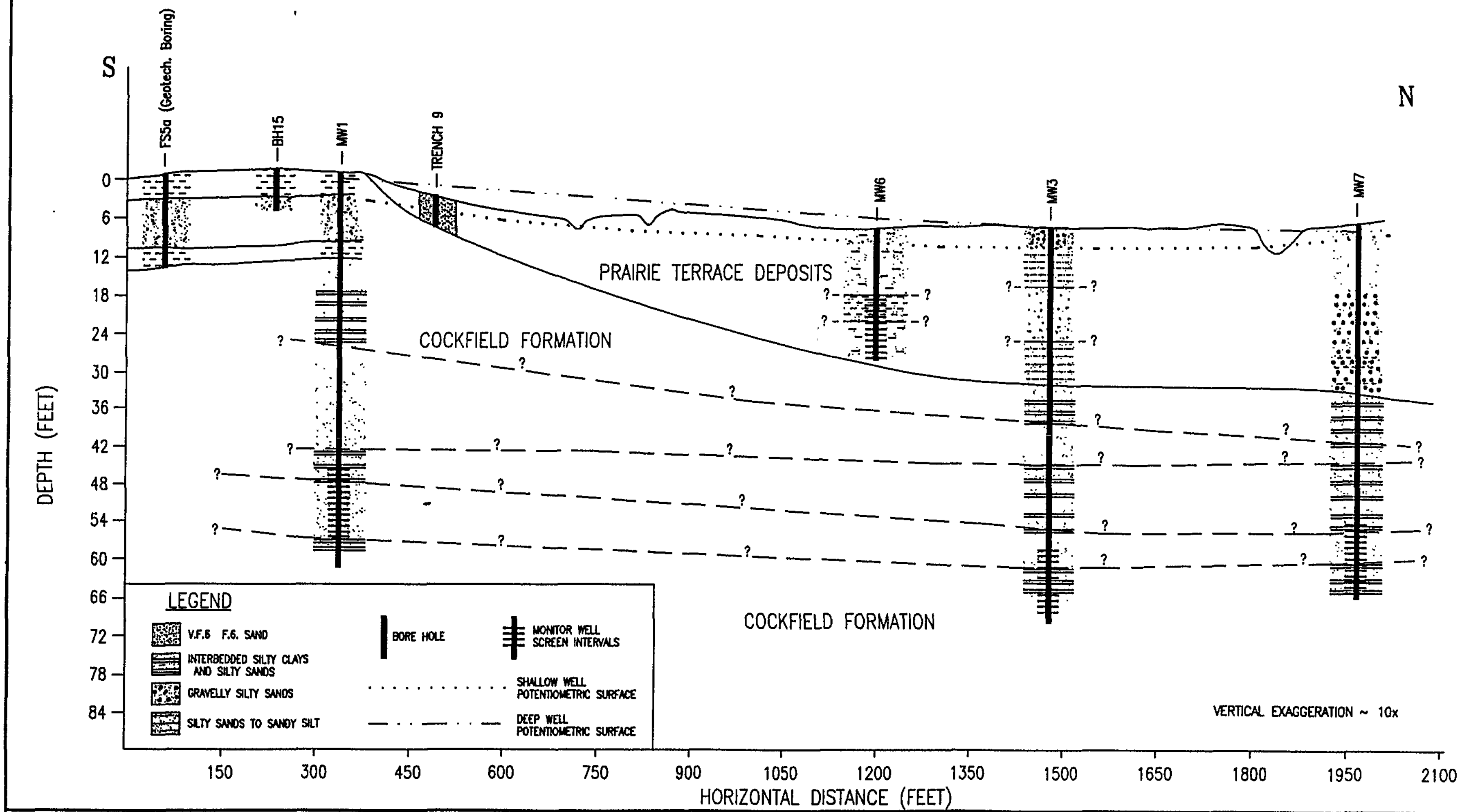

Project No.:
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American Creosote
Winnfield, Louisiana

CDM FEDERAL PROGRAMS CORPORATION
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Site Geologic Cross-Section

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Figure No.:
2-5

6/92

in many places have small veins of lignite, characteristic of the Cockfield Formation. The attitude of beds in an outcrop on the southern portion of the site was determined to have a strike of approximately N 45° E and a dip of about of seven degrees to the northwest. Figure 2-4 illustrates that there is good correlation between these units over short distances.

Installation of monitoring wells and borings in the north central portion of the site revealed approximately 25 feet of Pleistocene deposits above the Cockfield Formation. The contact was characterized by a change from massive structured, brown to gray brown, clayey silts and sands to interbedded silty clays and silty sands with lignite. In all cases, the lignite was concordant with bedding and ranged from 1/8 to 1 inch in thickness. Installation of MW 7 north of Creosote Branch revealed a contact between Pleistocene deposits and the Cockfield Formation at a depth of approximately 28 feet. The Pleistocene deposits at this location consisted of sands with intermittent gravels with a massive structure changing into interbedded silty clays and silty sands with intermittent lignite layers at the contact with the Cockfield Formation. Saturated flowing sands were encountered while drilling each of the four deep wells (MW 1, MW 2, MW 3, MW 7) and BH 16. These horizons quickly flowed to create a level surface when extracted from the core barrel and placed in PVC sample trays. When drilling operations intersected these zones, there were often problems encountered as a result of sand flowing into the auger flights. In general, two main horizons of flowing sands approximately 10 feet in thickness were encountered in each deep borehole.

The site geologic cross-section presented in Figure 2-5 shows a distinct correlation between the units of the Cockfield Formation. Borehole logs plotted on the cross-section, demonstrate that silty interbedded units occur in three distinct zones separated by thicker flowing sands. These sands are at approximately 36 and 54 feet in MW 1 and apparently dip towards the northwest as indicated by the increasing depth of these units in MW 2, MW 3, and MW 7. This observation is consistent with the observed dip at surface outcrops of the Cockfield Formation in the southern portion of the site.

Pleistocene sediments of the Prairie Terrace show little correlation in cross-section. However, the deposits do show a general upward-fining sequence in most boreholes. Sediments near the base of this unit typically consist of silty sands to gravely sands. The sequence typically changes upward in section into a sandy to clayey silt. Within this sequence are lenses of clay, sand, and gravel. These lenses do not correlate from borehole to borehole and were especially evident in the MW 7 borehole where several gravel lenses were observed. The shallow subsurface material (0-2 feet) in some boreholes was characterized by a high gravel content. This probably is due to gravels brought onsite during the operating life of the plant. The general fining upward sequence observed in the Pleistocene deposits is common for sediments of fluvial origin.

2.4 HYDROGEOLOGY

2.4.1 REGIONAL HYDROGEOLOGY

The regional hydrogeology underlying northern Louisiana is controlled by the deltaic and marine beds laid down during the post-Cretaceous period. Potable water is found primarily in the confined aquifers within the Sparta Sand and Cockfield Formation. Fresh water is present in the upper portion of the Sparta Aquifer underlying north-central Louisiana. A saline layer is present at depth. Saline water is present within the entire aquifer thickness in central and north-eastern Louisiana. The southern limit of fresh water in the Sparta Aquifer lies approximately three miles south of the City of Winnfield (Smoot and Seanor, 1991). The Cockfield Aquifer consists of interbedded silty sands and produces lower yields of potable water than that of the Sparta Sand.

Recharge to the western portion of the Sparta Aquifer, and to a lesser extent in the Cockfield Aquifer, occurs predominantly from direct precipitation on exposures of these units in the highlands of northwestern Louisiana. Some Cockfield Aquifer recharge also occurs as upward flow from the underlying Sparta Aquifer east of the recharge zone. In this area, the relatively greater pressure heads within the Sparta Aquifer promote upward flow through the Cook

Mountain Formation to the Cockfield Aquifer. The natural regional flow direction in both aquifers tends to follow the regional geologic dip to the southeast. In northern Louisiana, the natural flow direction is east and southeast with a gradient of approximately seven feet per mile. Natural discharge from these aquifers occurs along outcrops near the Mississippi River alluvium and, to a lesser extent, to local creeks and rivers. Municipal and industrial wells account for a small percentage of discharge (Smoot and Seanor, 1991).

Both aquifers become confined a short distance from their recharge zones as their respective beds dip towards the southeast and are overlain by less permeable shales. The Sparta Aquifer becomes confined as its beds dip below impermeable and semi-permeable beds of the Cook Mountain Formation. The interbedded silts and sandy silts within the channel sands of the Cockfield Formation create locally confined conditions.

Underlying Winn Parish, the more permeable Sparta Aquifer is found at depths of 180 to 300 feet and yields large supplies of fresh water. The Cockfield Aquifer, with its pockets of interbedded silty sands, has lower yields in this area and is not economical for municipal well withdrawal. Heavy pumpage of municipal and industrial wells in Ouichita Parish, northeast of Winn Parish, has changed the Winn Parish regional groundwater flow direction from east southeast to north northeast. The gradient of the potentiometric surface in this area is approximately 13 feet per mile. The fresh/saline water interface is found at depths of approximately 600 feet. The increase in the amount of groundwater usage from municipal and industrial wells has lowered the water table up to 120 feet in Winn Parish which has caused a rise in the underlying saline water (Smoot and Seanor, 1991).

2.4.2 SITE HYDROGEOLOGY

The following discussion of site hydrogeology is based on data gathered during the current investigation at the American Creosote site. Subsurface characterization data from previous investigations is limited to a depth of approximately 12 feet. During the current investigation, 12 piezometers and six monitoring wells were installed at depths of 15 to 25 feet. The purpose of these shallow monitoring points was to evaluate the rates and directions of flow and the degree of contamination in groundwater immediately beneath the site. Four deeper monitoring wells (50-60 feet below grade) were installed to provide information regarding the potential for downward migration of site contaminants and data on the degree of contamination present at these depths.

Lithologic descriptions made during monitoring well installation are presented in cross-section in Figure 2-5. Shallow monitoring wells (with the exception of MW-1A) and nearly all piezometers, are screened within the sandy alluvium of the Prairie Terrace deposits (Figure 2-6). All deep monitoring wells, piezometers PZ 2, PZ 9, and PZ 12, and monitoring well MW-1A are screened in the more fine-grained Cockfield Formation. Several continuous layers of interbedded sandy silt and silt separate the shallow and deep aquifer zones screened by the monitoring wells. The degree of hydraulic separation afforded by these layers of interbedded silt cannot be determined with data currently available. However, as will be discussed in Section 4.0, the absence of contaminants in groundwater samples collected below these interbedded layers suggests they are effective in limiting communication between the aquifer zones.

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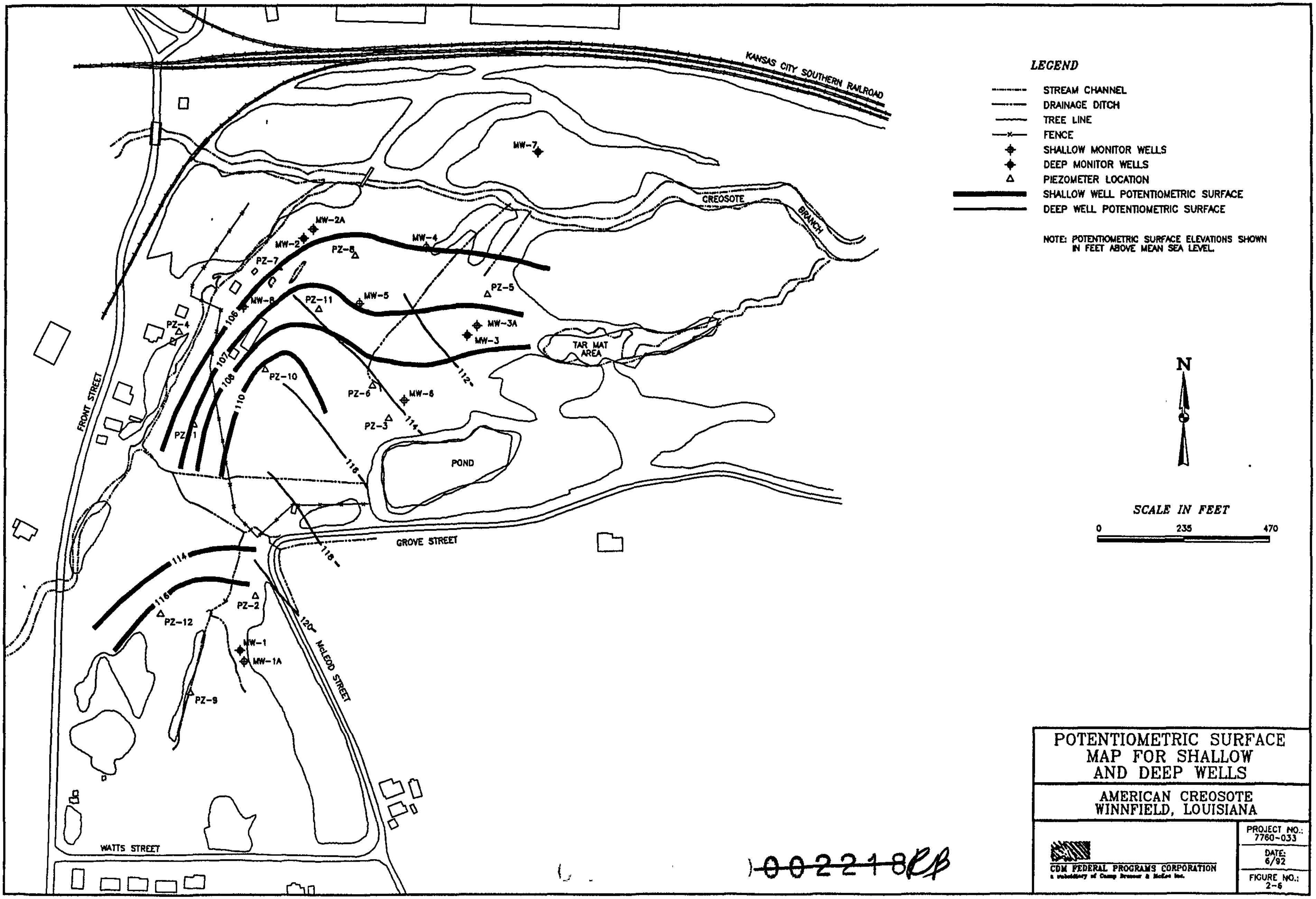
Groundwater within the Prairie Terrace deposits appears to be under confined conditions. During drilling, saturated materials were first encountered at a depth of eight to ten feet. Over a period of several hours, water would rise in the borehole to within a few feet of the surface. Saturated conditions continued downward throughout the alluvial deposits. In some instances, interbedded silt of the Cockfield Formation encountered between the shallow and deep aquifer zones was found to be unsaturated.

Water-level measurements taken at the 12 piezometers and six shallow monitoring wells were used to interpret the potentiometric surface for this aquifer zone (Figure 2-6). Potentiometric contours indicate the shallow aquifer zone discharges to Creosote Branch along the northern and



POTENTIOMETRIC SURFACE
MAP FOR SHALLOW
AND DEEP WELLS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
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PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 2-6

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western site boundaries. Flow direction within most of the site is to the north, towards Creosote Branch, with a gradient of approximately 0.007 foot per foot. The gradient steepens within approximately 300 feet of the creek, where drainage is westward or northward with a gradient of 0.028 foot per foot. A potentiometric high is situated in the vicinity of piezometer PZ-10, indicating the presence of a groundwater mound. This potentiometric high suggests the existence of a possible recharge zone west-southwest of the waste cell. Standing surface water resulting from precipitation (as was observed during the investigation) may recharge the shallow aquifer at this location.

The relationship between shallow groundwater-flow systems in the northern and southern portions of the site is not clear. Shallow wells and piezometers in the southern portion of the site are screened in the Cockfield Formation, while those in the northern portion are screened in the Prairie Terrace deposits. It appears that flow is generally from the south to the north. However, the potentiometric surface map suggests that some portion of the shallow groundwater flowing northward is discharged to the east-west drainage ditch originating at the intersection of McLeod and Grove Streets (Figure 2-6). A low-base flow was observed in this ditch throughout much of the field investigation.

The potentiometric surface for the deeper aquifer zone is also depicted in Figure 2-6. Water-level measurements from the four deep wells were used to interpret this surface. Flow direction is to the northeast at a gradient of approximately 0.010 feet per foot. Water levels in the four deep monitoring wells range from three feet above to one foot below grade. Comparison of the shallow and deep potentiometric surfaces illustrates the presence of an upward vertical gradient across the site. An analysis of the vertical gradient present at each monitoring well pair is presented in Table 2-1. The presence of an upward vertical gradient suggests groundwater flow may exist from the deep to the shallow aquifer zone. This flow would be impeded by the interbedded silts and sandy silts present between these aquifer zones. Insufficient data exist to evaluate or quantify vertical groundwater flow at the site. However, analytical data presented in Section 4.0 indicate that the deep zone is not contaminated which may be due to both the presence of geologic confining units and the upward hydraulic gradient observed.

TABLE 2-1

ANALYSIS OF VERTICAL HYDRAULIC GRADIENTS AT SHALLOW AND DEEP MONITORING WELL PAIRS

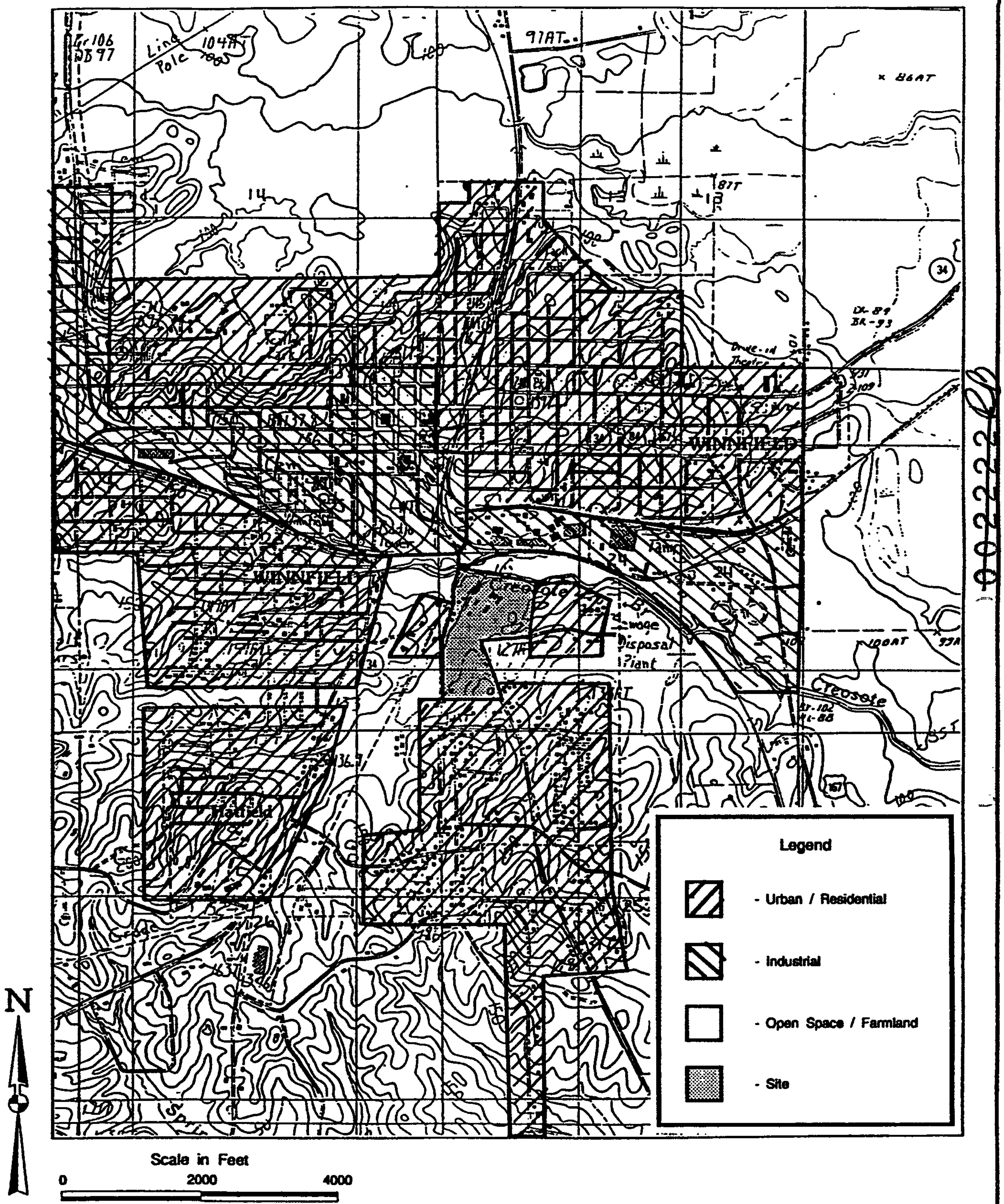
WELL ID	SCREENED INTERVAL (ft)	WATER LEVEL ELEVATION (4/28/92)	DIFFERENCE (ft)	UPWARD VERTICAL GRADIENT (ft/ft)
MW-1	47.5-57.5	121.64	+3.55	0.15
MW-1A	14-24	118.09		
MW-2	52.5-62.5	112.92	+8.58	0.26
MW-2A	9-19	104.34		
MW-3	52.5-62.5	110.34	+2.39	0.07
MW-3A	5-20	107.95		

Horizontal hydraulic conductivity of the shallow and deep aquifer zones was determined through the interpretation of slug-test data collected during the current investigation. Methods employed in the conduct and interpretation of slug tests are described in Appendix A. Values determined for the shallow aquifer zone (Prairie Terrace deposits) range from 0.25 to 4.0 gal/day/ft^2. Results obtained for the deeper aquifer zone were 0.25 to 3.5 gal/day/ft^2. Conductivity values for both aquifer zones fall within the expected range for unconsolidated silts and silty sands (Freeze and Cherry, 1979). Assuming a porosity of 30 percent and an average hydraulic conductivity of 2.05 gal/day/ft^2 for sediments of the shallow zone, calculated groundwater horizontal flow rates would be approximately 0.006 feet per day in the north-central portion of the site and 0.025 feet per day near Creosote Branch. Using the same figure for porosity in the deep aquifer zone and a mean hydraulic conductivity of 1.88 gal/day/ft^2, the calculated groundwater horizontal-flow rate would be 0.008 feet per day.

2.5 DEMOGRAPHY AND LAND USE

Land in the Winnfield area supports agricultural, residential, and recreational uses. Agricultural uses are localized in a few small areas between forested lands and land used for residential housing. The crop land is cultivated for several different types of crops including soybeans, wheat, cotton, and corn. The forests within the area are used for lumber production and several lumber mills exist in the surrounding area of Winnfield. One large former lumbermill which produced fence posts and other forestry products was located immediately north of Creosote Branch adjacent to the Kansas-Missouri Railroad. Production of lumber has been a primary industry in the area for several decades. Lumber produced includes wood from trees such as the white pine, cypress, hickory, and oak.

Residential neighborhoods are present in all directions from the site. The City of Winnfield located north of the site has a population of approximately 7,000 residents. Numerous businesses and private residences are located within the city which covers approximately two square miles. A housing development lies to the south of the American Creosote site along McLeod and Watts Streets. Outside city limits, the area is primarily rural with very few residences. These lands are predominantly forests and cypress swamps with intermittent crop land. The forested lands in the area also support recreational uses such as hunting, fishing, camping, and hiking. The U.S. National Forest Service maintains camp sites and picnic areas in the nearby Kisatchie National Forest. Land use patterns in the vicinity of the American Creosote site are shown in Figure 2-7.



Source: USGS 7.5 min. Winnfield East & West, La. Quadrangles

Project No.: 7760-033	American Creosote Winnfield, Louisiana CDM FEDERAL PROGRAMS CORPORATION a subsidiary of Camp Dresser & McKee Inc.	Land Use Map	Figure No.: 2-7 4/92

Section 3.0

3.0 PREVIOUS INVESTIGATIONS

3.1 CHRONOLOGY AND METHODS

In March 1987, the EPA's Emergency Response Branch (ERB) assigned a Technical Assistance Team (TAT) to make a visual inspection of the American Creosote site to assess the nature and extent of contamination. At the time of the TAT's initial inspection, the site consisted of numerous unsecured buildings and structures including the following: a machine (tool and die) shop, simple chemistry lab, field office, several storage facilities, 15 above-ground storage tanks, at least one gas pump with accompanying underground storage tank, three boilers, and five retorts. The lab and storage facilities contained numerous chemicals, labware, and other material posing an environmental and public health hazard. Two storage tanks were without manway covers and were surrounded by pools of liquid creosote or soils saturated with creosote. Storage tank conditions were deteriorating, and none of the tanks had secondary containment structures to intercept spilled or leaking product from entering the soil. The retorts were located in shallow cement basins which contained rainwater, creosote, PCP, and related products. During storm events, these basins would overflow, and spill contaminated fluids to the adjacent soil and to Creosote Branch via overland flow and drainage ditches. A "black lagoon" or unlined impoundment formerly used for waste creosote, PCP solvents, and other spent wood-treating chemicals was present immediately east of the wood-treating facility. A swampy area containing a viscous tar-like material was located northeast of the process area had crusted over in many places and resembled asphalt. This tar mat extended along a natural drainage which emptied into Creosote Branch. The TAT investigation prompted further investigative measures.

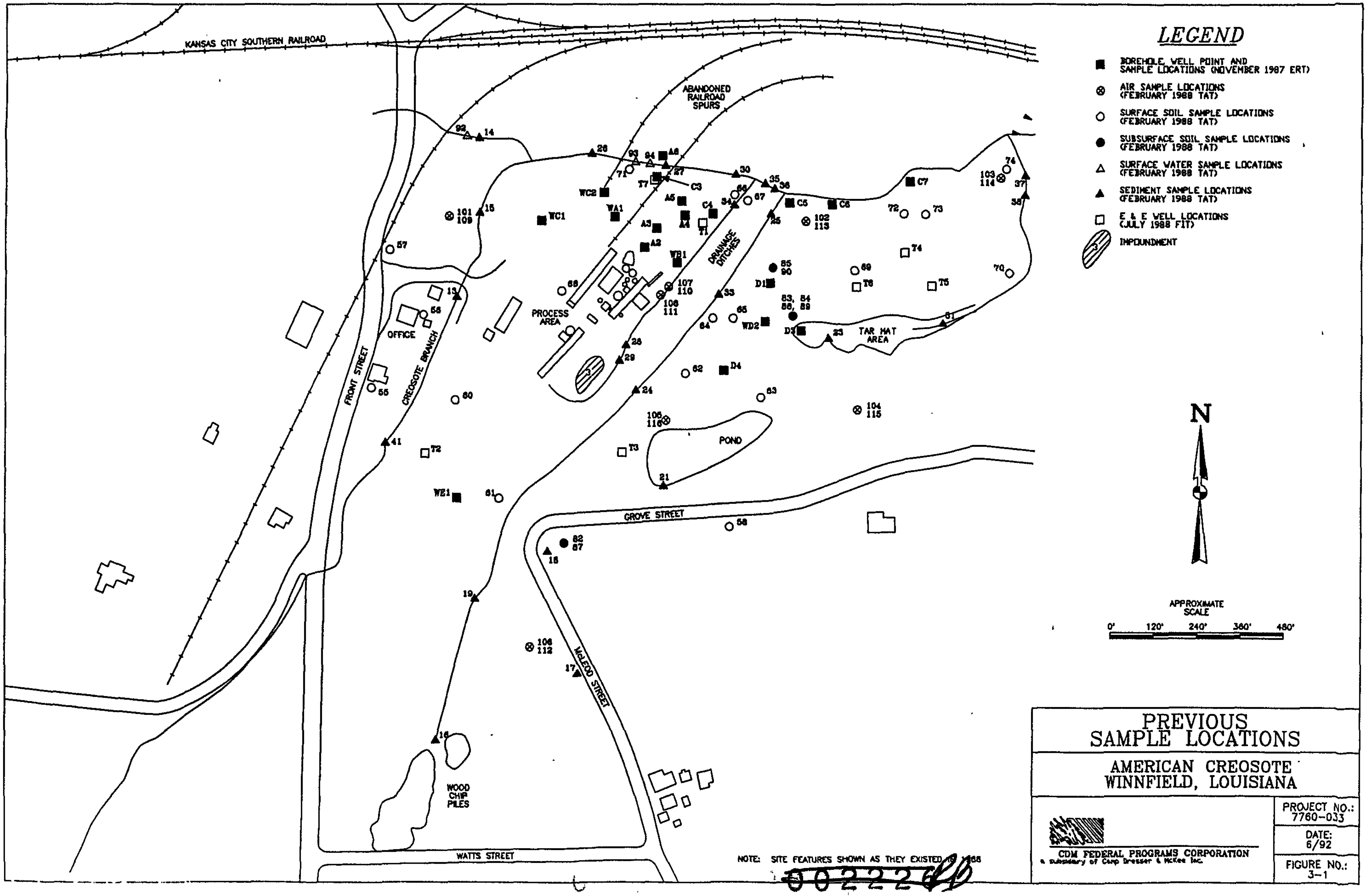
On August 3, 1987 EPA assembled a TAT Emergency Response Team (ERT) to conduct a more thorough site survey. The results prompted implementation of a detailed multimedia environmental sampling program. This effort was undertaken by ERT from August 24-28, 1987. The investigation consisted of soil-gas surveys, bio-assays, air monitoring, lagoon surface water sampling, municipal well water sampling, and sediment and surface soil sampling. Soil samples were taken from locations within the tar mat and from sections suspected to be abandoned sludge pits between the process area and Creosote Branch. Soil, water, and sediment samples were also taken for Priority Pollutant Analysis. In September of 1987, the TAT (or ERT) sampled fibrous material present on several retorts and tanks for asbestos analysis. Scanning electron microscope (SEM) and energy dispersion X-ray microanalysis (EDX) tests indicated this material was fiberglass insulation and contained no asbestos.

In November 1987 the ERT was tasked to collect onsite subsurface soil and groundwater samples in order to:

- Determine the extent of groundwater and soil contamination by volatile organic compounds (VOCs); base, neutral, and acid extractable compounds (BNAs); phenolics; and dioxin/furans
- Describe the obvious contaminated areas
- Calculate the volume of contaminated waste present in the soil, settling lagoons, the tar mat, and surrounding areas.

Twenty-three borings (seven of which were converted to monitoring wells) were drilled using a portable power auger. Boring locations were selected to characterize and define lithology and contamination in three general areas of the site (Figure 3-1). Borings labeled with the letter "A" were drilled along the northern portion of the process area; borings labeled "C" were located in a line along the south bank of Creosote Branch; borings labeled "D" intercepted suspect abandoned impoundments. Each of these borings was drilled to a depth of approximately 12 feet.

Soil boring samples were collected from zones exhibiting visual evidence of contamination. The ERT report also includes suggested response actions (ERT, 1987).



NOTE: SITE FEATURES SHOWN AS THEY EXISTED IN 1988

PREVIOUS SAMPLE LOCATIONS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 3-1

In February of 1988, EPA tasked a Field Investigation Team (FIT) to conduct additional sampling and gather information pertaining to potential and real environmental hazards on the site. Air samples were collected upwind and downwind from the plant process area, suspect sludge pits, and the existing tar mat. Surface soil and sediment samples were collected from areas along the two main drainage ditches, the north and northeast area drainages, and along Creosote Branch. Water samples were taken from the Winnfield and Redhill municipal water wells. Electromagnetic (EM-31) geophysical surveys were conducted along both sides of the main drainage ditches to be used as an aid in determining hydraulic conductivity. Demographic surveys were reportedly also conducted.

In the summer of 1988, the TAT conducted further investigations consisting of two phases. Phase I (June 20-24) consisted of borehole slug tests and seismic refraction tests to determine hydraulic conductivities and provide information on subsurface geologic features, respectively. Phase II (July 25-29) consisted of the installation of seven additional boreholes and collection of subsurface soil samples. Soil textures and grain size distributions were determined from soil sieve and hydrometer tests.

Table 3-1 provides a summary of previous investigations at the American Creosote site. Laboratory analytical data from previous investigations are presented in Appendix A. Sample designations used in Appendix A correspond to those presented in Figure 3-1.

3.2 RESPONSE ACTION

The results from the February 1988 FIT investigative efforts provided conclusive evidence that the site posed a significant health and environmental hazard. In March of 1988, the EPA issued an Administrative Order to Stallworth Timber Company to fence and post warning signs around the most contaminated portions of the site. A strong recommendation was made to Stallworth Timber Company by the EPA to excavate an east-west ditch through the center of the site to divert

TABLE 3-1

SUMMARY OF PREVIOUS INVESTIGATIONS AT THE AMERICAN CREOSOTE SITE

Investigative Team	Date	Activities
Technical Assistance Team (TAT)	March 1987	• Visual inspection to determine nature and extent of contamination
Emergency Response Team (ERT)	August 1987	• Multi-media environmental sampling program to assess contamination
Emergency Response Team (ERT)	September 1987	• Asbestos analysis of fibers on retorts
Emergency Response Team (ERT)	November 1987	• Subsurface soil samples collected and analyzed from 23 borings drilled along 4 transect lines - soil samples collected and analyzed for priority pollutants
		• Waste volume estimates calculated
Field Investigative Team (FIT)	February 1988	• Further sample collection undertaken - emphasis on surface soil, sediments and air samples
		• Demographic and geophysical survey undertaken
Technical Assistance Team (TAT)	June - July 1988	• Seismic refraction survey and slug test undertaken to determine subsurface features and hydraulic conductivity, respectively
		• Determination of soil textures from sieve and hydrometer tests
		• Collection of additional subsurface soil samples from new boreholes drilled.

surface water from the southern portion of the site away from the former process area. The EPA further recommended Stallworth Timber Company fill in the existing north-south ditches draining process area.

In June 1988, the most contaminated portion of the site was fenced in by Stallworth Timber Company. During oversight monitoring of this action, an Emergency Response Cleanup Services (ERCS) contractor noticed two storage tanks which were in imminent danger of rupturing. This prompted immediate mobilization of an ERCS team to drain the tanks and construct a berm around the process area in order to contain and stabilize the heavily contaminated soils. Heavy rains in July of 1988 threatened to overflow and erode the berm. Consequently ERCS was remobilized to extend the berm height and install an overflow filtration system.

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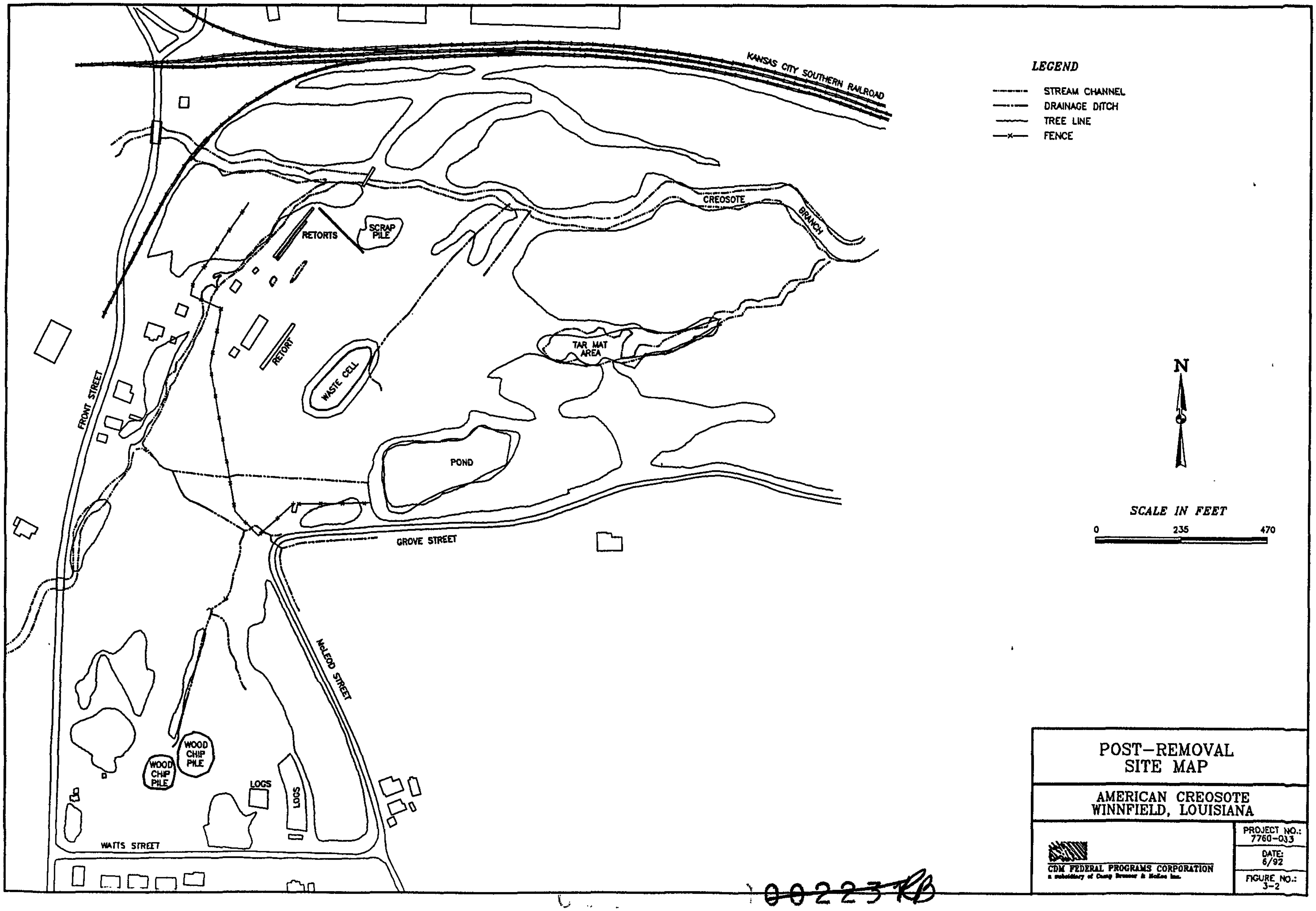
In February 1989, the EPA endorsed a Request for Removal Action based on site data collected during the previously described investigations. Between March 17 and August 31, 1989 EPA's ERCS conducted an Emergency Removal Action at the site. The following steps were taken to stabilize the site.

- Fluids from all storage tanks were consolidated into a single tank.
- An east-west drainage ditch was constructed to redirect surface water originating from the southern portion of the site away from the heavily contaminated northern portion.
- The largest north-south drainage ditch running through the most contaminated area, was backfilled.
- Contaminated water from holding ponds, lagoons, storage tanks, and containment basins was filtered and discharged (presumably to Creosote Branch).
- Waste wood-treating fluids and sludges from storage tanks and contaminant areas were transferred to a former impoundment, solidified with fly ash and rice hulls, and capped.

- Building and process equipment were dismantled and an attempt was made to decontaminate the debris. This debris was placed in a scrap pile immediately northwest of the process area.

Figure 3-2 illustrates American Creosote site features following the 1989 EPA Removal Action. No further removal or stabilization activities have taken place at the site.



POST–REMOVAL
SITE MAP

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 3-2

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Section 4.0

4.0 REMEDIAL INVESTIGATION

4.1 OBJECTIVES

The overall objective of the American Creosote Remedial Investigation was to collect data to determine the nature and extent of contamination onsite as well as assess the degree which contaminants have migrated offsite. The data collected was intended to be sufficient for use in current and potential risks and to evaluate remedial alternatives for the selection of a conceptual remedy. In expediting the RI/FS process for this project, it was assumed that some details of site interpretation would be shifted to the remedial design phase. The section presents the methods and results of the Remedial Investigation necessary for conceptual remedy selection.

In order to accomplish the stated objectives, a field investigation was conducted from February 10, 1992 to March 15, 1992. The field investigation was conducted according to plans and procedures described in the Field Sampling Plan (CDM 1992) and discussed in Section 4.6. The field investigation included the following tasks:

- Site survey and mapping
- Surface soil investigation
- Surface water and sediment investigation
- Subsurface soil investigation
- Groundwater investigation
- Waste characterization sampling

Air sampling was not considered to be necessary since previous investigations found no emissions at site perimeter. In order to interpret the extent of contamination, estimate waste quantities, and locate migration pathways, site surveying and mapping were performed and are presented in Section 2.0. Methods and results of waste characterization sampling are presented in Appendix F. The methods and results of each of the other investigation tasks are discussed in this section.

4.2 SURFACE SOIL INVESTIGATION

The aim of the surface soil sampling program was to define the extent and magnitude of surface soil contamination at the site under present conditions.

4.2.1 SAMPLING LOCATIONS, DESIGNATIONS, AND ANALYSIS

Twenty one surface soil samples were collected during February and March 1992 for the RI/FS at the American Creosote site. The sampling locations are shown in Figure 4-1.

The former process area consists of approximately five acres in the northwest portion of the site, south of Creosote Branch. Sampling locations in the former process area included SS-1, SS-2, SS-4 through SS-9, SS-13, and SS-18. Soil samples from most of these locations showed visible signs of contamination, including black stains, pieces of hardened creosote, and a creosote odor. Samples collected at locations SS-1, SS-2, SS-4, SS-5, SS-7, and SS-18 showed visible signs of contamination. Of these, SS-5 and SS-18 appeared to be the most contaminated.

The impoundment and drainage areas (including the tar mat) are located north and east of the former process area. One sample, SS-14, was collected in the former impoundment area. No visible contamination was noted at this location. Sample SS-15, SS-16, and SS-17 were collected to characterize drainage areas other than the tar mat. Of these samples, only SS-17 had visible evidence of contamination.

Samples collected outside of the former process, impoundment, and drainage areas included the area north of Creosote Branch (locations SS-19, SS-21, and SS-22) and the southern portion of the site (locations SS-10, SS-11, and SS-12). None of these samples were visibly contaminated.

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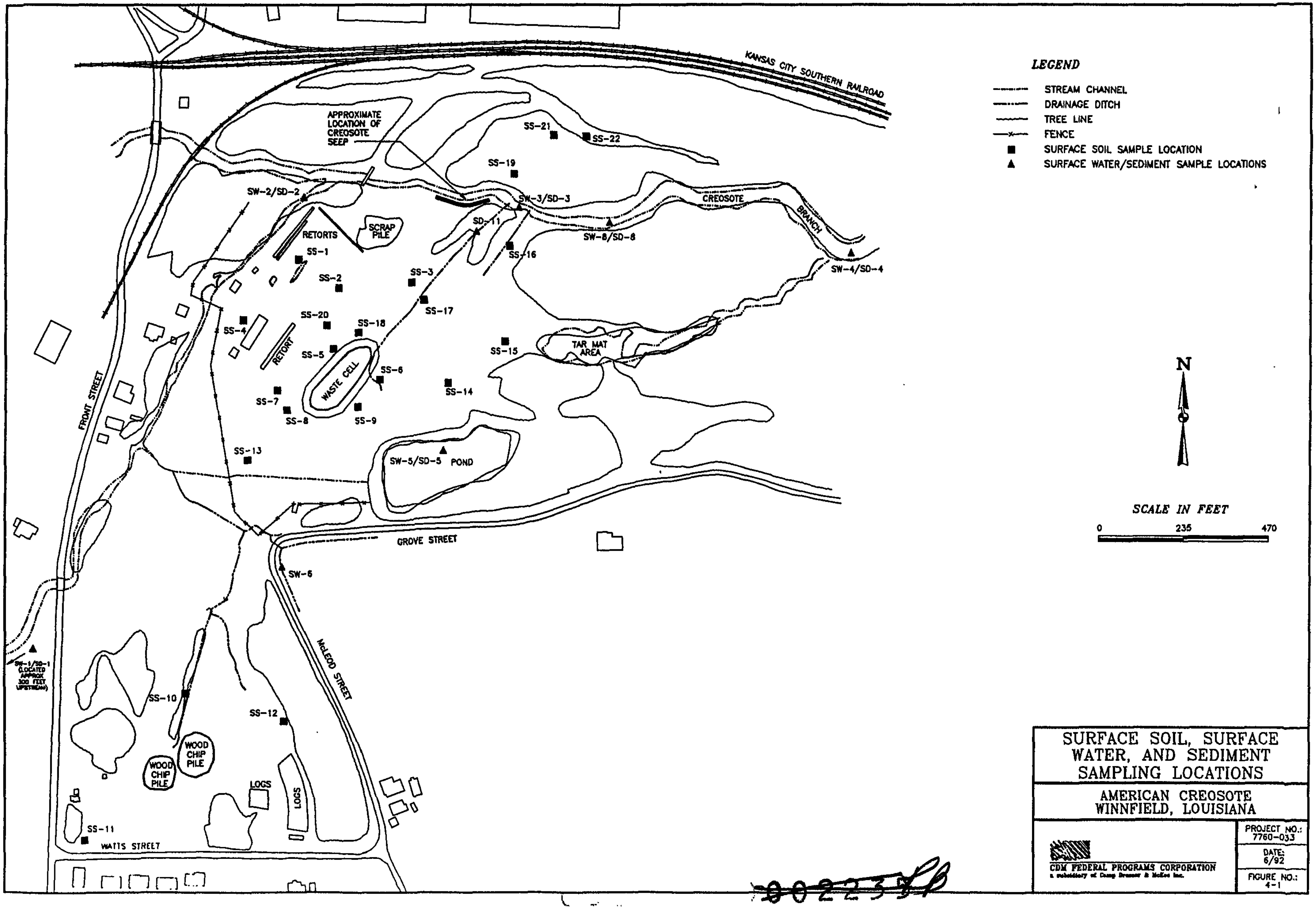

SURFACE SOIL, SURFACE WATER, AND SEDIMENT SAMPLING LOCATIONS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 4-1

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Each surface soil sample is identified by a unique code which indicates the site number, sample location, media sampled, and sample number from that location. An example identification code for surface soil samples is shown below:

200-SS-07-SL-001

In this example, 200 is the American Creosote site number, SS-07 is the surface soil sampling location, SL indicates that the sample matrix is soil, and 001 is the sample number taken from that location. In most cases, one sample was collected at each sampling location. However, a colocated sample and a split sample were collected at location SS-05 and were identified using sample numbers 002 and 003, respectively. Table 4-1 lists the subsurface soil samples taken as well as other pertinent information including EPA identification numbers.

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4.2.2 SURFACE SOIL SAMPLING RESULTS

Analytical data for surface soils are available from current and previous investigations. Surface soil data from previous investigations are most useful for those areas not disturbed during the 1989 removal action at the site. Surface soil sampling in the current investigation focused on providing information in those areas modified during the removal action or not covered by previous sampling. Figures 4-1 and 3-1 illustrate surface soil sampling locations for the current and previous investigations, respectively. Data for surface soil samples collected during the current and previous investigations are presented in Table 4-2 and in Appendix A, respectively. Portions of the site for which surface soil data exist include the following areas which can be seen in Figure 1-2.

- The former process area
- The former impoundment area
- The drainage areas north and northeast of the process area
- The southern portion of the site

TABLE 4-1

MATRIX OF SURFACE SOIL, SURFACE WATER, AND SEDIMENT SAMPLES COLLECTED

	Sampling Information					QTM		SAS				TCLP		
Sample I.D.	Depth (in)	Grab	Comp.	Split	Colocate	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
SS-01-SL-001	0-2		X			QF0175	QF0175							
SS-02-SL-001	0-2		X			QF0173	QF0173							
SS-03-SL-001	0-2		X			QF0176	QF0176							
SS-04-SL-001	0-2		X			QF0177	QF0177							
SS-05-SL-001	0-2		X			QF0213	QF0213	SF2490	SF2484	SF2493		SF2496	SF2484	SF2496
SS-05-SL-002	0-2		X		X	QF0214	QF0214	SF2491	SF2485	SF2494		SF2488	SF2485	SF2497
SS-05-SL-003	0-2		X	X		QF0215	QF0215	SF2492	SF2486	SF2495		SF2489	SF2486	SF2498
SS-06-SL-001	0-2		X			QF0222	QF0222							
SS-07-SL-001	0-2		X			QF0182	QF0182							
SS-08-SL-001	0-2		X			QF0178	QF0178							
SS-09-SL-001	0-2		X			QF0179	QF0179							
SS-10-SL-001	0-2		X			QF0169	QF0169							
SS-11-SL-001	0-2		X			QF0170	QF0170							
SS-12-SL-001	0-2		X			QF0171	1F0171							
SS-13-SL-001	0-2		X			QF0216	QF0216							
SS-14-SL-001	0-2		X			QF0217	QF0217							
SS-15-SL-001	0-2		X			QF0218	QF0218							
SS-16-SL-001	0-2		X			QF0219	QF0219							
SS-17-SL-001	0-2		X			QF0220	QF0220							
SS-18-SL-001	0-2		X			QF0174	QF0174							
SS-19-SL-001	0-2		X			QF0221	QF0221							
SS-21-SL-001	0-2		X			QF0240	QF0238							
SS-22-SL-001	0-2		X			QF0239	QF0237							

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TABLE 4-1 (continued)

MATRIX OF SURFACE SOIL, SURFACE WATER, AND SEDIMENT SAMPLES COLLECTED

	Sampling Information					QTM		SAS						
												TCLP		
Sample I.D.	Depth (in)	Grab	Comp.	Split	Colocate	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
SD-01-SD-001		X				QF0180	QF0180							
SD-02-SD-001		X				QF0181	QF0181							
SD-03-SD-001		X				QF0193	QF0193	SF2451	SF2468	SF2459		SF2456	SF2465	SF2462
SD-03-SD-002		X			X	QF0194	QF0194	SF2452	SF2469	SF2460		SF2457	SF2466	SF2463
SD-03-SD-003		X		X		QF0195	QF0195	SF2453	SF24470	SF2461		SF2458	SF2467	SF2464
SD-04-SD-001		X				QF0188	QF0188							
SD-05-SD-001		X				QF0189	QF0189							
SD-07-SD-001		X				QFO190	QF0190							
SD-08-SD-001		X				QF0223	QF0223							
SD-09-SD-001		X				QF0230	QF0227							
SD-10-SD-001		X				QF0229	QF0228					SF2457	SF2466	SF2463
SD-11-SD-001		X									SF2907			
SW-01-SW-001		X				QF0184	QF0184							
SW-02-SW-001		X				QF0183	QF0183							
SW-03-SW-001		X				QF0197	QF0197	SF2454		SF2471				
SW-03-SW-002		X			X	QFO196	QFO196	SF2455		SF2472				
SW-04-SW-001		X				QF0186	QF0186							
SW-05-SW-001		X				QF0187	QF0187							
SW-06-SW-001		X				QF0203	QF0203							
SW-08-SW-001		X				QF0224	QF0224	SF2499		SF2500				

[1] GC-FID (see QTM Statement of Work 7/91).
[2] GC-PID-ELCD (see QTM Statement of Work 7/91).
[3] GC-FID (see QTM Statement of Work 7/91).
[4] U.S. EPA SW-846, Method 8020.
[5] U.S. EPA SW-846, Method 8310.
[6] U.S. EPA SW-846, Method 8040.
[7] U.S. EPA SW-846, Method 8280.
[8] U.S. EPA SW-846, Method 6010.
[9] U.S. EPA SW-846, Method 8270.
[10] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8240 (analysis).
[11] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8270 (analysis).
[12] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8280 (analysis).
[13] U.S. EPA TCLP, Method 1311 (extraction) and CLP Statement of Work 3/90.

TABLE 4-2. SUMMARY OF QTM DATA FOR SURFACE SOIL SAMPLES.

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH	SS-01-SL-001 QF0175		SS-02-SL-001 QF0173		SS-03-SL-001 QF0176		SS-04-SL-001 QF0177		SS-05-SL-001 QF0213		SS-06-SL-001 QF0222		SS-07-SL-001 QF0182		SS-08-SL-001 QF0178		SS-09-SL-001 QF0179		SS-10-SL-001 QF0169	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PAH ANALYTES (330)	QF0175RE µg/Kg	Q	QF0173 µg/Kg	Q	QF0176RE µg/Kg	Q	QF0177RE µg/Kg	Q	QF0213 µg/Kg	Q	QF0222 µg/Kg	Q	QF0182 µg/Kg	Q	QF0178RE µg/Kg	Q	QF0179RE µg/Kg	Q	QF0169 µg/Kg	Q
NAPHTHALENE	960.00	J	163.00	J	310.00	J	76.00	J	650.00	J	31.00	J	188.00	J	290.00	J	200.00	J	41.00	J
ACENAPHTHYLENE	1200.00	J	-	UJ	670.00	J	2000.00	J	700.00	J	95.00	J	615.00	J	110.00	J	140.00	J	-	UJ
ACENAPHTHENE	570.00	J	687.00	J	1700.00	J	1500.00	J	630.00	J	49.00	J	910.00	J	120.00	J	240.00	J	-	UJ
FLUORENE	690.00	J	1092.00	J	1100.00	J	6700.00	J	2300.00	J	38.00	J	2160.00	J	120.00	J	510.00	J	-	UJ
PHENANTHRENE	7600.00	J	3316.00	J	6300.00	J	13000.00	J	9200.00	J	300.00	J	-	UJ	1300.00	J	1700.00	J	92.00	J
ANTHRACENE	4600.00	J	27440.00	J	6700.00	J	5300.00	J	20000.00	J	450.00	J	-	UJ	1200.00	J	29000.00	J	-	UJ
FLUORANTHENE	24000.00	J	30846.00	J	-	UJ	16000.00	J	15000.00	J	1200.00	J	-	UJ	3500.00	J	32000.00	J	202.00	J
PYRENE	24000.00	J	28631.00	J	-	UJ	16000.00	J	16000.00	J	1300.00	J	-	UJ	4500.00	J	55000.00	J	215.00	J
BENZ(A)ANTHRACENE	23000.00	J	13094.00	J	-	UJ	950.00	J	10000.00	J	1400.00	J	-	UJ	4200.00	J	14000.00	J	161.00	J
CHRYSENE	16000.00	J	14948.00	J	37000.00	J	730.00	J	7600.00	J	840.00	J	41755.00	J	3100.00	J	13000.00	J	247.00	J
BENZO(B)/(K)FLUORANTHENE	-	UJ	19278.00	J	-	UJ	1700.00	J	19000.00	J	3200.00	J	-	UJ	7100.00	J	16000.00	J	490.00	J
BENZO(A)PYRENE	11000.00	J	7234.00	J	24000.00	J	260.00	J	6900.00	J	1200.00	J	16099.00	J	2800.00	J	5200.00	J	109.00	J
INDENO(1,2,3-CD)PYRENE	-	UJ	4531.00	J	8800.00	J	720.00	J	8200.00	J	1500.00	J	-	UJ	3400.00	J	3900.00	J	188.00	J
DIBENZ(A,H)ANTHRACENE	16000.00	J	1845.00	J	4400.00	J	260.00	J	3400.00	J	610.00	J	10193.00	J	1300.00	J	1600.00	J	-	UJ
BENZO(G,H,I)PERYLENE	15000.00	J	3917.00	J	7600.00	J	750.00	J	7000.00	J	1500.00	J	7360.00	J	2900.00	J	3000.00	J	299.00	J
B(A)P Equivalence Conc.	29460		12919		29650		864		14096		2428		26710		5601		10320		195	
Total PAHs	144620		157022		98580		65946		126580		13713		79280		35940		175490		2044	
PHENOL ANALYTES (1700)	QF0175 µg/Kg	Q	QF0173 µg/Kg	Q	QF0176 µg/Kg	Q	QF0177 µg/Kg	Q	QF0213RE µg/Kg	Q	QF0222 µg/Kg	Q	QF0182RE µg/Kg	Q	QF0178 µg/Kg	Q	QF0179 µg/Kg	Q	QF0169 µg/Kg	Q
PHENOL	-	UJ	-	UJ	-	UJ	0.06	J	480.00	J	-	UJ	40.00	J	-	UJ	-	UJ	-	UJ
2-CHLOROPHENOL	0.33	J	-	UJ	-	UJ	-	UJ	96.00	J	-	UJ	130.00	J	-	UJ	-	UJ	-	UJ
O-CRESOL	0.01	R	0.08	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	UJ	-	UJ	-	UJ	0.13	J	-	UJ	220.00	J	-	UJ	-	UJ	0.05	R	-	UJ
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	0.13	R	4.40	J	0.07	R	0.06	R	70.00	J	-	UJ	-	UJ	0.07	R	0.25	R	0.44	J
2,4-DICHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	84.00	J	-	UJ	460.00	J	-	UJ	-	UJ	-	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	97.00	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	-	UJ	-	UJ	0.14	J	68.00	J	300.00	J	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DINITROPHENOL	-	UJ	-	UJ	-	UJ	0.83	J	-	UJ	-	R	-	UJ	-	UJ	-	UJ	-	UJ
4-NITROPHENOL	-	UJ	-	UJ	-	UJ	0.56	J	83.00	J	-	UJ	56.00	J	-	UJ	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	0.33	J	0.12	J	1.30	J	3.00	J	30.00	J	-	UJ	450.00	J	1.00	J	1.00	J	0.12	J
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ	0.21	R	0.98	J	71.00	J	-	R	-	UJ	-	UJ	-	UJ	-	UJ
PENTACHLOROPHENOL	0.76	R	0.21	J	29.00	J	5.00	J	2100.00	J	250.00	R	890.00	J	0.23	J	1.60	R	0.19	J

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TABLE 4-2. SUMMARY OF QTM DATA FOR SURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER:	SS-11-SL-001		SS-12-SL-001		SS-13-SL-001		SS-14-SL-001		SS-15-SL-001		SS-16-SL-001		SS-17-SL-001		SS-18-SL-001		SS-19-SL-001		SS-21-SL-001	
EPA SAMPLE NUMBER:	QF0170		QF0171		QF0216		QF0217		QF0218		QF0219		QF0220		QF0174		QF0221		QF0238	
DEPTH																				
VOA ANALYTES (40)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PAH ANALYTES (330)	QF0170	Q	QF0171	Q	QF0216	Q	QF0217	Q	QF0218	Q	QF0219	Q	QF0220	Q	QF0174	Q	QF0221	Q	QF0240	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	-	UJ	-	UJ	35.00	J	110.00	J	-	UJ	320.00	J	200.00	J	129.00	J	210.00	J	-	R
ACENAPHTHYLENE	-	UJ	-	UJ	55.00	J	280.00	J	150.00	J	200.00	J	770.00	J	-	UJ	75.00	J	-	R
ACENAPHTHENE	-	UJ	45.00	J	48.00	J	90.00	J	39.00	J	84.00	J	160.00	J	121.00	J	430.00	J	110.00	R
FLUORENE	-	UJ	54.00	J	45.00	J	83.00	J	42.00	J	2400.00	J	810.00	J	980.00	J	650.00	J	-	R
PHENANTHRENE	62.00	J	1392.00	J	270.00	J	560.00	J	190.00	J	5300.00	J	3800.00	J	3355.00	J	4900.00	J	190.00	R
ANTHRACENE	-	UJ	345.00	J	110.00	J	400.00	J	2600.00	J	24000.00	J	12000.00	J	12837.00	J	370.00	J	80.00	R
FLUORANTHENE	441.00	J	23146.00	J	640.00	J	1000.00	J	1400.00	J	2500.00	J	17000.00	J	20307.00	J	7000.00	J	770.00	R
PYRENE	394.00	J	45648.00	J	680.00	J	1100.00	J	1900.00	J	3100.00	J	17000.00	J	42183.00	J	4900.00	J	860.00	R
BENZ(A)ANTHRACENE	142.00	J	28973.00	J	470.00	J	2600.00	J	2200.00	J	1700.00	J	9700.00	J	17344.00	J	1500.00	J	1100.00	R
CHRYSENE	240.00	J	29904.00	J	-	UJ	1300.00	J	1400.00	J	1800.00	J	14000.00	J	24151.00	J	2000.00	J	1200.00	R
BENZO(B)/(K)FLUORANTHENE	383.00	J	29712.00	J	1600.00	J	5100.00	J	3700.00	J	5200.00	J	19000.00	J	47469.00	J	2300.00	J	2300.00	R
BENZO(A)PYRENE	102.00	J	17026.00	J	450.00	J	2100.00	J	1400.00	J	1800.00	J	7800.00	J	13772.00	J	710.00	J	1600.00	R
INDENO(1,2,3-CD)PYRENE	96.00	J	6849.00	J	200.00	J	3100.00	J	1900.00	J	2200.00	J	7700.00	J	11858.00	J	590.00	J	1200.00	R
DIBENZ(A,H)ANTHRACENE	-	UJ	3754.00	J	-	UJ	1300.00	J	710.00	J	960.00	J	3400.00	J	5285.00	J	230.00	J	240.00	R
BENZO(G,H,I)PERYLENE	154.00	J	5255.00	J	310.00	J	3000.00	J	1900.00	J	2100.00	J	7400.00	J	9151.00	J	500.00	J	650.00	R
B(A)P Equivalence Conc.	167		27632		677		4493		2904		3688		14980		26966		1399		2312	
Total PAHs	2014		192103		4913		22123		19531		53664		120740		208942		26365		10300	
PHENOL ANALYTES (1700)	QF0170	Q	QF0171	Q	QF0216RE	Q	QF0217RE	Q	QF0218RE	Q	QF0219RE	Q	QF0220RE	Q	QF0174	Q	QF0221	Q	QF0238RE	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	-	UJ	-	UJ	640.00	J	620.00	J	710.00	J	700.00	J	700.00	J	-	UJ	-	UJ	-	UJ
2-CHLOROPHENOL	-	UJ	-	UJ	150.00	J	150.00	J	150.00	J	190.00	J	140.00	J	-	UJ	-	UJ	-	UJ
O-CRESOL	0.04	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	UJ	-	UJ	-	UJ	-	UJ	130.00	J	120.00	J	110.00	J	-	UJ	230.00	J	710.00	J
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	130.00	J	-	UJ	90.00	J	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	6.30	J	0.77	J	102.00	J	90.00	J	97.00	J	150.00	J	110.00	J	0.22	J	-	UJ	-	UJ
2,4-DICHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	51.00	J	-	UJ	-	UJ	-	UJ	500.00	J	720.00	J
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	41.00	J	110.00	J	-	UJ	110.00	J	73.00	J	-	UJ	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	-	UJ	-	UJ	56.00	J	50.00	J	47.00	J	240.00	J	-	UJ	-	UJ	-	UJ
2,4-DINITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ
4-NITROPHENOL	-	UJ	-	UJ	66.00	J	57.00	J	60.00	J	73.00	J	74.00	J	-	UJ	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	0.12	J	0.04	J	-	UJ	51.00	J	-	UJ	110.00	J	180.00	J	0.28	J	1900.00	J	710.00	J
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ	52.00	J	44.00	J	61.00	J	47.00	J	46.00	J	-	UJ	-	R	70.00	R
PENTACHLOROPHENOL	0.27	J	0.30	J	200.00	J	1400.00	J	320.00	J	2300.00	J	2100.00	J	8.60	J	1400.00	R	-	UJ

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TABLE 4-2. SUMMARY OF QTM DATA FOR SURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH	SS-22-SL-001 QF0237	
VOA ANALYTES (40)	µg/Kg	Q
VINYL CHLORIDE	-	UJ
1,1-DICHLOROETHENE	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ
1,1-DICHLOROETHANE	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ
CHLOROFORM	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ
CARBON TETRACHLORIDE	-	UJ
BENZENE	-	UJ
1,2-DICHLOROETHANE	-	UJ
TRICHLOROETHENE	-	UJ
BROMODICHLOROMETHANE	-	UJ
TOLUENE	-	UJ
TETRACHLOROETHENE	-	UJ
CHLOROBENZENE	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ
ETHYLBENZENE	-	UJ
BROMOFORM	-	UJ
M,P-XYLENE	-	UJ
O-XYLENE	-	UJ
PAH ANALYTES (330)	QF0239 µg/Kg	Q
NAPHTHALENE	-	R
ACENAPHTHYLENE	-	R
ACENAPHTHENE	-	R
FLUORENE	-	R
PHENANTHRENE	-	R
ANTHRACENE	-	R
FLUORANTHENE	-	R
PYRENE	-	R
BENZ(A)ANTHRACENE	48.00	R
CHRYSENE	53.00	R
BENZO(B)/(K)FLUORANTHENE	-	R
BENZO(A)PYRENE	-	R
INDENO(1,2,3-CD)PYRENE	-	R
DIBENZ(A,H)ANTHRACENE	-	R
BENZO(G,H,I)PERYLENE	-	R
B(A)P Equivalence Conc.	5	
Total PAHs	101	
PHENOL ANALYTES (1700)	QF0237RE µg/Kg	Q
PHENOL	-	UJ
2-CHLOROPHENOL	160.00	J
O-CRESOL	-	UJ
M/P-CRESOL	-	UJ
2-NITROPHENOL	-	UJ
2,4-DIMETHYLPHENOL	-	UJ
2,4-DICHLOROPHENOL	-	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ
2,4-DINITROPHENOL	-	UJ
4-NITROPHENOL	-	UJ
2,3,4,6-TETRACHLOROPHENOL	380.00	J
4,6-DINITRO-2-METHYLPHENOL	-	R
PENTACHLOROPHENOL	-	UJ

- The portion of the site north of Creosote Branch
- The office area west of Creosote Branch.

The degree of contamination present in each of these areas is discussed below.

Surface soils with the highest concentrations of organic compound contamination are located in the former process area. Organic compounds detected in surface soils of this area consist primarily of PAHs with lesser concentrations of phenols. No volatile compounds were detected in any surface soil samples collected during the current investigation. Concentrations of individual PAH compounds in the former process area are typically in the thousands or tens of thousands of μg/kg. Benzo(a)pyrene [B(a)P] equivalent concentrations are present in concentrations ranging from 2,400 μg/kg (SS-6) to 30,000 μg/kg (SS-3). Method for calculation of this figure is presented in Section 7. Total PAH concentrations vary from 13,713 μg/kg (SS-6) to 208,942 μg/kg (SS-18). Phenol concentrations in some samples (e.g., SS-2, SS-18, SS-3) are near or below detection while concentrations are significantly higher in other locations (3,179 μg/kg total phenols in SS-5). Pentachlorophenol (PCP) concentrations similarly vary from less than 1 μg/kg (SS-2) to 2,100 μg/kg (SS-5).

A single surface soil sample collected during the current investigation was analyzed for dioxin concentrations. This process area sample, SS-5, was among the most contaminated samples collected. A calculated 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) equivalent concentration for this sample is 5.32 μg/kg. Method used to calculate this equivalent concentration is described in Section 7.

Concentrations of PAHs and phenols decrease slightly in samples collected west and south of the process area. Total PAHs in SS-8 and SS-9 are 35,940 and 175,490 μg/kg, respectively. B(a)P equivalent concentrations range from 864 μg/kg in SS-4 to 26,700 μg/kg in SS-7. Concentrations of PCP range from less than 1 to 890 μg/kg in SS-8 and SS-7, respectively.

Two samples were collected in the former impoundment area during the current investigation (SS-15, SS-14). Degree of contamination noted in these samples is somewhat lower than that found in most process area soils. These samples contain total PAHs totaling 19,500 to 22,100 μg/kg and total phenols of 1,800 to 2,600 μg/kg. Values for B(a)P equivalent concentration and PCP ranged from 2,900 to 4,500 μg/kg and 320 to 1,400 μg/kg, respectively.

A single surface soil sample was collected from the drainage area northeast of the process area (SS-16). Contamination detected included a total PAH of 53,664 μg/kg, PCP concentration of 2,300 μg/kg, and a B(a)P equivalent concentration of 3,700 μg/kg. Data from previous investigations (69, 72, 72, and 74, TAT 1988) provides information for the drainage area which lies between Creosote Branch and the stream which drains the tar mat (Figure 3-1). Levels of contamination which exist in this area are evidenced by total PAH values ranging from 22,400 to 43,300. B(a)P concentrations in these samples ranged from 2,200 to 6,300 μg/kg. A single sample was also collected during a previous investigation adjacent to the small stream draining the tar mat. Contaminant levels in this sample were significantly elevated. Total PAH in this sample is 1,460,000 μg/kg (TAT 1988), greater than any other surface soil samples collected on site during the current investigation. Phenol analyses were not conducted for any of the surface soil samples collected from the drainage areas during previous investigations.

Three surface soil samples were collected from the southern portion of the site during the current investigation (SS-10, SS-11, and SS-12). Analytical results show a pattern of low to moderate concentrations of PAHs and phenols consistent with intermittent, localized storage of treated wood in this area (see Figure 1-2). Samples SS-10 and SS-11, collected from the south-central and southwestern portions of the site, contain total PAH concentrations of 2,000 μg/kg each. Surface soil sample SS-12 from the southeastern portion of the site had 192,100 μg/kg of total PAHs and 27,600 μg/kg of B(a)P. This sample was collected in a location used briefly for treated wood storage based on historical aerial photographs. Data for a subsurface soil sample collected at this same location (BH-15, 4-5 feet) suggest that contamination at this location is largely limited to surface and shallow subsurface soils. Data for this subsurface soil indicate no detectable PAHs and only a total of 1,180 μg/kg total phenols and no detectable PCP. None of the three surface soil samples from the southern portion of the site contained detectable volatile organics, total phenol values for each were less than 10 μg/kg, and each had PCP concentrations of less than 1 μg/kg.

Surface soil data for three samples collected north of Creosote Branch demonstrate moderate levels of contaminants in stained soils at the railroad bridge crossing (SS-19) and lower levels further to the north (SS-21, SS-22). Total PAH and B(a)P equivalent concentration values for SS-19 are 26,400 μg/kg and 1,400 μg/kg, respectively, and PCP was detected at 1,400 μg/kg. Samples SS-21 and SS-22 contained 10,300 μg/kg and 101 μg/kg total PAH and 2,200 and 540 μg/kg total phenol, respectively, though no PCP was detected in either sample. Also of note, subsurface soil data for this portion of the site suggest that PAH concentrations may decrease rapidly with depth. Samples BH-12 and BH-13 were collected at a depth of 5 feet at the same locations as SS-22 and SS-21, respectively. Analytical results for these samples indicate no detectable PAHs at these depths implying minimal potential for downward migration of PAHs from surface soils. Reported phenol concentrations for BH-12 and BH-13 samples were similar to surface soil concentrations in these areas.

Three surface soil samples were collected from the office area during previous investigations. These data provide information about contaminant levels west of Creosote Branch. The three samples, 55, 56, and 57, contained low contaminant concentrations; total PAH values reported were 920, 2,760, and 390 μg/kg, respectively (TAT 1988). B(a)P was not detected in any of these samples. Analyses for phenols were not conducted.

In summary, the most heavily contaminated surface soils are located in the former process and impoundment areas and the drainage area to the north and east of these locations. Data presented in Section 4.4 demonstrates that these are also the portions of the site with the greatest degree of subsurface contamination. Surface soils in the southern and northern (north of Creosote Branch) portions of the site are also contaminated but generally to a lesser degree. Level of contamination in these areas appears to be localized and related to storage of treated wood during plant operations. Subsurface soil data in these areas suggest that contamination is largely limited to surface and shallow subsurface soils.

4.3 SURFACE WATER AND SEDIMENT INVESTIGATION

The purpose of the surface water and sediment sampling program was to delineate the extent and magnitude of surface water and sediment contamination onsite and offsite as a result of downstream migration of site-related contaminants.

4.3.1 SAMPLING LOCATIONS, DESIGNATIONS, AND ANALYSIS

Seven surface water and ten sediment samples were collected during February and March 1992 for the RI at the American Creosote site. The sampling locations are shown in Figures 4-1 and 4-2.

Creosote Branch is a small perennial stream, approximately 0.5 to 4 feet deep, that flows northerly along the western boundary of the site, turns east, and flows northeasterly across the north portion of the site. The stream separates the most northerly section of the site from the main process area.

One colocated surface water and sediment sample were collected from Creosote Branch approximately 500 feet upstream of Front Street which forms the west boundary of the site (SW-1/SD-1). The samples collected at this location showed no visible evidence of contamination. Onsite surface water and sediment sampling locations along Creosote Branch included SW-2/SD-2, SW-3/SD-3, SW-4/SD-4, and SW-8/SD-8. Samples SW-2/SD-2 were collected immediately upstream of the confluence of an unnamed tributary and Creosote Branch in the northwest corner of the site. This location is also upstream of the drainage ditches that drain the former process area and tar mat area. The sediment sample collected from this location appeared oily, but was not stained. Sample locations SW-3/SD-3, SW-8/SD-8 and SW-4/SD-4 represent sampling locations that were immediately downstream of the confluence of Creosote Branch and the northern ditch, southern ditch, and the tar mat area, respectively. Sample SW-3/SD-3 is also just downstream of a creosote seep observed along the bank of Creosote Branch (Figure 4-1). The sediment samples from these locations were stained black and had a creosote odor. The surface water at these sampling points also had an oily sheen. Sediment collected at sample location SW-8/SD-8 appeared the most contaminated.

Several sediment samples were collected downstream from the site to evaluate offsite migration of contaminants (Figure 4-2). Location SD-7 was approximately 5,000 feet downstream of the site boundary (at the junction of Route 167 and Creosote Branch). The sediment sample collected at location SD-7 showed appreciable black staining and a creosote odor from depths of 3 to 13 inches. Surface water along the edges of the stream at location SD-7 also had an oily sheen.

Additional sediment samples, SD-9 and SD-10, were collected approximately 1,300 feet and 5,000 feet downstream of SD-7, respectively. The sample collected at SD-10 was located downstream of what appears to be a creosote seep that was found along this stretch of Creosote Branch during the RI/FS. The seep may have originated at another one of the other local wood treating plants. Sediments at SD-10 featured an oily sheen, and corings collected during a previous reconnaissance trip near this location showed black staining at depths from 0 to 6 inches. There were no visible signs of contamination at SD-9.

A surface water and a sediment sample were also collected from the fire protection pond located along the eastern boundary of the site and just north of Grove Street (SW-5/SD-5). The characteristics of the pond include a surface area of approximately 0.5 acres, a depth of approximately eight feet, and a three-feet high berm. The colocated surface water and sediment sample collected from the pond did not show any visible signs of contamination.

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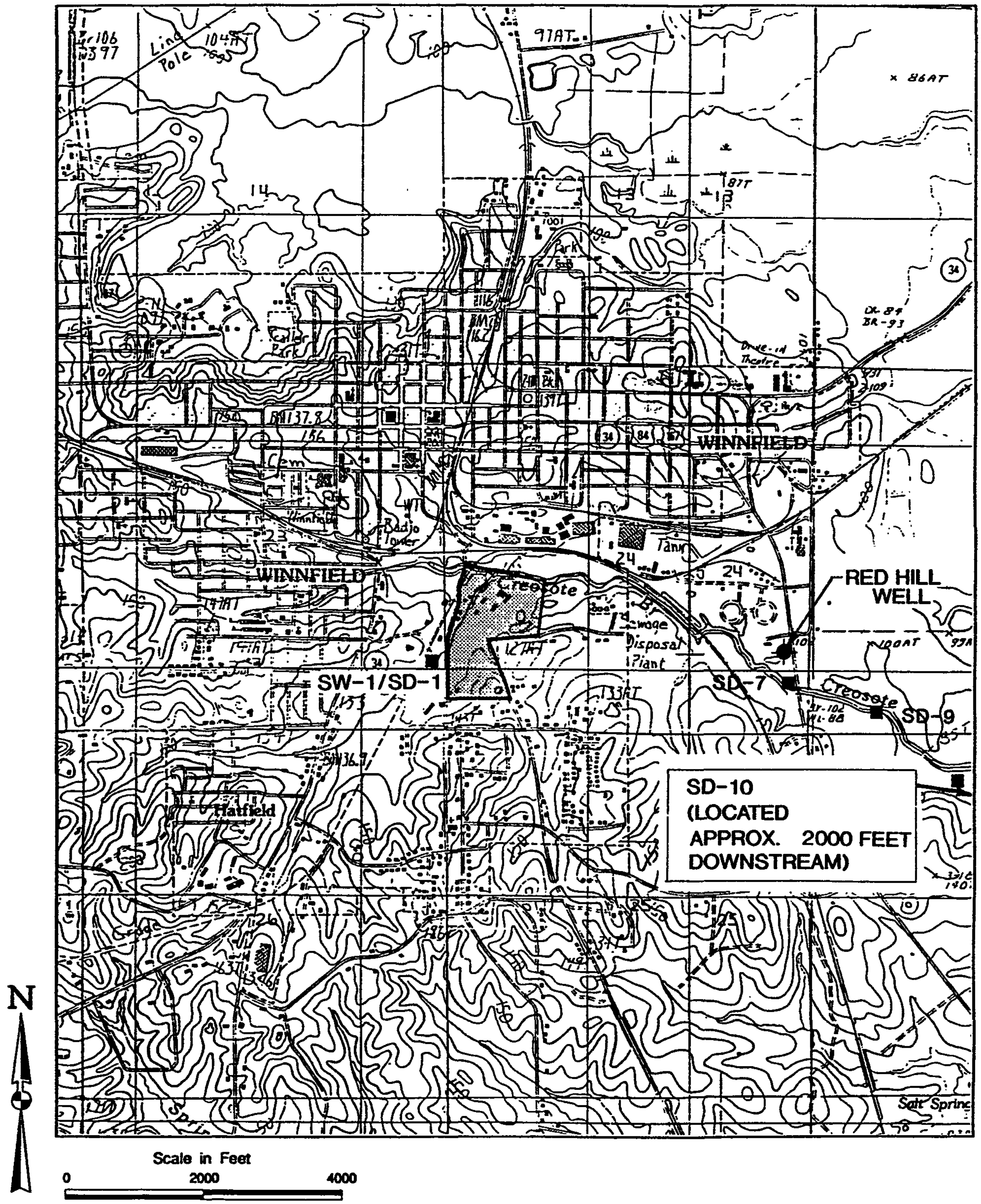

Source: USGS 7.5 min. Winnfield East & West, La. Quadrangles

Project No.:
7760-033

American Creosote
Winnfield, Louisiana

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

Offsite Surface Water,
Sediment Sampling and
Groundwater Locations

Figure No.:
4-2

4/92

Two samples were collected in drainage ditches at the site. A surface water sample (SW-6) was collected from the drainage ditch along McLeod Street on the southeast boundary of the site. The surface water in this ditch was shallow, approximately 3 inches deep, and featured an intermittent oily sheen. Sediment in the southern drainage ditch originating at the former process area was also sampled. This location corresponds to location SD-11 on Figure 4-1. Table 4-1 summarizes the surface water and sediment samples collected and analyses conducted.

4.3.2 SURFACE WATER AND SEDIMENT SAMPLING RESULTS

Analytical data for surface water and sediments are available from current and previous investigations. Surface water and sediment data from previous investigations are useful only in evaluating the nature and extent of contaminants in these media prior to the 1989 removal action at the site. Surface water and sediment sampling conducted as part of the current investigation focused on providing information regarding current impacts on these media and the relative importance of surface water as a pathway for contaminant dispersion from the site. Figures 3-1 and 4-1 illustrate surface water and sediment sampling locations for the previous and current investigations, respectively. Analytical data for previous investigations can be found in Appendix A. Data for surface water and sediment samples collected during the current investigation are presented in Table 4-3 and in Appendix D. This section discusses present conditions only based primarily on results of the current investigation.

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Surface water and sediment samples were collected to characterize the degree of contamination at the following locations:

- Creosote Branch upstream of the site
- The McLeod Street ditch upstream of the site
- The onsite fire protection reservoir

TABLE 4-3. SUMMARY OF QTM DATA FOR SURFACE WATER AND SEDIMENT SAMPLES.

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH	SW-01-SW-001 QF0184		SW-02-SW-001 QF0183		SW-03-SW-001 QF0197		SW-04-SW-001 QF0186		SW-05-SW-001 QF0187		SW-06-SW-001 QF0203		SW-08-SW-001 QF0224	
VOA ANALYTES (20)	µg/L	Q	µg/L	Q	µg/L	Q	µg/L	Q	µg/L	Q	µg/L	Q	µg/L	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	15.00	J	-	UJ
PAH ANALYTES (20)	QF0184	Q	QF0183	Q	QF0197	Q	QF0186	Q	QF0187	Q	QF0203RE	Q	QF0224	Q
	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
NAPHTHALENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ACENAPHTHYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ACENAPHTHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
FLUORENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PHENANTHRENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ANTHRACENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
FLUORANTHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PYRENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZ(A)ANTHRACENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHRYSENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZO(A)PYRENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
B(A)P Equivalence Conc.	0		0		0		0		0		0		0	
Total PAHs	0		0		0		0		0		0		0	
PHENOL ANALYTES (50)	QF0184	Q	QF0183	Q	QF0197	Q	QF0186	Q	QF0187	Q	QF0203	Q	QF0224	Q
	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
PHENOL	-	R	-	R	-	R	-	UJ	-	UJ	-	R	-	UJ
2-CHLOROPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-CRESOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2-NITROPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DICHLOROPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
4-CHLORO-3-METHYLPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	R	-	R	-	UJ	-	R	-	R	-	UJ	-	UJ
2,4-DINITROPHENOL	-	R	-	R	-	R	-	R	-	R	-	R	-	R
4-NITROPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	-	R	-	R	-	UJ	99.00	J	140.00	J	-	UJ	-	UJ
4,6-DINITRO-2-METHYLPHENOL	-	R	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PENTACHLOROPHENOL	-	R	-	R	68.00	J	-	UJ	-	UJ	-	UJ	-	UJ

TABLE 4-3. SUMMARY OF QTM DATA FOR SURFACE WATER AND SEDIMENT SAMPLES (continued).

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH	SD-01-SD-001 QF0180		SD-02-SD-001 QF0181		SD-03-SD-001 QF0193		SD-04-SD-001 QF0188		SD-05-SD-001 QF0189		SD-07-SD-001 QF0190		SD-08-SD-001 QF0223		SD-09-SD-001 QF0227		SD-10-SD-001 QF0228	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PAH ANALYTES (330)	QF0180 µg/Kg	Q	QF0181 µg/Kg	Q	QF0193RE µg/Kg	Q	QF0188 µg/Kg	Q	QF0189 µg/Kg	Q	QF0190 µg/Kg	Q	QF0223 µg/Kg	Q	QF0230 µg/Kg	Q	QF0229 µg/Kg	Q
NAPHTHALENE	-	UJ	26.00	J	270.00	J	-	UJ	-	UJ	77.00	J	38.00	J	-	R	-	R
ACENAPHTHYLENE	-	UJ	-	UJ	52.00	J	54.00	J	-	UJ	160.00	J	72.00	J	-	R	-	R
ACENAPHTHENE	-	UJ	78.00	J	460.00	J	500.00	J	-	UJ	1100.00	J	530.00	J	-	R	-	R
FLUORENE	-	UJ	82.00	J	570.00	J	420.00	J	-	UJ	1200.00	J	630.00	J	-	R	48.00	R
PHENANTHRENE	-	UJ	282.00	J	1700.00	J	120.00	J	-	UJ	2600.00	J	780.00	J	74.00	R	230.00	R
ANTHRACENE	-	UJ	27.00	J	270.00	J	74.00	J	-	UJ	770.00	J	290.00	J	-	R	-	R
FLUORANTHENE	-	UJ	247.00	J	1700.00	J	1900.00	J	-	UJ	4300.00	J	3000.00	J	160.00	R	490.00	R
PYRENE	-	UJ	239.00	J	1500.00	J	3000.00	J	-	UJ	4000.00	J	2500.00	J	190.00	R	590.00	R
BENZ(A)ANTHRACENE	-	UJ	159.00	J	450.00	J	1300.00	J	-	UJ	1800.00	J	1000.00	J	270.00	R	520.00	R
CHRYSENE	-	UJ	136.00	J	480.00	J	1300.00	J	-	UJ	1800.00	J	770.00	J	280.00	R	560.00	R
BENZO(B)/(K)FLUORANTHENE	-	UJ	384.00	J	670.00	J	2100.00	J	-	UJ	3000.00	J	1600.00	J	590.00	R	990.00	R
BENZO(A)PYRENE	-	UJ	151.00	J	370.00	J	820.00	J	-	UJ	1600.00	J	630.00	J	660.00	R	700.00	R
INDENO(1,2,3-CD)PYRENE	-	UJ	102.00	J	250.00	J	560.00	J	-	UJ	1200.00	J	530.00	J	360.00	R	650.00	R
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ	68.00	J	320.00	J	-	UJ	4600.00	J	110.00	J	-	R	130.00	R
BENZO(G,H,I)PERYLENE	-	UJ	133.00	J	230.00	J	460.00	J	-	UJ	1000.00	J	370.00	J	310.00	R	600.00	R
B(A)P Equivalence Conc.	0		217		580		1549		0		6818		1061		785		1052	
Total PAHs	0		2046		9040		12928		0		29207		12850		2894		5508	
PHENOL ANALYTES (1700)	QF0180RE µg/Kg	Q	QF0181RE µg/Kg	Q	QF0193 µg/Kg	Q	QF0188 µg/Kg	Q	QF0189 µg/Kg	Q	QF0190 µg/Kg	Q	QF0223 µg/Kg	Q	QF0227RE µg/Kg	Q	QF0228RE µg/Kg	Q
PHENOL	-	UJ	-	UJ	-	UJ	2.70	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2-CHLOROPHENOL	170.00	J	-	UJ	60.00	J	37.00	J	-	UJ	-	UJ	1200.00	J	60.00	J	130.00	J
O-CRESOL	-	UJ	-	UJ	-	UJ	7.10	R	-	R	-	R	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	UJ	-	UJ	-	UJ	3.20	R	-	UJ	-	UJ	290.00	J	-	UJ	97.00	J
2-NITROPHENOL	-	UJ	-	UJ	65.00	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	UJ	-	UJ	24.00	R	40.00	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DICHLOROPHENOL	690.00	J	490.00	J	-	UJ	-	UJ	-	UJ	-	UJ	430.00	J	810.00	J	450.00	J
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	12.00	R	14.00	R	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	-	UJ	3.00	R	1.70	R	-	UJ	-	UJ	-	UJ	460.00	R	570.00	J
2,4-DINITROPHENOL	-	UJ	-	UJ	32.00	R	-	R	-	R	-	R	-	R	-	UJ	-	UJ
4-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	R	-	UJ	-	UJ	-	UJ	120.00	J	-	UJ
2,3,4,6-TETRACHLOROPHENOL	450.00	J	380.00	J	-	UJ	48.00	J	62.00	R	-	UJ	-	UJ	760.00	J	420.00	J
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	R	-	R	87.00	R	-	R
PENTACHLOROPHENOL	-	UJ	-	UJ	17.00	R	69.00	J	-	R	-	R	160.00	R	1100.00	J	-	UJ

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- Creosote Branch in the northwest portion of the site, upstream of the confluence with an unnamed tributary and with the majority of the site drainage ditches.
- Creosote Branch downstream of site drainage ditches and creosote seep as well as several locations downstream of the site.

The degree of contamination present in each of these areas is discussed below.

Surface water and sediment samples SW-1 and SD-1 were collected from Creosote Branch approximately 500 feet upstream of the site. No volatile compounds or PAHs were detected in either sample. Results for the sediment sample, SD-1, indicate a concentration of 1,310 μg/kg of total phenols; No PCP was detected. No phenols were detected in the surface water sample.

Observation of a film or sheen on water in the McLeod Street ditch upstream of the site prompted the collection of surface water sample SW-6. No organic contaminants were detected in this sample.

The pond located in the east-central portion of the site was the sampling location for SW-5 and SD-5. This pond was reportedly constructed as a reservoir for storage of fire protection water. Both the surface water and sediment samples from the pond contained detectable levels of 2,3,4,6-tetrachlorophenol. Reported concentrations were 140 μg/l in the surface water sample (SW-5) and 62 μg/kg in the sediment sample (SD-5). No other contaminants were detected. A single sediment sample was collected from the pond during a previous investigation of the site. This sample was analyzed for PAHs only and no contaminants were detected.

Surface water and sediment samples SW-2 and SD-2 were collected from Creosote Branch in the northwest portion of the site. Upstream of this point, the stream receives the discharge of the drainage ditch which carries nearly all runoff from the southern portion of the site and a limited amount from the central portion of the site. No contaminants were detected in the surface water sample (SW-2). However, some contaminants were detected in the sediment sample. Total PAHs for the sample (SD-2) were present at 2,046 μg/kg, including a B(a)P equivalent concentration of 217 μg/kg. Phenol concentrations totaled 870 μg/kg but no PCP was detected. This data suggests some impact on Creosote Branch from a source or sources along the western portion of the site.

Samples of surface water and sediment were collected along Creosote Branch downstream of two ditches which drain the former process and impoundment areas (SW-3/SD-3 and SW-8/SD-8). These samples were also downstream of the onsite creosote seep (Figure 4-1). Surface water sample SW-3 contained 68 μg/l of PCP. No other contaminants were detected in either SW-3 or SW-8. Total PAHs in these samples were 9,000 and 12,850 μg/kg in SD-3 and SD-8, respectively. B(a)P equivalent concentrations were 580 and 1,061 μg/kg. Phenols detected in SD-3 and SD-8 totaled 213 and 2,080 μg/kg with PCP concentrations of 17 and 160 μg/kg, respectively. Sample SD-3 is the only sediment or surface water sample for which dioxin analyses were conducted. Data reported indicate a 2,3,7,8-TCDD equivalent concentration of 0.01 μg/kg for this sample.

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A sample of surface water and sediment was collected immediately downstream of the confluence of the stream which drains the tar mat and Creosote Branch. The surface water sample (SW-4) contained 2,3,4,6-tetrachlorophenol at concentration of 99 μg/l. No other contaminants were detected in this sample. Results for the sediment sample (SD-4) indicate similar levels of PAHs and phenols as is present in sediments at the SD-3 and SD-8 locations. Total PAH and phenol values reported were 12,928 and 222 μg/kg, respectively, with a B(a)P equivalent of 1,549 μg/kg and PCP concentration of 69 μg/kg.

Three sediment samples were collected downstream of the site. Total PAH concentration for SD-7 is 29,207 μg/kg and the calculated B(a)P equivalent concentration is 6,818 μg/kg. No other contaminants were detected in this sample. Sediment samples SD-9 and SD-10, collected from Creosote Branch approximately 6,300 feet and 10,000 feet downstream of the site, respectively, contained lower concentrations of PAHs than SD-7 but did have detectable phenols. Total PAH values for SD-9 and SD-10 were 2,894 and 5,508 μg/kg while total phenols ranged from 488 to 1,196 μg/kg. The B(a)P equivalent concentration for each was 785 and 1,053 μg/kg. For SD-9, a concentration of 1,100 μg/kg PCP was reported; However PCP was not detected in SD-10. The slight elevation of PAHs and phenols between SD-9 and SD-10 may be related to the wood treating facilities in this area.

In summary, surface water and sediment data demonstrate contamination of these media in Creosote Branch both within and downstream of site boundaries. With the exception of some minor amounts of phenols detected in sediment sample SD-1, surface water entering the site appears to be free of organic contaminants analyzed for during the current investigation. Sediment samples collected at SD-3, SD-4, and SD-8 show the impact of site drainage on sediments in Creosote Branch within site boundaries. Sediment sample SD-7, nearly a mile downstream of the site, contained higher levels of contamination than the samples collected on site. This difference may be due to the fact that SD-7 was collected at a depth of 4-6 in. in the sediments while the on site samples were all collected from depths of 0-3 in. The deeper sediments sampled may represent older, more contaminated sediments or materials which are less exposed to aeration and other elements which might accelerate contaminant degradation. Surface water samples collected in locations of significant sediment contamination showed little, if any, evidence of organic compound contamination. These data suggest that adsorption of contaminants to sediments and dilution of surface water by running streams combine to minimize site impacts on surface water itself.

4.4 SUBSURFACE INVESTIGATION

The objectives of the subsurface investigation were to obtain, analyze, and observe geologic materials from known depths to:

- Provide data regarding subsurface lithology and hydrology

- Investigate the presence of contaminants in the subsurface and determine the areal and vertical extent.

4.4.1 INVESTIGATION METHODS

Quantitative, semi-quantitative, and qualitative data were collected during excavations and borings by backhoes, hollow-stem auger, and hand auger. The method of use and the types of data collected for each method are described below.

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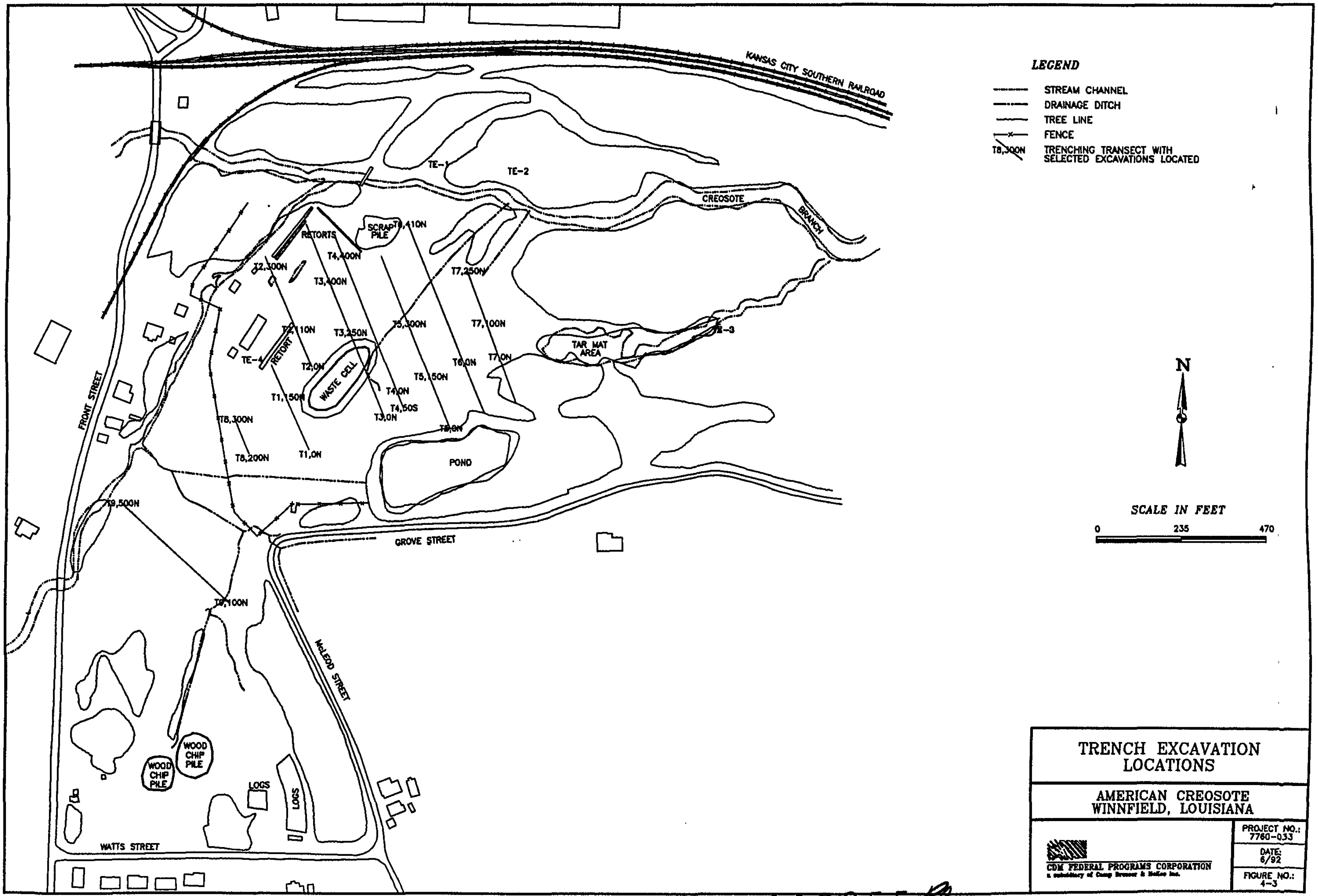
4.4.1.1 Trenching

Before trench excavations began, transects were laid out in the field using an auto level and fiberglass tape (Figure 4-3). Nine trench lines were located across the site in a northwest-southeast orientation. Trenching locations were marked with labeled wood surveyor's stakes. Initially, excavation locations were spaced at intervals of 35 feet. However, this spacing was later changed to 50 feet, except for two background trench lines whose spacing was 100 feet. Locations of each excavation were recorded based on the transect line number and distance along the transect (e.g., T7, 200N).

Trenching crews consisted of a Case Model 580A backhoe, a backhoe operator, and one or two CDM field personnel. Waste excavation materials were placed to one side while single scoops of materials representative of 2, 4, 6, 8, and 10 foot depths were placed to the other side. From these single scoops, lithologic descriptions, photoionization detector (PID) readings, and other pertinent information was collected and recorded in the field notebook. The lithologic and other information was later transferred from the field notebook to trench log forms. Photoionization detector readings were obtained by exposing a fresh portion of soil and placing the instrument's probe within a few millimeters of the soil surface. No samples for laboratory analysis were collected during trenching activities. Trench excavations were backfilled with material removed from that location.



TRENCH EXCAVATION LOCATIONS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 4-3

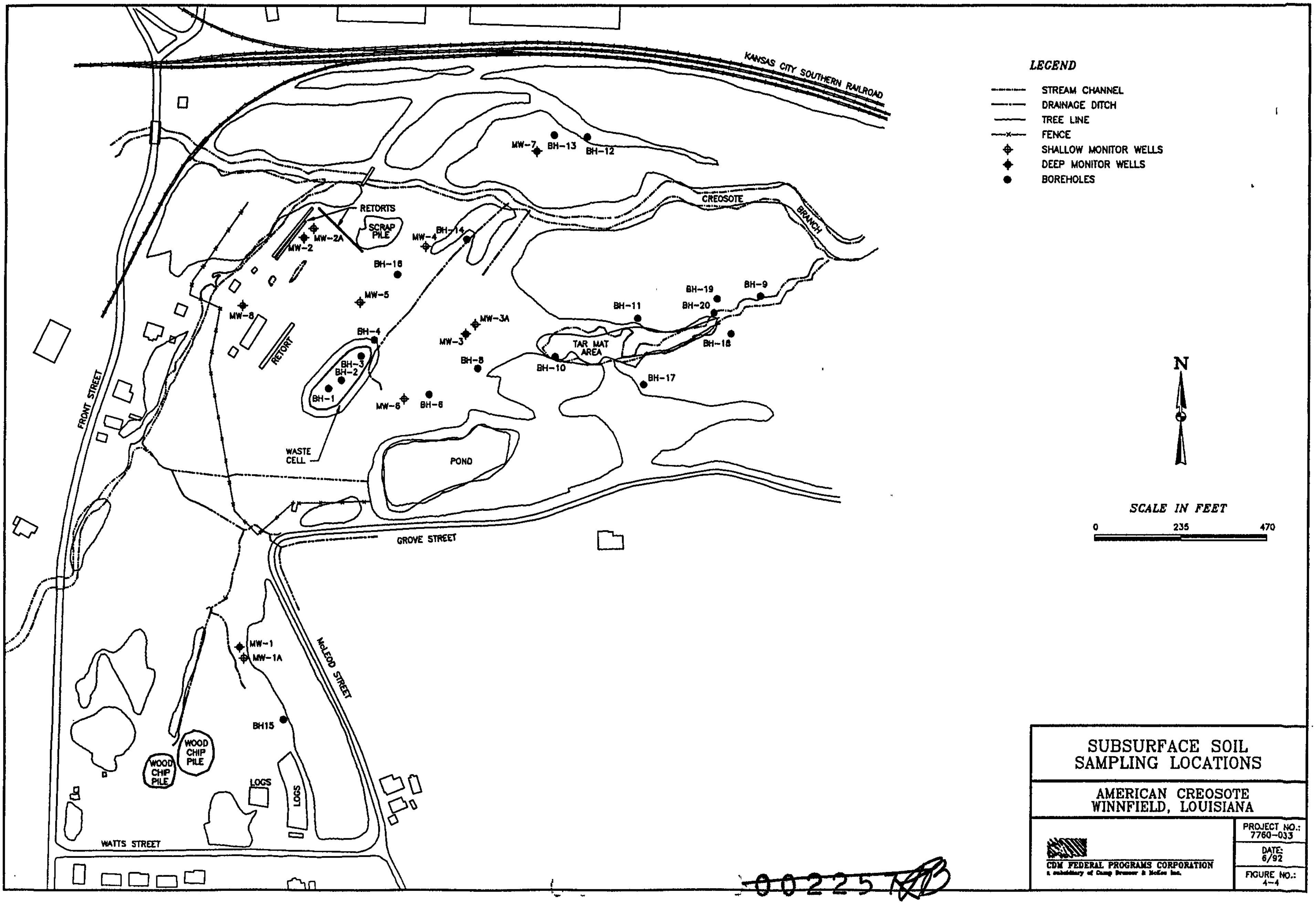
In areas inaccessible to the backhoes, "excavations" were performed using a hand auger. Information identical to that collected during backhoe trench excavations was recorded. Usually, these hand auger "excavations" extended existing trench lines and were labeled in accordance to their position on the line.

4.4.1.2 Hollow-Stem Auger

Hollow-stem auger drilling methods were used to obtain cores in boreholes from which subsurface soil samples were collected and lithologic descriptions prepared (Figure 4-4). Hollow-stem auger was also used for well and piezometer installation, although no samples were collected from piezometer borings. When the target depth was reached, boreholes were converted to monitor wells or sealed with bentonite grout.

Three different drill rigs were used during the American Creosote RI: A CME-75 and Mobile Drill B-53 operated by Southwestern Laboratories and an ARDCO C-1000 operated by MASA Drilling. The CME and Mobile Drill rigs utilized 3.75 in. inside diameter (ID) augers with an outside diameter (OD) of 7.75 in. The augers used on the ARDCO rig measured 4.25 in. ID and 7.0 in. OD. The CME-75 rig was equipped with 5-foot core barrels inserted through the hollow-stem auger from which subsurface soil cores were obtained. Cores obtained from the Mobile and ARDCO rigs were collected in either 2-foot Shelby tubes or 18-inch split spoon samplers.

Core recovery problems were encountered with Shelby tubes in subsurface materials which were saturated or of medium to high sand content. Cores were frequently lost in saturated materials due to a lack of adherence of the soil to the inner surfaces of the tube. In subsurface material of medium to high sand content, the material strength of the Shelby tubes was insufficient, as evidenced by the bent advancing end of the tube. In these instances, split spoon samplers were employed.



SUBSURFACE SOIL SAMPLING LOCATIONS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033

DATE: 6/92

FIGURE NO.: 4-4

Subsurface cores retrieved using 5-foot core barrels or Shelby tubes were removed by the drillers with the aid of an hydraulic extruder. Cores removed by this method or from split spoons were placed in decontaminated split lengths of PVC casing or on clean plastic sheeting for lithologic description and sampling. Lithologic descriptions and classifications of the subsurface material through visual examination and manual tests for textural properties were made by the on-site geologists. The lithologic logs prepared for the monitor wells and boreholes can be found in Appendix C. Sampling procedures are discussed in Section 4.6 and in the Field Sampling Plan (CDM 1992).

During drilling, sample collection, and lithologic logging activities, PIDs were used to monitor air quality. The breathing zone near the drill rig was regularly inspected to ensure safe working conditions and compliance with the Health and Safety Plan (CDM 1992). Readings were also taken of the cores as they were split open during logging and sampling. This information was recorded in the logbook and occasionally used to select an interval for biased grab samples.

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4.4.1.3 Hand Auger

Borings using a simple four inch O.D. hand auger were usually performed where additional information was required in areas inaccessible to drill rigs and backhoes. Water in the borehole, material sloughing, or flowing sands prevented boring much deeper than about 10 feet. Typical information recorded during hand augering include lithologic information, PID readings, the effort required to turn the auger, visual or other evidence of contamination, and approximate depth to water in the borehole. Lithologic logs prepared for hand augered boreholes are included in Appendix C. Cuttings were used to fill in the borehole when augering was complete.

Decontamination consisted of cleaning the bucket, extensions, and handle by steam cleaning and/or laboratory soap solution followed with tap water, methanol, and deionized water rinses.

The extent of decontamination depended upon the intended use of the hand auger. For example, more stringent decontamination procedures were implemented if laboratory samples were to be collected.

Hand auger borings were labeled "BH" (boreholes) when subsurface samples were collected for laboratory analysis. Sampling procedures were similar to those used for hollow-stem auger boreholes. When a hand auger boring was used to collect the same information as that during trenching, the borehole would be located with respect to an existing trench line or, when this was not possible, labeled "TE" (trench extension). Both BH and TE borings were later located during the site survey.

4.4.2 SAMPLE LOCATIONS, DESIGNATIONS, AND ANALYSIS

The location of boreholes, monitor wells, and trench lines are shown in Figures 4-3 and 4-4 respectively. No samples for laboratory analysis were collected during trenching activities. However, subsurface soil samples were collected from 18 boreholes and during the installation of 11 monitor wells. Borehole samples were collected from six hollow-stem auger boreholes, 12 hand auger boreholes, and during the installation of all 11 monitor wells. Shallow boreholes and monitor wells completed by hollow-stem auger were typically about 20 feet deep with grab samples taken at about 5 and 20 feet and a composite from 0-12 feet. Two to five grab samples were collected in deep boreholes and monitor wells. Grab samples were typically collected at about 5 and 10 feet in the hand auger boreholes.

Each subsurface soil sample is identified by a unique code which indicates the site number, sample location, sampling media, and sample number from that location. Example identification codes for subsurface soil samples are shown below:

200-BH4-SS-001
200-MW5-SS-002

In these examples, 200 is the American Creosote site number, BH4 is the borehole number, MW5 is the monitor well number, SS indicates the samples are subsurface soils, and 001 and 002 is the sample number taken from that location. Table 4-4 lists the subsurface soil samples collected, analyses conducted, and other pertinent information such as whether the sample was a grab or composite.

4.4.3 RESULTS

4.4.3.1 Trenching

During trenching activities, elevated PID readings were accompanied by visual evidence of contamination in nearly all cases. Information collected during these activities is summarized on Table 4-5. Heavily contaminated soils were very dark in color and PID readings above 100 ppm were commonly obtained. Hydrocarbon-based fluids encountered in these zones had the appearance of used motor oil. Soils with moderate visual contamination were usually gray in color with occasional black streaking. An oily sheen was observed and PID readings were generally less than 100 ppm. Some elevated PID readings were also found in soils with no outward evidence of contamination other than a slight sheen. In all cases, positive visual evidence was accompanied by a characteristic creosote odor.

Trenching was particularly difficult at locations where former site structures or rail lines were located. Digging was most difficult within a radius of 150 to 200 feet of MW-5. Sections of cable, pipes, railroad ties, concrete, and other debris often prevented excavating deeper than two or three feet and some trench excavations had to be moved several times before a successful attempt was made. In addition, frequent rainfall made working in this area particularly difficult as backhoes and other equipment repeatedly became mired.

The highest PID readings recorded for subsurface soils were found about 100 feet north of MW-5. At trench location T4, 400N, readings exceeding 400 ppm were obtained. In general,

TABLE 4-4

MATRIX OF SUBSURFACE SOIL SAMPLES COLLECTED

	Sampling Information					QTM		SAS				TCLP		
Sample I.D.	Depth (ft)	Grab	Comp.	Split	Colocate	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
BH-01-SS-001	1-12		X			QF0284	QF0283							
BH-01-SS-002	20	X				QF0286	QF0285							
BH-03-SS-001	.5-6		X			QF0292	QF0291	SF2523	SF2556	SF2549		SF2524	SF2558	SF2526
BH-04-SS-001	0-12		X			QF0288	QF0287							
BH-04-SS-002	20	X				QF0290	QF0289							
BH-06-SS-001	0-12		X			QF0272	QF0271							
BH-06-SS-002	20	X				QF0274	QF0273							
BH-06-SS-003	0-12		X	X		QFO276	QF0275							
BH-06-SS-004	20	X		X		QFO278	QFO277							
BH-06-SS-005	0-12		X		X	QFO280	QFO279							
BH-06-SS-006	20	X			X	QFO282	QFO281							
BH-08-SS-001	4	X				QF0249	QF0250							
BH-08-SS-002	10	X				QF0247	QF0248							
BH-09-SS-001	5	X				QF0254	QF0253	SF2514	SF2512	SF2515		SF2511	SF2513	SF2521
BH-09-SS-002	9.5	X				QF0256	QF0255							
BH-10-SS-001	5	X				QF0251	QF0252							
BH-10B-SS-001	2-3.5		X									SF2529	SF2555	SF2531
BH-11-SS-001	5	X				QF0258	QF0257							
BH-12-SS-001	5	X				QF0246	QF0244							
BH-13-SS-001	5	X				QF0245	QF0243							
BH-14-SS-001	0-10		X			QF0260	QF0259							
BH-14-SS-002	10-14.5		X			QF0262	QF0261							
BH-14-SS-003	18-21		X			QF0264	QF0263							
BH-14B-SS-001	2.5	X										SF2528	SF2554	SF2530
BH-15-SS-001	4-5		X			QF0232	QF0231							
BH-16-SS-001	28	X									SF2581			
BH-16-SS-002	38	X									SF2582			
BH-16-SS-003	47	X									SF2583			
BH-16-SS-004	58	X									SF2584			

TABLE 4-4 (continued)

MATRIX OF SUBSURFACE SOIL SAMPLES COLLECTED

	Sampling Information					QTM		SAS						
												TCLP		
Sample I.D.	Depth (ft)	Grab	Comp.	Split	Colocate	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
BH-16-SS-006	74	X									SF2585			
BH-17-SS-001	8	X									SF2904			
BH-18-SS-001	10	X									SF2905			
BH-19-SS-001	10	X									SF2906			
BH-20-SS-001	9	X									SF2908			
MW-01-SS-001	36	X				QF0294	QF0293							
MW-01-SS-002	51	X				QF0296	QF0295							
MW-01A-SS-001	0-10		X			QF0299	QF0298	SF2538	SF2552	SF2547				
MW-01A-SS-002	20	X				QF0300	QF0297	SF2939	SF2553	SF2548				
MW-02-SS-001	31-35		X			QF0234	QF0233	SF2507	SF2503	SF2506		SF2505	SF2504	SF2508
MW-02-SS-002	51	X				QF0270	QF0269	SF2516	SF2517	SF2522		SF2519	SF2518	SF2520
MW-02A-SS-001	0-10		X			QF0205	QF0205		SF2476	SF2478		SF2482	SF2476	SF2481
MW-02A-SS-002	15	X				QF0206	QF0206	SF2575	SF2477	SF2479		SF2483	SF2477	SF2480
MW-03-SS-001	32	X				QF0266	QF0265							
MW-03-SS-002	51	X				QF0302	QF0301							
MW-03A-SS-001	0-10		X			QF0198	QF0198							
MW-03A-SS-002	15	X				QF0199	QF0199							
MW-04-SS-001	5	X				QF0209	QF0209							
MW-04-SS-002	15	X				QF0210	QF0210							
MW-05-SS-001	0-10		X			QF0211	QF0211							
MW-05-SS-002	2-5		X			QF0212	QF0212							
MW-06-SS-001	1-10		X			QF0207	QF0207							
MW-06-SS-002	15	X				QF0208	QF0208							
MW-07-SS-001	0-10		X			QF0304	QF0303	SF2527	SF2557	SF2550				
MW-07-SS-002	19	X				QF0306	QF0305							

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TABLE 4-4 (continued)

MATRIX OF SUBSURFACE SOIL SAMPLES COLLECTED

	Sampling Information					QTM		SAS						
												TCLP		
Sample I.D.	Depth (ft)	Grab	Comp.	Split	Colocate	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
MW-08-SS-001	0-10		X			QF0200	QF0200							
MW-08-SS-002	15	X				QF0201	QF0201							

[1] GC-FID (see QTM Statement of Work 7/91).
[2] GC-PID-ELCD (see QTM Statement of Work 7/91).
[3] GC-FID (see QTM Statement of Work 7/91).
[4] U.S. EPA SW-846, Method 8020.
[5] U.S. EPA SW-846, Method 8310.
[6] U.S. EPA SW-846, Method 8040.
[7] U.S. EPA SW-846, Method 8280.
[8] U.S. EPA SW-846, Method 6010.
[9] U.S. EPA SW-846, Method 8270.
[10] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8240 (analysis).
[11] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8270 (analysis).
[12] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8280 (analysis).
[13] U.S. EPA TCLP, Method 1311 (extraction) and CLP Statement of Work 3/90.

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TABLE 4-5

SUMMARY OF TRENCHING OBSERVATIONS

Transect	Location	Total Depth	PID Peak				0'-8' or 0'-10' avg. PID[b]	Debris Depth	Visual Extent of Contamination	Remarks[c]
			0'-5' Peak	Depth	5'-10' Peak	Depth				
T1	0N	10'	0	-	0	-	0	-	None observed	∇=6-8'
	100N	10'	0	-	0	-	0	0-2'	None observed	Debris: wood, mud, bricks, gravel. ∇=6'
	150N, 10W	10'	73	2'	76	6'	55	0-2'	Heavy PID @ 0-2', mod. @ 2-10'	Debris: logs, metal, pipe, cable. ∇=8' w/sheen
	200N	10'	51	4'	0	-	10.2	0-5'	Mod. PID @ 3-4'	Debris: metal, wood, bricks. ∇=3' & 8'
	250N	10'	0	-	0	-	0	0-3'	Heavy @ 0-3'	Debris: mostly small pieces of wood. ∇=3'
T2	0N	2'	20	2'	-	-	-	0-2'	Heavy @ 0-2'	Debris: wood chips, mud, concrete pad
	50N	3'	22	2'	-	-	-	0-3'	Heavy @ 0-3'	Debris: ties, pipe, logs, metal
	100N	10'	30	4'	19	6'	15.1	0-4'	Heavy @ 0-4', mod. @ 4-8'	Debris: metal, woodchips. ∇= 4' w/product
	150N	10'	0.5	2'	0	-	0.1	2'-4'	Upper 2'	Debris: woodchips, clay. ∇= 4-6' w/slight sheen
	200N	10'	0	-	0	-	0	-	Slight upper 2' of fill	∇= 10' w/v.slight sheen
	250N	10'	28	4'	37	10'	23.8	0-1'	Mod. @ 1-10'	Debris: cable. ∇= 7' w/product
	300N	10'	0	-	30	8'	10.0	-	Mod. @ 6-10'	∇=4 & 10' w/product @ 6'
	330N,10W	10'	40	4'	19	6'	15.8	0-2'	Heavy @ 0-2', mod. @ 2-10'	Debris: pipe, wood. ∇= 2' w/oily water
T3	0N	8'	101	2'	0	-	20.7	0-3'	Heavy @ 0-4', none below	Debris: woodchips. ∇= 2-4' w/sheen
	40N, 10E	11'	0	-	45	8'	15.6	-	Mod. @ 8-11', none above	∇=11' w/product
	100N	10'	0	-	0	-	0	-	None observed	∇=6 & 10'
	150N	10'	0	-	32	10'	14.8	-	Mod. @ 6-10', none above	∇=6-8'
	250N	10'	30	4'	45	6'	26.8	0-6'	Mod. - Heavy 0-10'	Debris: concrete, pipe, metal rack. ∇=7' w/product
	400N	2'	0	-	-	-	-	0-2'	Heavy @ 0-2'	Debris: rice hulls, mud, wood, concrete pad
	450N	10'	84	4'	55	6'	42.8	0-4'	Heavy @ 0-4', none below	Debris: wood, pipe. ∇=4'& 6-8' w/product
	500N	10'	15	4'	40	7'	25.0	-	Heavy @ 0-7', mod. @ 8-10'	∇= ≈3' w/product
	550N	10'	75	3'	140	5'	64.0	-	Mod. - Heavy @ 0-10'	
	590N	10'	55	3'	120	5'	59.0	-	Slight @ 3-7'	Positive PID all depths
	0N, 150W	10'	0	-	0	-	0	-	None observed	
	10S, 100W	10'	0	-	0	-	0	-	None observed	
T4	0N	8'	5	1'	23	8'	13.3	0-2'	Mod. @ 0-2'	Debris: wood, roots 3-5'. ∇=4'
	60N	4'	0.4	2'	-	-	-	0-4'	Heavy @ 0-4'	Debris: treated wood, pipeline
	100N	10'	1.0	2'	75	8'	28.2	4-8'	Slight @ 0-6', mod. @ 6-10'	Debris: sticks, hose, wood
	150N	4'	35	4'	-	-	-	0-4'	Heavy @ 3-4'	Debris: rocks, cable. ∇=3' w/product
	200N	8'	93	3'	120	7'	95.3	2-8'	Heavy @ 0-8'	Debris: bricks, rice hulls, cables, etc.

TABLE 4-5 (continued)

SUMMARY OF TRENCHING OBSERVATIONS

Transect	Location	Total Depth	PID Peak				0'-8' or 0'-10' avg. PID[b]	Debris Depth	Visual Extent of Contamination	Remarks[c]
			0'-5' Peak	Depth	5'-10' Peak	Depth				
	250N	4'	35	1'	-	-	-	2-4'	Heavy @ 0-4'	Excavation stopped due to debris
	300N	2'	35	1'	-	-	-	0-2'	Heavy @ 0-2'	Excavation stopped due to debris
	350N	10'	320	3'	270	7'	272.2	0-1'	Heavy @ 0-4', mod. @ 4-10'	∇=product 2'
	400N	10'	428	3'	454	5'	362.4	-	Heavy @ 0-4', mod. @ 4-10'	∇=product 2'
	450N	10'	40	3'	110	5'	59.6	-	Mod. @ 0-10'	
T5	0N	10'	200	4'	235	8'	145.2	0-6'	Heavy @ 0-6', none below	Debris: woodchips. ∇=6' & 8' w/sheen
	50N	8'	269	4'	250	8'	-	0-6'	Heavy @ 0-6'	Debris: woodchips, logs. ∇=6' w/sheen
	100N	10'	15	2'	215	8'	100.0	0-5'	Heavy @ 0-5'	Debris: woodchips. Oily sheen on chips
	150N	10'	4	4'	29	6'	7.9	0-2'	Slight @ 4-8'	Debris: logs, ties. ∇=5'
	200N	8'	75	5'	145	7'	60.5	-	Slight grading to heavy from 0-8'	
	250N	10'	30	4'	175	10'	83.4	-	Mod. @ 4-10'	∇=product 6' & 9'
	300N	10'	8	4'	225	8'	110.4	-	Mod. @ 4-10'	Upper 2' fill mat'l.. ∇=product 6'
	350N	10'	14	4'	23	8' & 10'	14.6	0-4'	Heavy @ 0-4', mod. 4-7'	Debris: metal, woodchunks. ∇=2'
	400N	10'	158	3'	160	7'	141.6	-	Mod. @ 3-8'	
	450N	10'	215	3'	230	7'	191.0	-	Heavy @ 0-10'	
	500N	2'	82	1'	-	-	-	0-2'	Heavy 0-2'	Excavation stopped due to debris
T6	0N, 5W	2'	0	2'	-	-	-	2'	None observed	Debris: boulders (bedrock?)
	35N	4'	0.2	4'	-	-	-	4'	None observed	Debris: boulders (bedrock?)
	70N	8'	-	-	-	-	-	-	None observed	
	105N	4'	-	-	-	-	-	-	Heavy @ 4'	
	140N	8'	-	-	-	-	-	-	None observed	
	175N	11'	-	-	96	9'	-	0-1'	Heavy @ 0-11'	Debris: wood
	210N	11'	-	-	200	10'	-	-	Slight grading to heavy @ 0-11'	3 high PID @ 6-11'. Oily sheen on soils.
	245N	11'	220	4'	245	10'	177.8	0-3'	Heavy @ 0-11'	Debris: woodchips. Free product 8'.
	280N	11'	-	-	-	-	-	-	Heavy @ 0-11'	No log recorded due to rain
	315N	11'	168	4'	100	10'	-	0-2'	Heavy @ 0-3', mod. @ 3-11'	Debris: railroad ties, etc.
	360N	11'	20	4'	79	10'	45.8	2'	Heavy @ 4'11'	Debris: rocks. ∇=4' w/product. Soils had oily sheen
	410N	8'	18	4'	32	6'	16.1	0-3'	Heavy @ 0-3', mod. @ 3-8'	Debris: railroad ties. ∇=2' w/product
	50S	8'	0	-	0	-	0	-	Slight @ 6-8'	∇= 2.5'
	100S	10'	19	3'	0	-	17.0	0-2'	Heavy @ 0-10'	Debris: woodchips

TABLE 4-5 (continued)

SUMMARY OF TRENCHING OBSERVATIONS

Transect	Location	Total Depth	PID Peak				0'-8' or 0'-10' avg. PID[b]	Debris Depth	Visual Extent of Contamination	Remarks[c]
			0'-5' Peak	Depth	5'-10' Peak	Depth				
	145S, 10E	10'	0.5	1'	19	6'	0.1	-	Slight @ 1'	∇= ≈1', minor odor all depths
T7	0N	5'	33	4'	-	-	-	5'	Heavy @ 2-5'	Debris: logs, tire; ∇=3' w/product.
	50N	11'	90	4'	55	11'	43.0	2'-3'	Mod. @ 0-4'	Debris: railroad ties. ∇=3'. peat @ 3'
	100N	11'	7	4'	3	6'	2.2	-	Slight @ 4-6'	∇=4-6', peat @ 4'
	150N	10'	30	4'	4	6'	6.8	-	Mod. @ 3-4'	Peat @ 4'
	200N	10'	50	4'	229	6'	136.8	-	Slight-Mod. @ 3-7'	∇=3-6', Oily sheen on soil @ 6'
	250N	7'	0	-	-	-	-	-	None observed	Excavation stopped due to caving
	50S	2'	0	-	-	-	-	-	None observed	Hand auger stopped by rocks
	65S	7.5'	15.5	5'	70	6'	19.8	-	Mod. @ 4-5', slight @ 5-7.5'	Oily sheen on soil @ 5-7.5'
	130S	10'	0	-	1.6	8'	0.3	-	Slight @ 8'	Slight oily sheen @ 8'
T8	200N	10'	0	-	0	-	0	1-3'	None observed	Debris: railroad ties. ∇=9'
	300N	10'	0	-	0	-	0	-	None observed	
T9	100N	10'	0	-	0	-	0	1'	None observed	Debris: wood. ∇=9'
	200N	10'	0	-	0	-	0	-	None observed	∇=9'
	300N	10'	0	-	0	-	0	1'	None observed	Debris: treated wood. ∇=9'
	400N	10'	0	-	0	-	0	-	None observed	∇=9'
	500N	10'	0	-	0	-	0	1'	None observed	∇=29'
TE-1	180'N 21°E of T6, 410N	10'	0	-	0	-	0	1'	None observed	Materials saturated at 8'
TE-2	73'SW of MW7	8'	0	-	0	-	0	-	None observed	Water depth 7'
TE-3	E of tar mat	7'	1	3	18	7'	-	-	Slight @ 0-6', heavy @ 6-7'	Contamination increased with depth
TE-4	30'SE of *machine shop*	8'	-	-	-	-	-	-	None observed	Hand augering stopped @ 8' due to hard siltstone

[a] Photoionization detector (PID) readings were obtained in the field by placing the instrument's probe within a few millimeters of a freshly exposed portion of soil.

[b] Averages were taken only in those excavations which achieved depths greater than 8 feet and 4 or more PID readings were recorded.

[c] The use of the symbol "∇" is used in this column to indicate the depth at which water was entering the excavation.

soil PID readings increased with depth, with the readings typically occurring at seven to eight feet. One notable exception to this trend occurred in the area of T3, 0N, where a peak reading slightly over 100 ppm was recorded at a depth of two feet. Creosote-soaked wood chips were present from one to four feet, but PID readings below this depth did not exceed background.

4.4.3.2 Subsurface Soil Sampling Results

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Analytical data for subsurface soils are available primarily from current investigation results and, to a lesser extent, from previous investigations. Subsurface soil sampling during the current investigation focused on providing information in those areas not covered by previous sampling and on defining the vertical and lateral extent of subsurface contamination. Figures 3-1 and 4-4 illustrate subsurface soil sampling locations for the previous and current investigations, respectively. Analytical data for previous investigations are summarized in Appendix A. Data for subsurface soil samples collected during the current investigation are presented in Table 4-6 and in Appendix D. Portions of the site for which subsurface soil data exist include the following areas which can be seen on Figure 1-2:

- The former process area
- The former impoundments and drainage area northeast of the process area
- The tar mat
- The waste cell constructed during the removal action
- The southern portion of the site
- The portion of the site north of Creosote Branch.

The degree of contamination present in each of these areas is discussed below.

Some of the highest concentrations of contaminants found at the site are located within the former process area. Samples which provide examples of these high levels of contamination include MW-4 (5 feet), MW-5 (0-10 feet), BH-14 (0-10 feet). Total PAH values for these

TABLE 4-6. SUMMARY OF QTM DATA FOR SUBSURFACE SOIL SAMPLES.

FIELD SAMPLE NUMBER:	BH-01-SS-001		BH-01-SS-002		BH-03-SS-001		BH-04-SS-001		BH-04-SS-002		BH-06-SS-001		BH-06-SS-002		BH-08-SS-001		BH-08-SS-002		BH-09-SS-001	
EPA SAMPLE NUMBER:	QF0283		QF0285		QF0291		QF0287		QF0289		QF0271		QF0273		QF0250		QF0248		QF0253	
DEPTH	1-12'		20'		.5-6'		0-12'		20'		0-12'		20'		4'		10'		5'	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	240.00	J	130.00	J	63.00	J	220.00	J	-	UJ	4.00	J	7.90	J	53.00	J	100.00	J	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	540.00	J	710.00	J	520.00	J	140.00	J	-	UJ	20.00	J	6.10	J	160.00	J	250.00	J	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	810.00	J	1800.00	J	870.00	J	510.00	J	1400.00	J	14.00	J	-	UJ	96.00	J	130.00	J	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	760.00	J	1100.00	J	850.00	J	240.00	J	-	UJ	32.00	J	4.30	J	230.00	J	300.00	J	-	UJ
O-XYLENE	370.00	J	610.00	J	390.00	J	-	UJ	-	UJ	22.00	J	-	UJ	280.00	J	150.00	J	-	UJ
PAH ANALYTES (330)	QF0284	Q	QF0286	Q	QF0292	Q	QF0288	Q	QF0290	Q	QF0272	Q	QF0274	Q	QF0249	Q	QF0247	Q	QF0254	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	120000.0	J	48000.00	J	-	UJ	47000.00	J	-	UJ	30000.00	J	180.00	J	36000.00	J	38000.00	J	-	UJ
ACENAPHTHYLENE	-	UJ	1400.00	J	4900.00	J	4800.00	J	-	UJ	2700.00	J	-	UJ	700.00	J	2100.00	J	-	UJ
ACENAPHTHENE	37000.0	R	35000.00	R	2900.00	R	48000.00	R	320.00	R	35000.00	J	170.00	J	31000.00	J	33000.00	J	-	UJ
FLUORENE	51000.0	R	38000.00	R	10000.00	R	59000.00	R	270.00	R	34000.00	R	140.00	R	32000.00	J	35000.00	J	-	UJ
PHENANTHRENE	-	R	93000.00	R	-	R	79000.00	R	420.00	R	44000.00	J	550.00	J	45000.00	J	42000.00	J	-	UJ
ANTHRACENE	-	UJ	-	UJ	-	UJ	-	UJ	130.00	J	-	UJ	64.00	J	-	UJ	330.00	R	-	UJ
FLUORANTHENE	-	R	46000.00	J	740.00	R	77000.00	J	74.00	J	47000.00	J	35.00	J	42000.00	J	49000.00	J	140.00	J
PYRENE	4700.0	R	41000.00	J	-	UJ	9000.00	J	60.00	J	44000.00	J	30.00	J	41000.00	J	47000.00	J	170.00	J
BENZ(A)ANTHRACENE	10000.0	J	12000.00	J	21000.00	J	-	UJ	110.00	J	13000.00	J	67.00	J	10000.00	J	15000.00	J	80.00	J
CHRYSENE	110000.0	J	11000.00	J	6700.00	R	18000.00	J	120.00	J	11000.00	J	58.00	J	10000.00	J	14000.00	J	100.00	J
BENZO(B)/(K)FLUORANTHENE	35000.0	J	3900.00	J	1300.00	R	28000.00	J	-	UJ	4000.00	J	-	UJ	15000.00	J	22000.00	J	330.00	J
BENZO(A)PYRENE	31000.0	R	3500.00	J	3100.00	R	31000.00	J	-	UJ	3400.00	J	-	UJ	3200.00	R	4900.00	R	110.00	J
INDENO(1,2,3-CD)PYRENE	-	UJ	1000.00	J	-	UJ	-	UJ	-	UJ	1500.00	J	-	UJ	1000.00	R	320.00	J	210.00	J
DIBENZ(A,H)ANTHRACENE	-	UJ	480.00	J	-	UJ	15000.00	J	-	UJ	260.00	J	-	UJ	210.00	R	-	UJ	0.00	J
BENZO(G,H,I)PERYLENE	12000.0	J	840.00	R	460.00	R	-	R	-	UJ	910.00	J	-	UJ	700.00	R	-	UJ	0.00	J
B(A)P Equivalence Conc.	36600		5780		5397		48980		12		5620		7		6110		8772		173	
Total PAHs	410700		335120		51100		415800		1504		270770		1294		267810		302650		1140	
PHENOL ANALYTES (1700)	QF0283	Q	QF0285	Q	QF0291	Q	QF0287	Q	QF0289	Q	QF0271	Q	QF0273	Q	QF0250	Q	QF0248	Q	QF0253	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	13000.0	J	8700.0	J	5500.00	J	-	UJ	-	UJ	1800.0	J	6600.00	J	5100.0	R	-	R	-	UJ
2-CHLOROPHENOL	650.0	J	3100.0	J	870.00	J	2800.00	J	240.00	J	-	UJ	340.00	J	1700.0	R	9100.00	R	990.00	J
O-CRESOL	5500.0	J	1800.0	J	1700.00	J	160.00	J	-	UJ	550.0	J	1900.00	J	3200.0	R	3200.00	R	-	UJ
M/P-CRESOL	16000.0	J	6000.0	J	5800.00	J	470.00	J	240.00	J	1800.0	R	6500.00	R	8900.0	R	10000.00	R	200.00	J
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	R	-	R	-	R	-	UJ
2,4-DIMETHYLPHENOL	9300.0	J	1300.0	J	5900.00	J	1500.00	J	-	UJ	820.0	R	1100.00	R	4500.0	R	3200.00	R	-	UJ
2,4-DICHLOROPHENOL	17000.0	J	5100.0	J	7000.00	J	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	R	-	UJ
4-CHLORO-3-METHYLPHENOL	320.0	J	1800.0	J	760.00	J	3400.00	J	-	UJ	2600.0	J	-	UJ	3900.0	R	3700.00	R	-	UJ
2,4,5/6-TRICHLOROPHENOL	800.0	J	100000.0	J	870.00	J	430.00	J	-	UJ	210.0	J	-	UJ	590.0	R	-	R	-	UJ
2,4-DINITROPHENOL	6600.0	J	540.0	J	7100.00	J	2300.00	J	-	UJ	2000.0	J	-	UJ	10000.0	R	9600.00	R	-	R
4-NITROPHENOL	4900.0	J	560.0	J	4900.00	J	1400.00	J	-	UJ	1600.0	UJ	190.00	J	2600.0	R	2300.00	R	-	UJ
2,3,4,6-TETRACHLOROPHENOL	5800.0	J	1500.0	J	13000.00	J	4200.00	J	560.00	J	13000.0	J	89.00	J	8200.0	R	4800.00	R	-	UJ
4,6-DINITRO-2-METHYLPHENOL	13000.0	J	500.0	J	11000.00	J	2200.00	J	-	UJ	2400.0	J	92.00	J	6800.0	R	3600.00	R	-	UJ
PENTACHLOROPHENOL	170000.0	J	2300.0	J	27000.00	J	17000.00	J	-	UJ	300000.0	J	1700.00	J	140000.0	R	83000.00	R	-	UJ

TABLE 4-6. SUMMARY OF QTM DATA FOR SUBSURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER:	BH-09-SS-002		BH-10-SS-001		BH-11-SS-001		BH-12-SS-001		BH-13-SS-001		BH-14-SS-001		BH-14-SS-002		BH-14-SS-003		BH-15-SS-001	
EPA SAMPLE NUMBER:	QF0255		QF0252		QF0257		QF0244		QF0243		QF0259		QF0261		QF0263		QF0231	
DEPTH	9.5'		5'		5'		5'		5'		0-10'		10-14.5'		18-21'		4-5'	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	24.00	J	-	UJ	-	UJ	-	UJ	150.00	J	65.00	J	24.00	J	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	9.40	J	270.00	J	-	UJ	-	UJ	-	UJ	410.00	J	81.00	J	32.00	J	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	39.00	J	550.00	J	-	UJ	-	UJ	-	UJ	290.00	J	36.00	J	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	100.00	J	1100.00	J	-	UJ	-	UJ	-	UJ	550.00	J	61.00	J	470.00	J	-	UJ
O-XYLENE	52.00	J	640.00	J	740.00	J	-	UJ	-	UJ	350.00	J	1800.00	J	180.00	J	-	UJ
PAH ANALYTES (330)	QF0256	Q	QF0251	Q	QF0258	Q	QF0246	Q	QF0245	Q	QF0260	Q	QF0262	Q	QF0264	Q	QF0232	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	6000.00	J	28000.00	J	-	UJ	-	R	-	R	58000.0	J	2600.00	J	130.00	J	-	R
ACENAPHTHYLENE	770.00	J	850.00	J	-	UJ	-	R	-	R	6100.0	J	760.00	J	-	UJ	-	R
ACENAPHTHENE	6000.00	J	16000.00	J	-	UJ	-	R	-	R	64000.0	J	1400.00	J	150.00	J	-	R
FLUORENE	6000.00	J	22000.00	J	-	UJ	-	R	-	R	57000.0	J	2000.00	J	180.00	J	-	R
PHENANTHRENE	21000.00	J	38000.00	J	80.00	J	-	R	-	R	100000.0	J	5700.00	J	470.00	J	-	R
ANTHRACENE	3000.00	J	12000.00	J	-	UJ	-	R	-	R	-	UJ	5600.00	J	92.00	J	-	R
FLUORANTHENE	12000.00	J	25000.00	J	170.00	J	-	R	-	R	100000.0	J	2700.00	J	150.00	J	-	R
PYRENE	10000.00	J	19000.00	J	150.00	J	-	R	-	R	54000.0	J	2100.00	J	93.00	J	-	R
BENZ(A)ANTHRACENE	3000.00	J	5700.00	J	-	UJ	-	R	-	R	97000.0	J	590.00	J	-	UJ	-	R
CHRYSENE	2900.00	J	4900.00	J	-	UJ	-	R	-	R	330.0	J	640.00	J	-	UJ	-	R
BENZO(B)/(K)FLUORANTHENE	3900.00	J	10000.00	J	70.00	J	-	R	-	R	65000.0	J	6900.00	J	-	UJ	-	R
BENZO(A)PYRENE	2100.00	J	2500.00	R	260.00	J	-	R	-	R	36000.0	J	11000.00	J	1300.00	J	-	R
INDENO(1,2,3-CD)PYRENE	1200.00	J	1000.00	R	-	UJ	-	R	-	R	12000.0	J	3200.00	J	1100.00	J	-	R
DIBENZ(A,H)ANTHRACENE	240.00	J	300.00	R	-	UJ	-	R	-	R	-	UJ	690.00	J	230.00	J	-	R
BENZO(G,H,I)PERYLENE	1000.00	J	880.00	R	-	UJ	-	R	-	R	12000.0	J	3000.00	J	780.00	J	-	R
B(A)P Equivalence Conc.	3179		4519		267		0		0		53403		12765		1640		0	
Total PAHs	79110		186130		730		0		0		661430		48880		4675		0	
PHENOL ANALYTES (1700)	QF0255	Q	QF0252	Q	QF0257	Q	QF0244RE	Q	QF0243RE	Q	QF0259	Q	QF0261	Q	QF0263	Q	QF0231RE	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	-	UJ	-	R	54.00	J	-	UJ	-	UJ	1100.0	J	-	UJ	60.00	J	-	UJ
2-CHLOROPHENOL	1300.00	J	750.00	R	-	UJ	200.00	J	150.00	J	3200.0	J	1600.00	J	1800.00	J	120.00	J
O-CRESOL	-	UJ	300.00	R	-	UJ	-	UJ	-	UJ	-	UJ	810.00	J	690.00	J	-	UJ
M/P-CRESOL	270.00	J	440.00	R	240.00	J	110.00	J	-	UJ	6100.0	J	1700.00	J	1000.00	J	-	UJ
2-NITROPHENOL	-	UJ	-	R	-	UJ	-	UJ	-	UJ	510.0	J	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	UJ	1400.00	R	-	UJ	-	UJ	-	UJ	21000.0	J	2200.00	J	590.00	J	-	UJ
2,4-DICHLOROPHENOL	-	UJ	-	R	-	UJ	-	UJ	350.00	J	-	UJ	-	UJ	-	UJ	490.00	J
4-CHLORO-3-METHYLPHENOL	240.00	J	1400.00	R	-	UJ	-	UJ	-	UJ	-	UJ	5400.00	J	110.00	J	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	550.00	R	-	UJ	-	UJ	280.00	R	11000.0	R	900.00	R	-	UJ	210.00	J
2,4-DINITROPHENOL	910.00	R	1800.00	R	-	R	-	UJ	-	UJ	220000.0	R	1900.00	R	870.00	R	-	UJ
4-NITROPHENOL	190.00	J	1300.00	R	-	UJ	-	UJ	-	UJ	820000.0	J	1300.00	J	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	1200.00	J	710.00	R	1900.00	J	500.00	J	340.00	J	270000.0	J	1600.00	J	1400.00	J	360.00	J
4,6-DINITRO-2-METHYLPHENOL	240.00	R	1600.00	R	-	UJ	-	R	-	R	170000.0	R	1800.00	J	-	UJ	-	R
PENTACHLOROPHENOL	820.00	R	1700.00	R	1900.00	J	-	UJ	-	UJ	200000.0	R	6800.00	J	740.00	R	-	UJ

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TABLE 4-6. SUMMARY OF QTM DATA FOR SUBSURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER:	MW-01-SS-001		MW-01-SS-002		MW-01A-SS-001		MW-01A-SS-002		MW-02-SS-001		MW-02-SS-002		MW-02A-SS-001		MW-02A-SS-002		MW-03-SS-001		MW-03-SS-002	
EPA SAMPLE NUMBER:	QF0293		QF0295		QF0298		QF0297		QF0233		QF0269		QF0205		QF0206		QF0265		QF0301	
DEPTH	36'		51'		0-10'				31-35'		51'		0-10'		15'		32'		51'	
VOA ANALYTES (40)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	13.00	J	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	89.00	J	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	320.00	J	-	UJ	-	UJ	-	UJ	-	UJ	70.00	R	-	R	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	220.00	J	5.00	J	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	110.00	R	100.00	R	110.00	J	-	UJ
PAH ANALYTES (330)	QF0294	Q	QF0296	Q	QF0299	Q	QF0300	Q	QF0234		QF0270	Q	QF0205	Q	QF0206	Q	QF0266	Q	QF0302	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	80000.0	J	25000.00	J	-	UJ	-	UJ
ACENAPHTHYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	8200.0	J	1100.00	J	-	UJ	-	UJ
ACENAPHTHENE	380.00	J	390.00	J	-	UJ	-	UJ	-	R	200.00	J	98000.0	J	22000.00	J	-	UJ	-	UJ
FLUORENE	260.00	J	330.00	J	-	UJ	-	UJ	910.00	R	-	R	120000.0	J	27000.00	J	78.00	J	-	UJ
PHENANTHRENE	360.00	R	280.00	R	-	UJ	-	UJ	6700.00	R	-	UJ	-	UJ	85000.00	J	160.00	J	-	UJ
ANTHRACENE	110.00	J	-	UJ	-	UJ	-	UJ	4600.00	R	-	UJ	370000.0	J	9000.00	J	-	UJ	-	UJ
FLUORANTHENE	60.00	J	47.00	J	-	UJ	-	UJ	3000.00	R	-	UJ	-	UJ	41000.00	J	45.00	J	-	UJ
PYRENE	45.00	J	-	UJ	-	UJ	-	UJ	1600.00	R	-	UJ	-	UJ	28000.00	J	-	UJ	-	UJ
BENZ(A)ANTHRACENE	54.00	J	-	UJ	-	UJ	-	UJ	460.00	R	-	UJ	29000.0	R	7100.00	J	-	UJ	-	UJ
CHRYSENE	50.00	R	-	UJ	-	UJ	-	UJ	480.00	R	-	UJ	27000.0	R	6100.00	J	-	UJ	-	UJ
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ	-	UJ	-	UJ	120.00	R	-	UJ	25000.0	J	5200.00	J	-	UJ	-	UJ
BENZO(A)PYRENE	-	UJ	-	UJ	-	UJ	-	UJ	81.00	R	-	UJ	12000.0	R	2600.00	J	230.00	J	-	UJ
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	5400.0	R	1500.00	J	490.00	J	-	UJ
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	2500.0	R	800.00	J	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	4600.0	R	1300.00	J	400.00	J	-	UJ
B(A)P Equivalence Conc.	6		0		0		0		144		0		20710		4841		279		0	
Total PAHs	1319		1047		0		0		17951		200		781700		262700		1403		0	
PHENOL ANALYTES (1700)	QF0293	Q	QF0295	Q	QF0298	Q	QF0297	Q	QF0233RE	Q	QF0269	Q	QF0205	Q	QF0206	Q	QF0265	Q	QF0301	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	-	UJ	350.00	J	1000.00	R	-	R	43.00	J	760.00	J	-	UJ	-	UJ	110.00	J	850.00	R
2-CHLOROPHENOL	570.00	J	220.00	J	290.00	J	1300.00	J	150.00	J	-	UJ	280.00	J	940.00	J	1300.00	J	210.00	J
O-CRESOL	-	UJ	-	UJ	22.00	J	31.00	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	UJ	240.00	J	31.00	R	190.00	R	73.00	J	-	R	-	UJ	360.00	J	480.00	J	66.00	R
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	65.00	J	-	UJ	-	R	-	UJ	-	UJ	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	UJ	-	UJ	160.00	J	180.00	J	-	UJ	-	R	-	UJ	-	UJ	-	UJ	190.00	R
2,4-DICHLOROPHENOL	-	UJ	-	UJ	51.00	J	45.00	J	-	UJ	-	UJ	110.00	J	-	UJ	-	UJ	110.00	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	1400.00	J	78.00	J	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	740.00	R	440.00	J	190.00	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	170.00	J
2,4-DINITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	950.00	R	-	R	-	R	-	UJ
4-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	57.00	J	67.00	J	880.00	J	-	UJ	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	-	UJ	720.00	J	33.00	J	-	UJ	680.00	J	150.00	J	500.00	J	510.00	J	-	UJ	-	UJ
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	-	R	-	UJ	500.00	R	110.00	R	-	UJ	-	UJ
PENTACHLOROPHENOL	-	UJ	-	UJ	82.00	J	49.00	J	610.00	J	210.00	J	2000.00	J	370.00	J	-	UJ	-	UJ

TABLE 4-6. SUMMARY OF QTM DATA FOR SUBSURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER:	MW-03A-SS-001		MW-03A-SS-002		MW-04-SS-001		MW-04-SS-002		MW-05-SS-001		MW-05-SS-002		MW-06-SS-001		MW-06-SS-002		MW-07-SS-001		MW-07-SS-002	
EPA SAMPLE NUMBER:	QF0198		QF0199		QF0209		QF0210		QF0211		QF0212		QF0207		QF0208		QF0303		QF0305	
DEPTH	0-10'		15'		5'		15'		0-10'		2-5'		1-10'		15'		0-10'		19'	
VOA ANALYTES (40)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	21.00	J	180.00	J	29.00	J	24.00	J	120.00	J	790.00	J	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	76.00	J	630.00	J	25.00	J	18.00	J	230.00	J	1200.00	J	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	350.00	J	400.00	J	100.00	J	550.00	J	290.00	R	590.00	R	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	190.00	J	1100.00	J	54.00	J	-	UJ	340.00	J	1200.00	J	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	50.00	J	610.00	J	1200.00	J	55.00	J	150.00	R	970.00	R	-	UJ	-	UJ
PAH ANALYTES (330)	QF0198RE	Q	QF0199RE	Q	QF0209	Q	QF0210	Q	QF0211	Q	QF0212	Q	QF0207	Q	QF0208	Q	QF0304	Q	QF0306	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	130.00	J	-	UJ	30000.0	R	120000.0	J	41000.0	J	-	UJ	260000.0	J	-	R	-	UJ	-	UJ
ACENAPHTHYLENE	9000.00	J	-	UJ	8300.0	R	28000.0	J	9200.0	J	-	UJ	19000.0	J	82000.0	R	-	UJ	-	UJ
ACENAPHTHENE	14000.00	J	-	UJ	91000.0	R	61000.0	J	170000.0	J	-	UJ	240000.0	J	-	R	-	UJ	70.00	J
FLUORENE	16000.00	J	-	UJ	300000.0	R	-	UJ	270000.0	R	120.00	J	-	UJ	75000.0	R	-	UJ	50.00	J
PHENANTHRENE	22000.00	J	-	UJ	-	R	-	UJ	40000.0	J	390.00	J	-	UJ	380000.0	R	38.00	R	110.00	J
ANTHRACENE	28000.00	J	-	UJ	-	R	-	UJ	-	UJ	120.00	J	480000.0	J	-	R	-	UJ	-	UJ
FLUORANTHENE	7500.00	J	-	UJ	-	R	-	UJ	-	UJ	150.00	J	-	UJ	210000.0	R	180.00	J	80.00	J
PYRENE	12000.00	J	-	UJ	14000.0	R	23000.0	J	17000.0	J	110.00	J	22000.0	J	-	R	220.00	J	76.00	J
BENZ(A)ANTHRACENE	-	UJ	-	UJ	-	R	-	UJ	-	UJ	-	UJ	-	UJ	-	R	140.00	J	52.00	J
CHRYSENE	4000.00	J	-	UJ	96000.0	R	-	UJ	84000.0	R	-	UJ	-	UJ	19000.0	R	180.00	J	44.00	J
BENZO(B)/(K)FLUORANTHENE	1700.00	R	-	UJ	-	R	300.0	UJ	-	UJ	-	UJ	-	UJ	39000.0	R	190.00	J	50.00	J
BENZO(A)PYRENE	10000.00	J	-	UJ	26000.0	R	34000.0	J	25000.0	R	-	UJ	30000.0	R	-	R	110.00	J	-	UJ
INDENO(1,2,3-CD)PYRENE	4500.00	J	-	UJ	-	R	31000.0	R	-	UJ	-	UJ	-	UJ	23000.0	R	-	UJ	-	UJ
DIBENZ(A,H)ANTHRACENE	8200.00	J	-	UJ	26000.0	R	-	UJ	23000.0	R	-	UJ	22000.0	J	-	R	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	2700.00	J	100.00	J	-	R	25000.0	J	-	UJ	-	UJ	-	UJ	11000.0	R	-	UJ	-	UJ
B(A)P Equivalence Conc.	18860		0		52960		37130		48840		0		52000		6390		145		11	
Total PAHs	139730		100		591300		322300		679200		890		1073000		839000		1058		532	
PHENOL ANALYTES (1700)	QF0198	Q	QF0199	Q	QF0209RE	Q	QF0210RE	Q	QF0211RE	Q	QF0212	Q	QF0207RE	Q	QF0208RE	Q	QF0303	Q	QF0305	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	-	UJ	390.00	R	-	UJ	-	UJ	-	UJ	-	UJ	17000.0	J	-	UJ	980.00	R	970.00	R
2-CHLOROPHENOL	44.00	J	-	UJ	990.00	J	2000.00	J	1700.0	J	1600.00	J	1300.0	J	97000.0	J	260.00	J	280.00	J
O-CRESOL	5.00	R	-	UJ	-	UJ	2500.00	J	39.0	J	63.00	J	9300.0	J	35000.0	J	-	UJ	-	UJ
M/P-CRESOL	3.00	J	-	UJ	620.00	J	5200.00	J	700.0	J	-	UJ	26000.0	J	-	UJ	140.00	R	180.00	R
2-NITROPHENOL	-	J	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	66.00	J
2,4-DIMETHYLPHENOL	29.00	R	-	UJ	-	UJ	9200.00	J	-	UJ	-	UJ	12000.0	J	42000.0	J	220.00	J	110.00	J
2,4-DICHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	260.0	J	-	UJ	-	UJ	-	UJ	57.00	J	-	UJ
4-CHLORO-3-METHYLPHENOL	15.00	R	-	UJ	3700.00	J	210.00	J	90.0	R	-	UJ	20000.0	J	650.0	J	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	3.00	R	190.00	J	100.00	J	1100.00	J	300.0	J	-	UJ	930.0	J	2000.0	J	380.00	J	220.00	J
2,4-DINITROPHENOL	35.00	R	-	UJ	1600.00	R	4500.00	R	2800.0	R	-	R	8900.0	R	47000.0	R	-	UJ	-	UJ
4-NITROPHENOL	8.00	R	-	UJ	1300.00	J	3700.00	J	1800.0	J	-	UJ	4900.0	J	15000.0	J	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	63.00	R	1200.00	J	2700.00	J	7000.00	R	6500.0	J	54.00	J	24000.0	J	14000.0	J	-	UJ	-	UJ
4,6-DINITRO-2-METHYLPHENOL	42.00	R	-	R	2200.00	R	5300.00	R	2700.0	R	-	UJ	13000.0	R	40000.0	R	-	UJ	-	UJ
PENTACHLOROPHENOL	2107.00	R	770.00	J	13000.00	J	14000.00	J	110000.0	J	150.00	J	450000.0	J	310000.0	J	92.00	J	-	UJ

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TABLE 4-6. SUMMARY OF QTM DATA FOR SUBSURFACE SOIL SAMPLES (continued).

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH	MW-08-SS-001 QF0200 0-10'		MW-08-SS-002 QF0201 15'	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ
PAH ANALYTES (330)	QF0200RE µg/Kg	Q	QF0201RE µg/Kg	Q
NAPHTHALENE	-	UJ	-	UJ
ACENAPHTHYLENE	-	UJ	-	UJ
ACENAPHTHENE	-	UJ	-	UJ
FLUORENE	-	UJ	-	UJ
PHENANTHRENE	23.00	J	-	UJ
ANTHRACENE	-	UJ	-	UJ
FLUORANTHENE	62.00	J	-	UJ
PYRENE	91.00	J	-	UJ
BENZ(A)ANTHRACENE	-	UJ	-	UJ
CHRYSENE	65.00	J	-	UJ
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ
BENZO(A)PYRENE	-	UJ	-	UJ
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	56.00	J	-	UJ
B(A)P Equivalence Conc.	1		0	
Total PAHs	297		0	
PHENOL ANALYTES (1700)	QF0200 µg/Kg	Q	QF0201 µg/Kg	Q
PHENOL	-	UJ	780.00	J
2-CHLOROPHENOL	-	UJ	-	UJ
O-CRESOL	-	UJ	-	UJ
M/P-CRESOL	160.00	J	120.00	J
2-NITROPHENOL	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	UJ	-	UJ
2,4-DICHLOROPHENOL	540.00	J	-	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	240.00	J	2300.00	J
2,4-DINITROPHENOL	-	R	-	R
4-NITROPHENOL	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	2000.00	J	-	UJ
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ
PENTACHLOROPHENOL	750.00	J	-	UJ

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samples are 591,300 μg/kg, 679,200 μg/kg, and 661,100 μg/kg, respectively. The sample collected at BH-14 (0-10 feet) had the highest B(a)P equivalent concentration of the three samples at 53,400 μg/kg. Phenol concentrations are also high in subsurface soils of the former process area. The PCP level in the BH-14 (0-10) sample was the highest at 200,000 μg/kg with levels of 13,000 and 110,000 μg/kg in MW-4 and MW-5, respectively.

Volatile organic compounds, consisting of benzene, toluene, ethylbenzene, and xylene, were detected in most subsurface soil samples from the former process area. Benzene concentrations for MW-4 (5 feet), MW-5 (0-10 feet), and BH-14 (0-10 feet) are 21 μg/kg, 29 μg/kg, and 150 μg/kg, respectively.

Four samples were collected for dioxin analysis from various depths during the drilling of MW-2A and MW-2. Calculated 2,3,7,8-TCDD equivalent concentrations were relatively low and decreased with increasing depth of the sampling interval. TCDD equivalent concentrations were 0.49 μg/kg at 0-10 feet, 0.01 μg/kg at the 13-16 feet and 31-35 feet depths, and undetected at 51 feet.

Concentrations of contaminants in subsurface soils of the former impoundment and drainage areas are similar to those found in the process area. However, the areal extent and depth of contamination in this area are not as great. As with subsurface soils in the process area, analytical data correlate well with evidence from visual observations and field screening methods employed during trenching and borehole drilling. Samples collected from BH-8 (10 feet) and MW-6 (1-10 feet), have been selected as representative of in this area. Total PAHs in these samples range from 303,000 to 1,073,000 μg/kg while B(a)P equivalent values vary from 8,800 to 52,000 μg/kg in BH-8 (10 feet) and MW-6 (1-10 feet), respectively. Reported PCP concentrations for these samples are 83,000 and 450,000 μg/kg. Volatile compounds were also detected in samples from this area with benzene concentrations of 100 and 120 μg/kg in the two samples discussed above.

Contamination in subsurface soils of the tar mat area can be characterized by samples BH-9 (9.5 feet) and BH-10 (5 feet). Visually, the BH-9 sample appeared only slightly contaminated (i.e., sheen observed on soil surface) whereas the sample collected at BH-10 could be described as moderately contaminated (i.e, gray color with dark streaks). Total PAHs were 79,000 and 186,000 μg/kg with B(a)P equivalent concentrations of 3,200 and 4,500 μg/kg for BH-9 and BH-10, respectively. The PCP concentrations for these two samples were 820 and 1,700 μg/kg. Benzene was not detected in the BH-9 sample although total BTEX present was 200 μg/kg. Total BTEX in the BH-10 sample was 2,600 μg/kg but benzene was reported to be only 24 μg/kg. The only dioxin analyses conducted on samples from this area were for BH-9 (5 feet). The calculated 2,3,7,8-TCDD equivalent for this sample was 0.69 μg/kg. Concentrations of PAHs and phenols in this sample were several orders of magnitude less than those detected in obviously contaminated samples collected in the area.

Three subsurface soil samples were collected to determine contaminant concentrations for material in the waste cell constructed during the 1989 removal action. The first sample collected in borehole BH-1 (1-12 feet) was a composite representing the stabilized waste present in the cell. The second sample from this boring (20 feet) was collected below the waste and liner to provide information regarding contaminant concentrations below the cell. A second sample of the waste material was collected from BH-3 at a depth of 0.5 to 6 feet. Total PAH concentrations in these three samples ranged from 51,100 to 410,700 μg/kg and maximum B(a)P equivalent and PCP concentrations reported were 36,600 and 170,000 μg/kg, respectively. Volatile compounds were present in all three samples with a maximum reported benzene value of 240 μg/kg from stabilized waste materials. The single sample from BH-3 was analyzed for dioxin. The calculated 2,3,7,8-TCDD equivalent value for this sample is 3.23 μg/kg.

Results for subsurface soil samples collected in the southern portion of the site indicate significantly less contamination exists in this area relative to other portions of the site such as the process area. Sample MW-1A (0-10 feet) contained 82 μg/kg of PCP but no PAHs or volatile compounds were detected. Conversely, MW-1 (51 feet) reported no PCP, but had

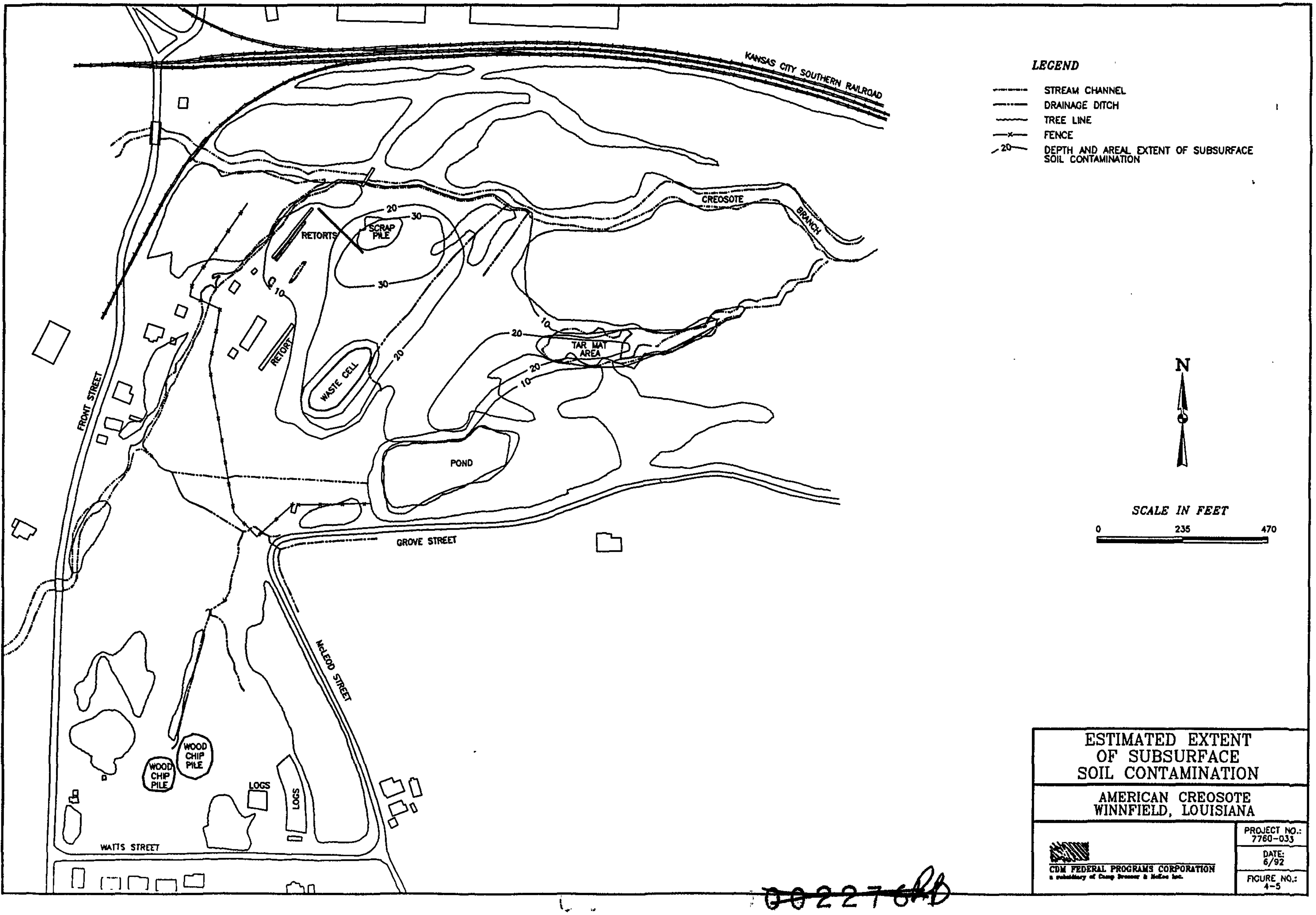
2,300 μg/kg total phenols, 1,050 μg/kg total PAHs, and 320 μg/kg ethylbenzene. B(a)P and B(a)P equivalents concentrations were undetected in these samples. Sample MW-1A (0-10 feet) was also analyzed for dioxin and a 2,3,7,8-TCDD equivalent value of 0.002 μg/kg was calculated.

North of Creosote Branch, contaminants similar were detected at concentrations as were found in magnitude to that found in the south portion of the site. A sample collected at MW-7 (0-10 feet) had a concentration of 1,060 μg/kg total PAHs and a B(a)P equivalent concentration of 145 μg/kg. No volatile compounds were detected, but 92 μg/kg PCP were reported. MW-7 is located in the center of the eastern most of the old railroad sidings.

In summary, grossly contaminated subsurface soils are present throughout the former process area, the impoundment area, and the drainage areas to the north and east. Lesser concentrations of some contaminants are present at depth in the southern and northern portions of the site. Concentrations of contaminants in these locations decline rapidly with depth.

4.4.3.3 Areal and Vertical Extent of Contamination

The estimated areal and vertical extent of subsurface soil contamination at American Creosote is shown in Figure 4-5. This figure was prepared using data and information from a variety of sources. Visual evidence and PID readings recording during trenching excavations and hand auger borings provided data critical to determination of the extent of contamination in the upper 10 feet of the subsurface. Generally, outside the 10 foot contour line represents those areas where there is no visual or PID evidence of contamination. Information at depths greater than 10 feet was obtained from borehole lithologic descriptions, laboratory results of samples collected during monitor well installation and boreholes, and to a lesser extent, PID readings. In preparing Figure 4-5, subsurface soil samples containing more than about 10,000 μg/kg total organic compounds were included within the extent of contamination shown. In areas where data were lacking (e.g., depths greater than 10 feet in the tar mat area) professional judgement was used to estimate the areal and vertical extent of contamination.



ESTIMATED EXTENT OF SUBSURFACE SOIL CONTAMINATION

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 4-5

The largest volume of contaminated soils is located in the former process area. Contaminated soils in this area occupy an area of roughly five acres and extend to a maximum identified depth of 40 feet. The deepest contamination appears to be centered in an area north of the former tank farm and boiler building. Based on review of historical aerial photographs, this portion of the site received spills, runoff and possibly discharges over much of the operating life of the plant (80 years). An exploratory soil boring, BH-16, was advanced near the center of this contaminated area. Stained subsurface soil was observed to a depth of 40 feet. Analytical data from samples collected in this borehole corroborated visual evidence of gross contamination to a depth of at least 38 feet but no more than 47 feet in this area.

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Figures 4-6 and 4-7 depict the extent of grossly contaminated soils at two different intervals based strictly on visual evidence obtained during trenching activities. For these figures, gross visual contamination is defined as those soils darkened in appearance by creosote contamination with very little or none of the original soil coloration remaining.

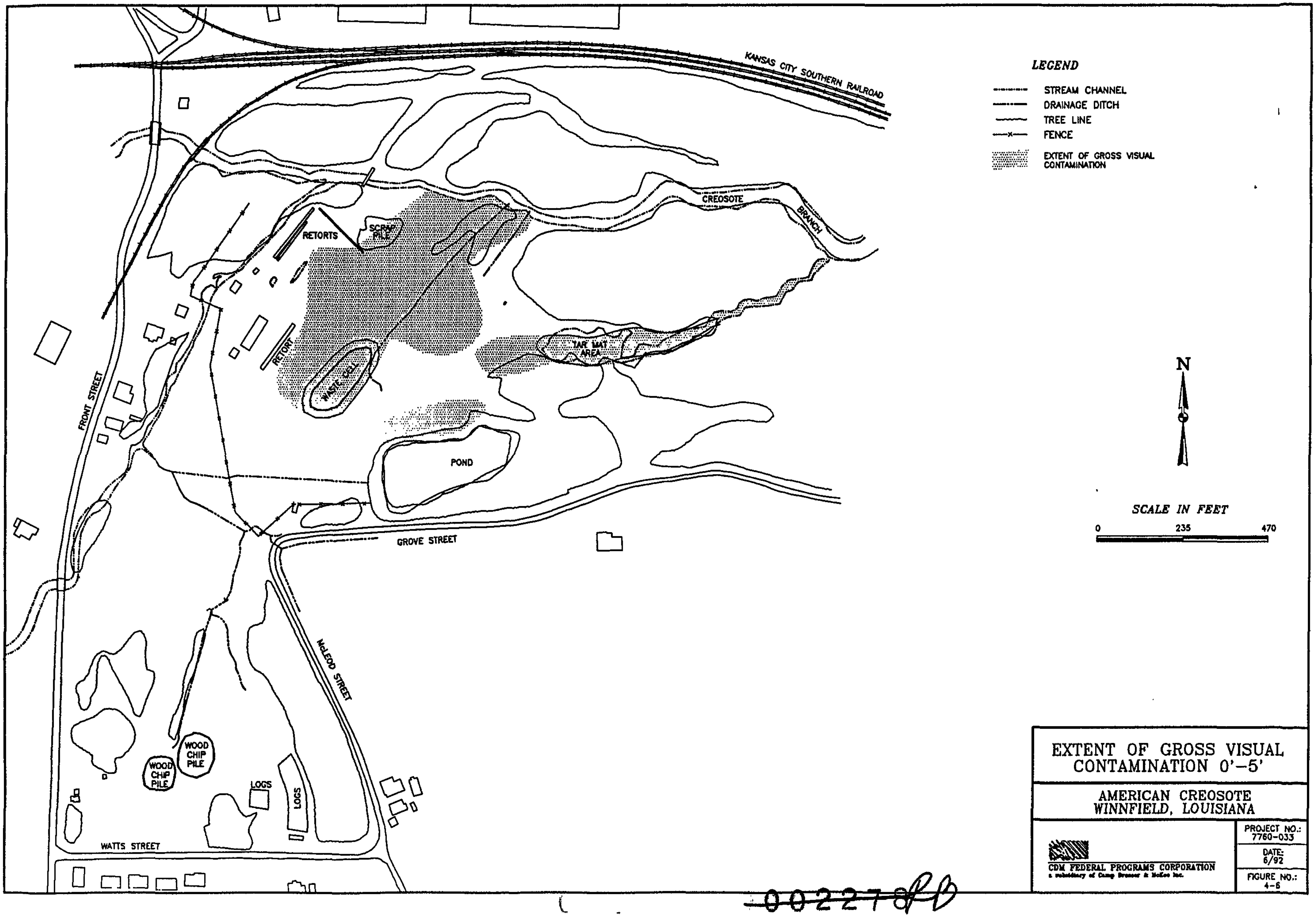
4.5 GROUNDWATER INVESTIGATION

The objectives of the groundwater investigation were as follows:

- Determine the depth, direction and rate of movement of the site groundwater.
- Characterize groundwater quality immediately up-gradient of the site.
- Determine the nature and extent of site-related contaminants present in groundwater.
- Assist in characterizing the volume and distribution of contaminated groundwater at the site.

4.5.1 INVESTIGATION METHODS

Groundwater investigations began with the installation of piezometers throughout the site. Piezometers were installed to confirm groundwater flow directions so monitor wells could be



EXTENT OF GROSS VISUAL CONTAMINATION 0'–5'

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WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
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DATE: 6/92

FIGURE NO.: 4-6

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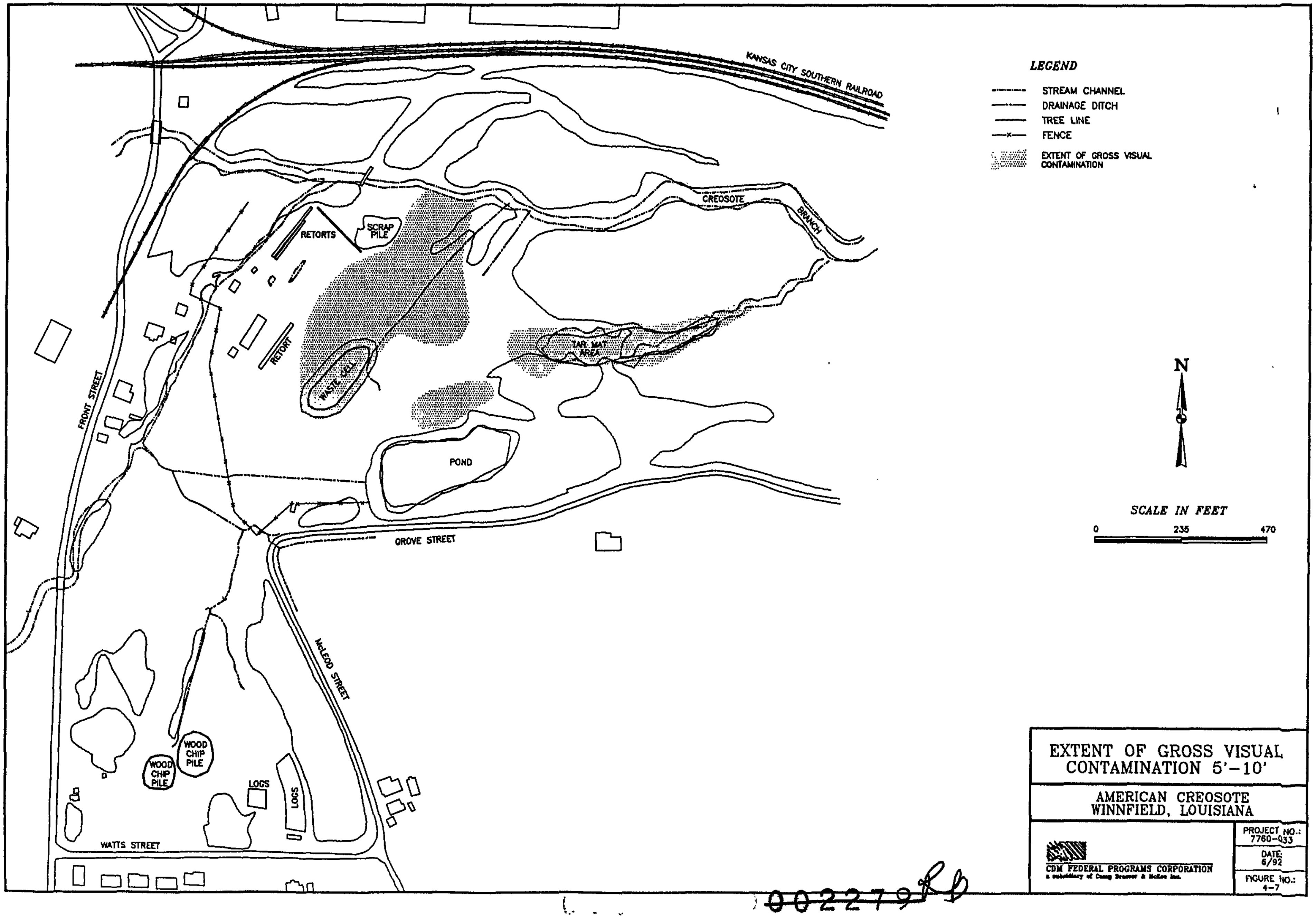

EXTENT OF GROSS VISUAL CONTAMINATION 5'-10'

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DATE: 6/92

FIGURE NO.: 4-7

optimally located. Methods of installations and construction details for piezometers and monitor wells are described below.

4.5.1.1 Piezometer Installation

A total of 12 piezometers were installed on-site to characterize the hydraulic gradient of the shallow aquifer in the contaminated area. Eleven of the twelve piezometers were positioned within the portion the site area bounded by Creosote Branch. One piezometer was installed on the other side of the creek, in the former American Creosote office yard, to evaluate the hydraulic effects of the stream on the shallow aquifer.

Piezometer boreholes were drilled using a CME-55 or CME-75 drill rig equipped with a 3.25 in. I.D. (7.75 in. O.D.) hollow-stem auger or an ARDCO C-1000 drill rig with a 4.25 in. I.D. (7.0 in. O.D.) hollow-stem auger. This borehole diameter provided an annular space between the borehole wall and the piezometer casing to facilitate placement of a gravel pack and bentonite seal. Boreholes were drilled approximately 5 feet below the top of the uppermost water bearing zone, resulting in total depths between 15 and 25 feet. An exception is piezometer 10 (PZ-10) with a total depth of approximately 10 feet. After drilling the borehole to its final depth the screen and attached risers were placed through the hollow-stem auger.

The bottom 2.5 feet of each piezometer was constructed of 0.01 in. slot stainless steel wrap screen 1.25 in. I.D.. Five foot lengths of 1.25 in. I.D. black steel, threaded, flush jointed pipe was used for piezometer risers. The risers were completed with a threaded steel cap. No thread lubricant or pipe dope was used on any casing joints.

Piezometer screens were packed with a 20/40 silica sand to one-foot above the stainless steel screen. A two-foot bentonite seal was place above the sand pack. The seal was composed of dry bentonite pellets that were slowly poured in the borehole annular space. Soil from the excavated borehole was used to back-fill the remaining annular space up to the surface.

Relative elevations of the piezometers were surveyed using a rod and automatic level. Approximate locations were plotted on a site map. Measurements of water levels in each piezometer permitted the development of a shallow aquifer potentiometric map to facilitate monitor well locations.

4.5.1.2 Monitoring Well Installation

The piezometric water levels were used to strategically place four-deep and seven-shallow monitor wells up- and down-gradient of the contaminated portions of the site. The shallow monitor well boreholes were screened within fine to medium sand and gravel in the top ten feet of aquifer and ranged from 20 to 25 feet in total depth. Deep monitor wells were screened in a fine sand and silty zone approximately sixty feet below grade. Individual well construction diagrams are included in Appendix C. Shallow monitor wells were installed according to procedures in the Field Sampling Plan (CDM 1992). However, there was some variability in the procedures used to install deep monitor wells. Deep well installation is discussed below.

Three of the four deep monitor wells (MW-1, 2, and 3) were drilled using a CME 75 hollow-stem auger with a 3.25 in. I.D. (7.75 O.D.). Monitor well 7 was drilled using a ARDCO C-1000 drill rig by mud rotary method. Use of mud rotary techniques were necessary because the light all-terrain drill rig which could access this site was unable to achieve the desired depth by hollow-stem methods. A pilot hole approximately four inches in diameter was drilled initially for MW-7. This borehole was then reamed out to approximately 10 inches. The single-cased well then was constructed in the open borehole.

Monitor wells 2 and 3 were drilled in several phases in order to allow a double casing construction to reduce the chance for cross-connection of aquifer zones. The first phase consisted of drilling a 3.25 in. pilot hole to approximately the 40 foot depth. A larger borehole was reamed out with a ten inch hollow-stem auger using the smaller pilot hole as a guide. An eight inch outer steel casing wall was placed in the ten inch reamed borehole extending to approximately forty feet below grade and terminating in less permeable interbedded silts. A "Volclay" seal was placed in the borehole/casing annular space. A bentonite/cement grout was placed above the Volclay seal and extended to the surface. Annular materials were allowed to cure for 48 hours. Hollow-stem auger was used to drill through the cured Volclay and into native material for an additional twenty feet. Upon reaching the sixty to sixty five foot completion depth, a 2 in. stainless steel well was constructed within the outer casing.

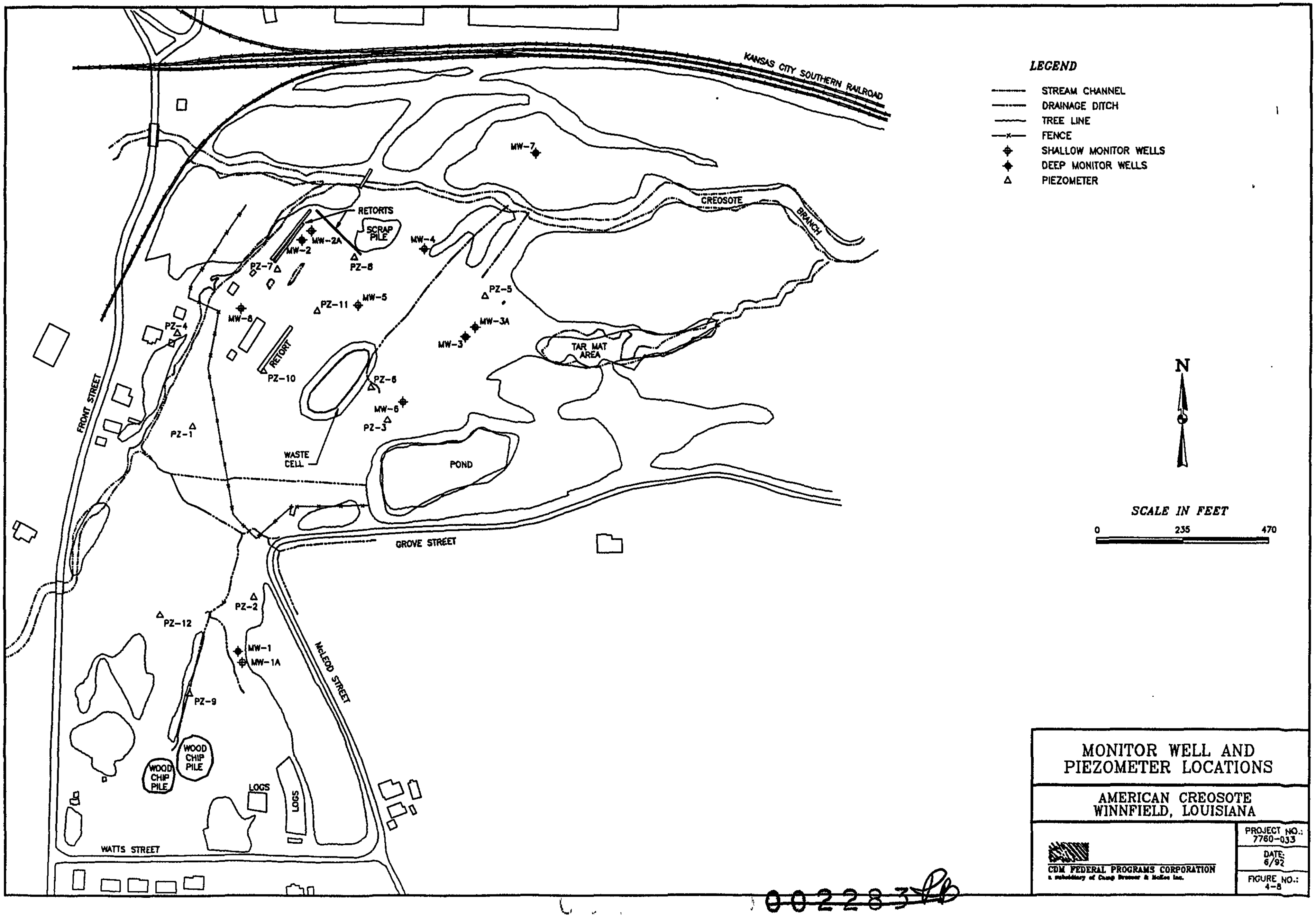
The deep monitor wells MW-1 and MW-7 were constructed with 2 in. stainless steel casing and 0.01 in. screen. Sand packs, bentonite seals, and the cement/bentonite grout were placed in the same locations relative to the screened intervals as monitor wells 2 and 3. Double casings were not employed on wells MW-1 and MW-7 because of the lack of evidence of shallow groundwater contamination in these areas.

4.5.1.3 Well Development

Following monitor well installation each well was developed by removing at least five casing volumes of water and purging until clean water was obtained or no improvement in clarity was noted. This was accomplished using a Brainard-Kilman hand pump in those wells with sufficient recovery rates to support its use and which showed no evidence of non-aqueous phase liquids. The remainder of the wells were developed using a hand bailer. In addition, those wells showing no indication of non-aqueous phase liquids were surged during development using steel and teflon surge blocks.

4.5.2 SAMPLE LOCATIONS, DESIGNATIONS, AND ANALYSIS

Twelve groundwater samples were collected between March 10-13, 1992 for the American Creosote site RI/FS. Eleven of these samples were collected from monitoring wells, which are shown in Figure 4-8. One sample was also collected from the Red Hill drinking water supply well. The location of this well is shown in Figure 4-2. On June 1 and 2, 1992 monitor



MONITOR WELL AND PIEZOMETER LOCATIONS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033

DATE: 6/92

FIGURE NO.: 4-8

wells MW 1, 3, 6, and 7 were resampled for PAHs and phenols. Laboratory data reports for these samples are included in Appendix E. The data quality problems which prompted this resampling effort are described in Section 5.0.

Example identification codes for groundwater samples are shown below:

200-MW2A-GW-001
200-MW3-GW-002

In these examples, 200 is the American Creosote site number, MW2A and MW3 are the monitor well number, and GW indicates that the sample is groundwater. The Red Hill well was designated MW-9. In most cases, one sample was collected from each well, corresponding to number 001. Field duplicates (colocated samples) corresponded to sample number 002 and were collected from MW-3, MW-5, and MW-6. Table 4-7 summarizes the samples collected and analyses conducted.

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4.5.3 GROUNDWATER SAMPLING RESULTS

Analytical data for groundwater are available from current and previous investigations. Groundwater data from previous investigations are most useful for those areas not sampled during the current investigation, particularly the area between the channel draining the tar mat and Creosote Branch. Monitor well installation and groundwater sampling in the current investigation focused on providing information up-gradient and down-gradient of known or potential source areas. Selection of monitor well locations was somewhat impeded by physical barriers at the site (e.g., stream channels, densely forested or swampy areas). Figures 3-1, 4-2, and 4-6 illustrate onsite sampling locations for previous investigations and onsite and offsite groundwater sampling locations for the current investigation and on-site sampling locations for previous investigations, respectively. Data for groundwater samples collected during the current

TABLE 4-7

MATRIX OF GROUNDWATER SAMPLES COLLECTED

	Sampling Information					QTM		SAS				TCLP		
Sample I.D.	Depth	Grab	Comp.	Split	Colocated	PAH[1]	VOA[2], Phenol[3]	Aromatics[4], PAH[5], Phenol[6]	Dioxin/ Furan[7]	Metals[8]	BNA[9]	VOA[10]/BNA[11]	Dioxin/ Furan[12]	Metals/ CN[13]
MW-01-GW-001	Deep	X						SF2590		SF2912				
MW-01A-GW-001	Shallow	X						SF2591						
MW-02-GW-001	Deep	X						SF3301						
MW-2A-GW-001	Shallow	X						SF2572		SF2573				
MW-03-GW-001	Deep	X						SF2587		SF2910				
MW-03-GW-002	Deep	X		X				SF2588		SF2911				
MW-03A-GW-001	Shallow	X						SF2574		SF2575				
MW-04-GW-001	Shallow	X						SF2596						
MW-05-GW-001	Shallow	X						SF2579		SF2580				
MW-05-GW-002	Shallow	X		X				SF2577		SF2578				
MW-06-GW-001	Shallow	X						SF2594		SF2914				
MW-06-GW-002	Shallow	X		X				SF2595						
MW-07-GW-001	Deep	X						SF2592						
MW-08-GW-001	Shallow	X						SF2586		SF2909				
MW-09-GW-001 (Red Hill Well)	632-682 ft	X						SF2593						

[1] GC-FID (see QTM Statement of Work 7/91).
[2] GC-PID-ELCD (see QTM Statement of Work 7/91).
[3] GC-FID (see QTM Statement of Work 7/91).
[4] U.S. EPA SW-846, Method 8020.
[5] U.S. EPA SW-846, Method 8310.
[6] U.S. EPA SW-846, Method 8040.
[7] U.S. EPA SW-846, Method 8280.
[8] U.S. EPA SW-846, Method 6010.
[9] U.S. EPA SW-846, Method 8270
[10] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8240 (analysis).
[11] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8270 (analysis).
[12] U.S. EPA TCLP, Method 1311 (extraction) and SW-846, Method 8280 (analysis).
[13] U.S. EPA TCLP, Method 1311 (extraction) and CLP Statement of Work 3/90.

investigation are presented in Appendix D. Locations for which groundwater data exist include the following areas which can be seen on Figure 1-2.

- The southern portion of the site
- The former process area
- The former impoundment area
- The drainage areas north and northeast of the process area
- The portion of the site north of Creosote Branch
- The Red Hill water supply well

The degree of contamination present in each of these areas is discussed below. The only data set for groundwater samples collected during the current investigation was provided through the EPA Contract Laboratory Program (CLP) Special Analytical Services (SAS). These data, particularly the phenols results, were considered suspect due to significant differences between the SAS data and that produced by the CLP Quick Turn-around Method (QTM) for soil samples. This prompted the resampling of monitor wells 1, 3, 6, and 7 for PAHs and phenols.

Sources of groundwater contaminants include spills, leaks and discharges of preservatives from tanks and containment structures in the former process area, unlined impoundments, discharges or runoff from plant facilities, treated wood drying or storage areas, and contaminated soils. Historical sources of groundwater contamination can be identified on Figure 1-2. Contaminated soils depicted on Figures 4-5, 4-6, and 4-7 act as continuing sources of contamination to groundwater. Anticipated migration of contaminants can be determined through evaluation of the potentiometric surface data represented on Figure 2-6.

Shallow monitor well MW-1A and deep monitor well MW-1 were installed on the southern portion of the site to provide data on groundwater quality upgradient of contaminant sources present on site. The only organic compound detected in groundwater from MW-1A was fluorene at a concentration of less than 1 μg/l. Several PAH compounds were reportedly detected in the sample from MW-1 but each was present at less than 1 μg/l. Data from the April 1992 resampling of MW-1 indicated no PAH compounds or phenols above detection limits. These data document that groundwater entering the site is essentially free of the organic compounds associated with site contamination.

Based on available data and professional judgement, the areas of greatest groundwater contamination by site-related organic compounds are the former process area, impoundment area, and portions of the site which lie hydraulically down-gradient of these locations. Phase-separated liquids have been identified in at least two shallow wells representing these portions of the site, MW-4 and MW-6. Observations of monitor well MW-4, located north of the former process area and screened from 11 to 21 feet, have found both LNAPL or "floating" and DNAPL or "sinking" product phases. The sinking product phase has been determined to be approximately 1 foot thick at the bottom of this well. Floating product is also present in MW-4 and its thickness has been estimated at approximately 2 inches. A thin layer of floating product as well as traces of sinking product has been observed in MW-6, which is screened from 5 to 20 feet. Additionally, during the field investigation, product was observed seeping directly from the bank of Creosote Branch to the stream surface, particularly in the location depicted on Figure 4-1. Groundwater samples collected from monitor wells MW-4 and MW-6 contain the highest concentrations of dissolved contaminants detected in site groundwater samples. Total PAH concentrations detected in groundwater from MW-4 and MW-6 are 42,545 and 40,325 μg/l, respectively with B(a)P equivalent concentrations of 868 and 369 μg/l. Concentrations of many of the individual compounds are just above or just below maximum solubility for these compounds (see Section 6). Benzene is also present in groundwater samples from these wells. Reported concentrations for this compound are 162 and 146 μg/l, respectively. No phenols were detected in MW-4 and MW-6 in the SAS results. However, the resampling of MW-6 indicates total phenols of 154,400 μg/l using U.S. EPA Method 625 for semi-volatile compounds. No PCP was found though the stated detection limit was 3,000 μg/l for this analyte. This result and a comparison of QTM and SAS split data for soils indicates that the SAS groundwater data for phenols is suspect (see Section 5).

Shallow monitor wells MW-3A and MW-5, screened from 5 to 20 and 17 to 27 feet, respectively, are also located within the area of contaminated soils surrounding the process and impoundment areas. Analytical data for groundwater samples from these wells demonstrate groundwater contamination exists in these areas but at lower concentrations than those in MW-4 and MW-6. No LNAPLs or DNAPLs were observed. Total PAH concentrations reported for MW-3A and MW-5 are 670 and 1,371 μg/l, respectively. Benzene was present in these samples at concentrations of 12 and 18 μg/l. Phenols were again not detected.

Groundwater from shallow monitor well MW-2A, located near the western limit of the contaminated subsurface soils, exhibits lower concentrations of contaminants than MW-3A and MW-5. No evidence of LNAPLs or DNAPLs observed at this location. Total PAH concentration for this sample is 30 μg/l and benzene concentrations is 8 μg/l. No phenols are reported. Similar results were obtained from the shallow monitor well MW-8 west of the zone of subsurface soil contamination. Total PAH reported is 6 μg/l. No volatile organic compounds or phenols were detected in the groundwater at this location.

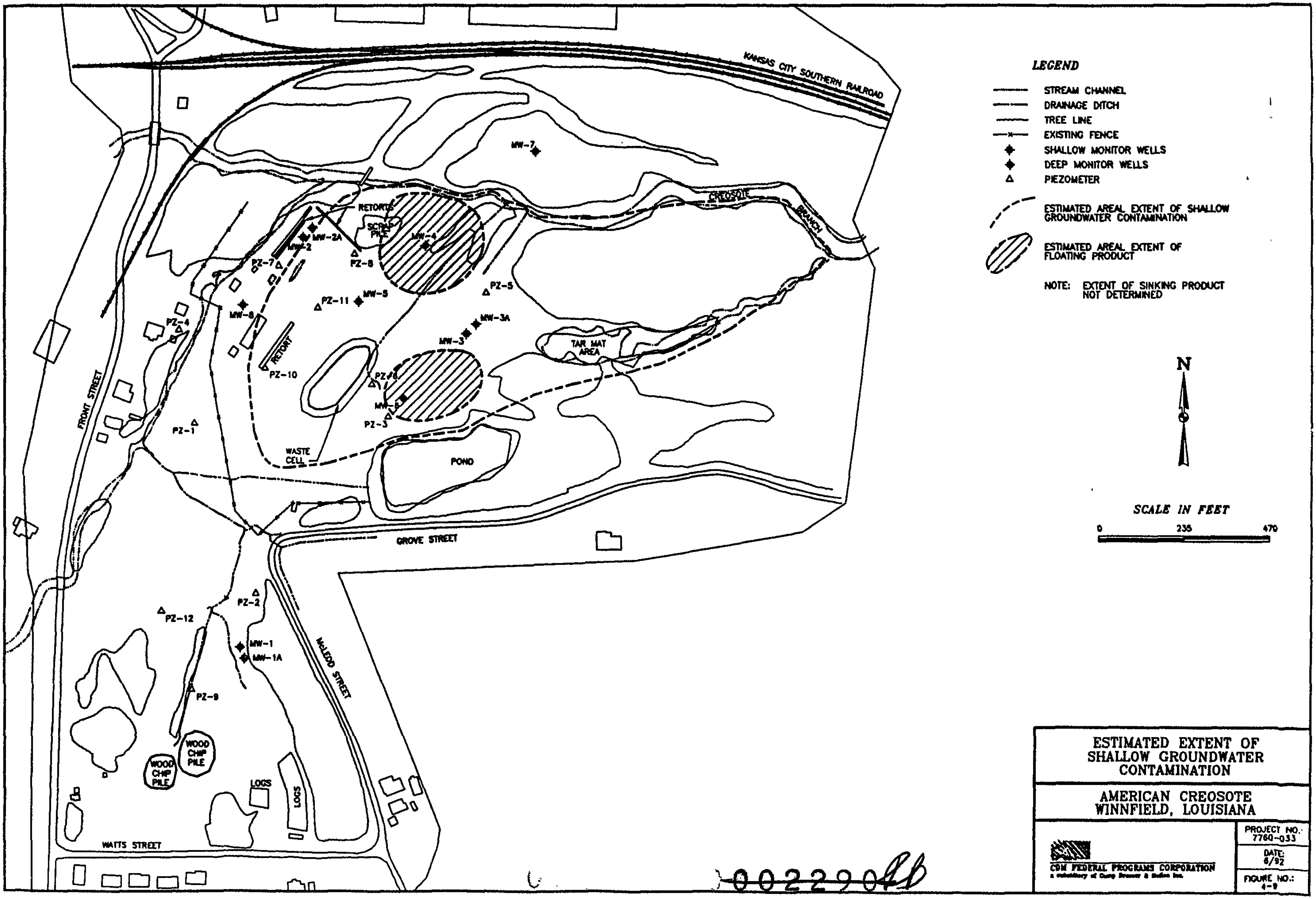
Shallow groundwater north of the tar mat was sampled during a previous investigation (FIT 1988). However, this data was not available at the time this report was prepared.

Deep monitor wells were installed to the east (MW-3), west (MW-2), and north (MW-7) of the former process area. Analytical data for groundwater from these wells reported no detectable organic compounds with the exception of extremely low levels of PAHs (less than 1 μg/l). However, subsurface soil samples collected from the intervals screened by MW-2 and MW-3 document the presence of adsorbed contaminants, particularly phenols at that depth. The resampling of MW-3 and MW-7 using U.S EPA Method 625 for semi-volatiles indicated that no PAHs or phenols were present in deep groundwater at these locations above detection limits.

Based on lithologic information, it appears unlikely that there is significant interaction between the zones in which the shallow and deep monitor wells are screened. Relatively dry, interbedded silty sands and silty clays were encountered between 30 and 50 feet during the drilling of all deep monitor wells and deep boreholes. These interbedded layers in combination with the upward vertical hydraulic gradient (Section 2.4) appear to prevent or least retard the migration of dissolved contaminants from the upper zone to the lower zone data. Data collected from deep borehole BH-16 suggest a maximum depth of migration for NAPLs of 40 feet.

A groundwater sample was also collected from a nearby public water supply well belonging to the Red Hill Water Cooperative (Figure 4-2) during both sampling events. This well is screened from approximately 550 to 600 feet in the Sparta Sand. The only organic compounds detected in the sample from this well are acenaphthene (3.29 μg/l) and fluorene (0.11 μg/l). A resample of this well, however, indicated no PAHs or phenols present above detection limits. In summary, sampling data from shallow monitor wells (approximate depth 15-25 feet) indicates that the extent of groundwater contamination closely follows the pattern of contaminated subsurface soils illustrated in Figure 4-5. Estimated extent of shallow groundwater contamination is depicted in Figure 4-9. Although no shallow monitor wells are present north of Creosote Branch, low levels of contaminants present in subsurface soils collected from the MW-7 boring indicate that shallow groundwater in this portion of the site is probably unaffected. Creosote Branch appears to be effectively intercepting the northward migrating contamination from the former process and impoundments areas. The extent of groundwater contamination north and northeast of the tar mat can only be inferred due to limited data available in that area.

Based on data currently available, samples collected from deep monitor wells (approximate depth 55-65 feet) contained no detectable contamination. The presence of low concentration organic contaminants in subsurface soil samples collected from the intervals screened by these wells suggest that any contaminants present are strongly sorbed to the matrix material and are not available for groundwater transport.



ESTIMATED EXTENT OF
SHALLOW GROUNDWATER
CONTAMINATION

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DATE: 6/92
FIGURE NO.: 4-9

4.6 SAMPLING PROCEDURES AND DEVIATIONS FROM THE FIELD SAMPLING PLAN

The Remedial Investigation of the American Creosote site was accomplished according to the general procedures outlined in the Field Sampling Plan (CDM 1992). This document contains operating procedures for site investigation protocol, surveying, well construction and development, sampling of various media, and instrument operation, use, and calibration. Additional detail on procedures used is provided below where this information would be necessary to duplicate investigation results. This section also describes any significant deviations from the plans and procedures described in the Field Sampling Plan.

4.6.1 SITE SURVEY

A digitized topographic base map was not available to CDM until after the field work was complete. In its place, a generalized map derived from a single aerial photograph taken in 1988 was used. This map was manually updated in the field, but no attempt was made to digitize the new information during the course of the investigation. Locating Global Positioning System (GPS) points (i.e., trenching locations, boreholes, etc.) was hampered due to the unavailability of a digitized base map and by computer problems. A horizontal and vertical survey of various site features such as monitor wells, boreholes, sample locations, etc. was performed by CDM personnel rather than by the EPA. Vertical benchmarks, however, were surveyed by the EPA which allowed determination of actual elevations for the wells and piezometers. Horizontal location of these and other features were determined after sampling activities were completed.

The CDM survey did not establish the position of all monitoring wells with respect to State Plane Coordinates or a similar system. No operating procedure was available for the horizontal survey. CDM personnel employed traversing methods with a transit to find the horizontal location of various site features. The traverses, however, were not closed. Distances were determined using stadia intervals.

4.6.2 SURFACE SOIL INVESTIGATION

All samples were collected according to the general procedures outlined in the Field Sampling Plan (CDM 1992). Samples collected in the southern portion of the site (SS-10, SS-11, and SS-12) were collected first because samples from this portion of the site were expected to contain the lowest concentrations of contaminants.

Stainless steel trowels were used to collect the samples from 0 to 2 inches depth. Stainless steel spoons and bowls were used to homogenize samples. Each sample was obtained by compositing five subsamples. Subsampling points included five subsamples from the center and corners of a square having approximately 10 foot sides. If possible, the center point was located in an area showing visible surface soil contamination, ensuring that contaminated surface soils were represented. In most cases, there was a high degree of heterogeneity in visible contamination, amount of debris, and soil texture among the five subsamples. The center point of the sampling square corresponds to the sampling points shown in Figure 4-1. Sample jars were filled in the following order: VOC, phenol, then PAH samples. Volatile organics samples, including VOC and TCLP VOC samples, were collected prior to homogenization of the subsamples.

Sampling equipment was decontaminated between sampling points according to the following procedure: wash with Alconox and water, two tap water rinses, a methanol rinse, and two deionized water rinses.

Deviations to the Field Sampling Plan (CDM 1992) regarding the surface soil sampling program consisted of the addition of sample locations SS-21 and SS-22, and the deletion of SS-20. Locations SS-21 and SS-22 were added to delineate the extent of surface soil contamination in the northern portion of the American Creosote site. Location SS-20 was deleted from the sampling regime because the sampling location was disturbed during trench excavations.

4.6.3 SURFACE WATER AND SEDIMENT INVESTIGATION

All samples were collected according to the general procedures outlined in the Field Sampling Plan (CDM 1992). The farthest upstream locations on Creosote Branch were collected first (SW-1/SD-1 and SW-2/SD-2). Surface water samples were always collected prior to sediment samples, and the order of sample collection was VOC, phenol and PAH samples. Surface water samples were collected as grabs; the mouth of the jar facing upstream, the sampler located downstream. Samples were collected directly into sample containers, which were immersed approximately 0 to 3 inches below the water surface. Sediment samples were collected with stainless steel trowels, and stainless steel spoons and bowls were used to homogenize the samples. Sediment samples were collected from the center of the stream in each case from a depth of approximately 0 to 3 inches below the stream bed. Sediment samples for VOC and TCLP VOC analysis were collected before homogenizing.

Sediment samples collected downstream from the site were collected using stainless steel hand augers. At location SD-7, a hand auger was used to obtain a profile of sediments down to 13 inches depth. The sample collected at SD-7 was collected from 4 to 6 inches in order to obtain the most visibly contaminated layer. The sediment sample collected at SD-11 was also collected with a hand auger to keep sampling personnel out of the four-foot-deep ditch.

Sediment sampling equipment was decontaminated between samples according to the following procedure: wash with Alconox® and water, two tap water rinses, methanol rinse, and two deionized water rinses.

Deviations to the Field Sampling Plan regarding the surface water and sediment sampling program consisted of the addition of sampling points SW-6, SW-8/SD-8, SD-9, SD-10 and SD-11, and the relocation of sampling point SW-3/SD-3 from downstream of the confluence of Creosote Branch and the southern drainage ditch to downstream of the confluence of Creosote Branch and the northern drainage ditch. SW-8/SD-8 was added to represent a sample point downstream of the confluence of the southern drainage ditch and the Creosote Branch. SW-6 was added to evaluate the quality of water entering the site from the east after an oily sheen was detected in a ditch along McLeod Street. SD-11 was collected to determine levels of contaminants in sediments present in an on-site ditch. Samples SD-9 and SD-10 were necessary to evaluate the impacts of other wood-treating facilities downstream of the site on sediments of Creosote Branch.

4.6.4 SUBSURFACE SOIL INVESTIGATION

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Subsurface soil samples were collected during hollow-stem auger drilling and hand augering. Sampling objectives were to obtain grab or composite samples representing both saturated and unsaturated material encountered.

Most samples collected from the unsaturated zone were collected as composite samples in order to be representative of soils which require treatment. Since the water bearing zone was approximately 10 to 12 feet below ground surface (BGS), the composite interval generally extended from ground surface to 12 feet BGS for hollow-stem augered samples and from ground surface to 5 or 10 feet BGS for hand augered samples. Hand augered boreholes were typically shallower due to the limitations of manually-operated equipment.

The unsaturated zone grab samples collected by hollow-stem and hand augering typically came from about four to seven feet below ground surface (BGS). Samples for VOC analyses were collected as grab samples, typically from the middle of a composited interval. Since sampling efforts were intended to document the location and magnitude of contamination for selection of an appropriate remediation technique, the exact VOC sampling location was adjusted to include more grossly contaminated material as evidenced by photoionization detector (PID) readings, odor, or visual inspection. In this way, maximum contaminant concentrations could be designed for.

The grab samples obtained from saturated materials were typically collected from the bottom of the borehole, from the last soil core retrieved. For the shallow wells and boreholes, this depth was generally between 18 and 20 feet. Sampling intervals in five deep boreholes were selected to characterize contaminant concentrations in deeper saturated materials.

Samples for VOC analysis were collected first. Immediately upon delivery of the core and just prior to collecting the sample, the core was split open to obtain a reading with the PID. The soil was then quickly collected into a pre-cleaned, 4 oz. glass sampling jar.

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Following the collection of VOC samples, composite sampling began. Once the subsurface soil had been transferred to the mixing bowl, the bowl was covered tightly with clean aluminum foil. This process was repeated over the entire length of the composite interval. The contents of the mixing bowl was then mixed thoroughly. When colocated samples were required over the composite interval, a second mixing bowl was filled. Samples from this second bowl were collected in the same manner as described above. Split samples were collected from the original sample composite.

Nine trench lines were excavated by backhoe at the American Creosote site. Rather than excavate open trenches 200-800 feet along, small trenches 10-15 feet long were excavated at fixed intervals along a trench line. This change in procedure was made for the following reasons:

- Although slightly less information may have been obtained, trenching proceeded at a quicker pace.
- Smaller excavations could utilize the full reach of the backhoes (10-11 feet) with less chance of sloughing or collapse.
- Access around the site by other heavy equipment was less impeded by smaller excavations. Continuous trenching would have required this equipment cross backfilled excavations, increasing the risk of getting stuck.

The number of trenches was increased from six to nine and locations were altered slightly to accommodate site conditions. Hand augers were used to collect subsurface information beyond the ends of the trenching transects in areas inaccessible to the backhoes. Data from these "trench extension borings" were recorded on trench log forms.

Several changes were made to Operating Procedure 6, Procedure for Documenting Backhoe Excavations:

- When possible, the backhoe was positioned upwind of the excavation based on the judgment of the operators, Health and Safety Coordinator, and/or supervising geologist.
- Trench excavations were usually about 10 feet deep. Waste materials were placed to one side of the excavation and when target depths of 2, 4, 6, 8 and 10 feet were reached, single piles representing these depths were placed in line on the other side. Descriptions of these piles, including lithology and PID readings, were recorded in a field notebook.
- At no time did any personnel enter an excavation. Lithologic descriptions were made from the piles representing specific depths. Excavations were briefly approached to note depths of water or product seeps, photograph or video tape the excavation, and to make other in-situ observations of excavation walls.
- All pertinent information was recorded in a field notebook prior to refilling each excavation and was later transferred to trenching log forms.
- Due to the limited availability of film and video cameras, not all trench excavations were photographed and/or videotaped.

Deviations in subsurface sampling were minimal. Only core barrels, Shelby tubes, split spoons, and hand auger buckets were used to collect subsurface samples. Cores were laid out on decontaminated PVC sample trays or clean polyethylene sheeting and samples collected in a similar manner to that described in Operating Procedure five for split-spoon sampling. After the core was split with a knife, however, care was taken to collect the sample from inside the core to avoid material which may have contacted the barrel or tube. No borings were conducted at borehole locations BH-5 and BH-7 during the investigation due to limits on laboratory capacity. BH-2 was conducted as an exploratory boring with no sampling conducted for the same reason. An additional deep borehole, BH-16, was added at the request of EPA. The purpose of this borehole was to investigate the depth to which contaminants had migrated in the portion of the site north of the former process area. Samples were collected from this borehole for BNA analysis approximately every 10 feet from 25 to 75 feet.

4.6.5 GROUNDWATER INVESTIGATION

The Red Hill drinking water supply well was added as MW 9 and sampled for VOAs, PAHs, and phenols. This well is located offsite approximately one mile from the site, on Highway 167 approximately 200 yds north of Creosote Branch (Figure 4-2). The well is situated within a fenced plot approximately 50 yards west of Highway 167. According to Mr. Eugene Rosier of the Red Hill Water Company, the well is 682 feet deep, with screened interval of about 630 to 680 feet. and static water level of approximately 41 feet below ground surface. The well contains a submersible pump which pumps approximately 12,000 gpd to a storage tank located 3-4 miles south of the well.

The Red Hill water supply well was sampled on March 12, 1992. Water was allowed to run from the tap for approximately 15 minutes prior to sampling. Field water quality parameters were then collected after every 10 gallons of water purged. After three field measurements had indicated that the groundwater quality parameters had stabilized, as outlined in the Field Sampling Plan, groundwater samples were collected.

Five well volumes of water were removed from each monitor well during purging to ensure that groundwater samples were representative of the aquifer water quality. Field water quality parameters (pH, temperature, and specific conductance) were measured at regular intervals in wells 1 and 1A during the purging to ensure that these parameters had stabilized prior to sampling according to the Field Sampling Plan. Field water quality parameter instruments were not working properly during the purging of all other monitoring wells. New water quality parameter instruments were immediately ordered to be shipped to the site so that water quality parameters could be measured during sampling.

Several low recharge wells had significant drawdown of the groundwater or went dry following purging. Monitoring wells 1A, 3A, 6 and 8 had moderate drawdown (approximately 3-5 feet after purging), wells 4 and 5 had significant drawdown (approximately 5-8 feet after purging), and well 7 purged nearly dry. All low recharge wells were allowed to recover until at least 80 percent of the static water level measured prior to purging was attained before groundwater samples were collected.

Two monitoring wells had significant drawdown during groundwater sampling. The drawdown in monitoring wells 4 and 5 was so great and recovery so slow that groundwater sample collection extended over two days. Groundwater samples in these wells were collected until water levels came within several feet of the bottom of the well. Samples for some groundwater analyses, typically metals, were collected the following day, within 24 hours of purging.

Deviations from operating procedures detailed in the Field Sampling Plan included use of an HNU instrument instead of an HNU and a CGI instrument to monitor potential for volatile and combustible gases in the well. Use of a CGI was determined to be unnecessary due to adequate ventilation at the well head. A water level meter was used in place of an oil/water interface probe to measure depth to water. This change was made after problems were encountered decontaminating water level meters which had contacted creosote-based product. Although a rented oil/water probe was available on site it was decided not to risk permanent contamination of this equipment. Nylon rope was used rather than a stainless steel wire leader line to lower the bailers into the well. This change was made primarily because steel wire leaders are difficult to handle. It was determined that the use of new nylon rope for each well would eliminate the chance for cross-contamination and allow well sampling and analysis without chemical interference.

Section 5.0

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance requirements, as presented in the Sampling and Analysis Plan (CDM 1992), were implemented to assure the delivery of a high quality product. Included in the requirements were Operating Procedures (OPs) for RI activities which were utilized throughout the work assignment. The OPs were included as part of the Field Sampling Plan (CDM 1992).

An integral part of quality assurance/quality control (QA/QC) is a technical and QA review of all documents. This RI report has undergone technical review by a Technical Review Committee (TRC) composed of experienced, technically qualified CDM staff members. Quality assurance direction and review has been provided by the ARCS Team Quality Assurance Director.

Laboratory data review/validation for this work assignment was provided by EPA Region VI, Environmental Services Division (ESD). At the time this report was produced, validation of all laboratory data was not complete. The significance of site interpretations made using unvalidated data are discussed in this section. The field sampling program included split samples, colocated samples, and decontamination blanks as QC samples. A QA Field Audit was performed by CDM QA staff during the Phase I RI Field Investigation to assure adherence to QA requirements.

5.1 REVIEW OF FIELD QA/QC SAMPLE DATA

Approximately one in every 20 samples (per matrix) was split in the field and analyzed separately. Split samples allow a check on laboratory methods of analysis, taking into account natural variability in the sampled medium. Splits were collected by splitting a single sample into two parts after thorough mixing; however, split samples analyzed for volatile organics were not mixed so that volatilization of potential contaminants would be minimized in the sampling process. Mixing of soil samples for non-volatile analyses was accomplished by placing an adequate volume of sample into a decontaminated stainless steel vessel and homogenizing the sample material with a decontaminated stainless steel instrument. The material was then divided and placed into the appropriate sample bottles. Groundwater splits were collected from the same or consecutive bailers withdrawn from a well.

Approximately one in every 20 samples was collected as a colocated duplicate and analyzed separately. Colocated samples were collected during a single sampling event at the same location. Colocated water samples were collected from the same location as the original sample but after the original sample had been collected. Colocated soil and sediment samples were collected from adjacent locations. Colocated samples allow a check on the cumulative precision of the field technique, the homogeneity of the sample matrix in a general sampling location, and precision of the laboratory methods of analysis. Analytical results for split and colocated samples analyzed by QTM methods are presented in Table 5-1. Data for split and colocated samples analyzed by SAS methods are summarized in Appendix D.

Six decontamination blanks, consisting of equipment rinsate water from the final stage of the decontamination process were collected during the sampling program. Decontamination blanks allow a determination of the effectiveness of the decontamination process. Field blanks consist of a VOA vial that is filled with deionized water. At the sampling location, the water is transferred to another VOA vial and back again, a total of three times. Field blanks provide information regarding possible sample contamination resulting from volatile organic compound vapors present at the site.

Volatile organics trip blanks consist of distilled or deionized water in a VOA vial, shipped with other samples. Eight trip blanks were submitted for analysis during the field program. Analysis of the trip blank provides a measurement of potential volatile organics cross contamination during shipping.

Results of QTM analysis of decontamination, field and trip blanks are presented in Table 5-2. Data for blanks analyzed by SAS are summarized in Appendix D.

TABLE 5-1. SUMMARY OF QTM DATA FOR SPLIT AND COLOCATED SAMPLES.

FIELD SAMPLE NUMBER:	SS-05-SL-001		SS-05-SL-002		SS-05-SL-003		SD-03-SD-001		SD-03-SD-002		SD-03-SD-003	
EPA SAMPLE NUMBER:	QF0213		QF0214		QF0215		QF0193		QF0194		QF0195	
DEPTH												
SAMPLE TYPE	ORIGINAL		COLOCATED		SPLIT		ORIGINAL		COLOCATED		SPLIT	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
PAH ANALYTES (330)	QF0213	Q	QF0214	Q	QF0215	Q	QF0193RE	Q	QF0194RE	Q	QF0195RE	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
NAPHTHALENE	650.00	J	350.00	J	1000.00	J	270.00	J	88.00	J	300.00	J
ACENAPHTHYLENE	700.00	J	450.00	J	980.00	J	52.00	J	58.00	J	31.00	J
ACENAPHTHENE	630.00	J	510.00	J	580.00	J	460.00	J	660.00	J	460.00	J
FLUORENE	2300.00	J	2700.00	J	730.00	J	570.00	J	760.00	J	670.00	J
PHENANTHRENE	9200.00	J	11000.00	J	5000.00	J	1700.00	J	1300.00	J	3300.00	J
ANTHRACENE	20000.00	J	22000.00	J	4000.00	J	270.00	J	310.00	J	460.00	J
FLUORANTHENE	15000.00	J	10000.00	J	14000.00	J	1700.00	J	2300.00	J	2800.00	J
PYRENE	16000.00	J	8800.00	J	17000.00	J	1500.00	J	300.00	J	2200.00	J
BENZ(A)ANTHRACENE	10000.00	J	7000.00	J	15000.00	J	450.00	J	560.00	J	660.00	J
CHRYSENE	7600.00	J	4900.00	J	8700.00	J	480.00	J	580.00	J	760.00	J
BENZO(B)/(K)FLUORANTHENE	19000.00	J	13000.00	J	27000.00	J	670.00	J	790.00	J	880.00	J
BENZO(A)PYRENE	6900.00	J	5200.00	J	11000.00	J	370.00	J	370.00	J	420.00	J
INDENO(1,2,3-CD)PYRENE	8200.00	J	5700.00	J	11000.00	J	250.00	J	280.00	J	310.00	J
DIBENZ(A,H)ANTHRACENE	3400.00	J	2600.00	J	4900.00	J	68.00	J	78.00	J	83.00	J
BENZO(G,H,I)PERYLENE	7000.00	J	4700.00	J	9500.00	J	230.00	J	230.00	J	280.00	J
B(A)P Equivalence Conc.	14096		10419		21287		580		617		696	
Total PAHs	126580		98910		130390		9040		8664		13614	
PHENOL ANALYTES (1700)	QF0213RE	Q	QF0214RE	Q	QF0215RE	Q	QF0193	Q	QF0194	Q	QF0195	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
PHENOL	480.00	J	860.00	J	650.00	J	-	UJ	-	UJ	-	UJ
2-CHLOROPHENOL	96.00	J	130.00	J	110.00	J	60.00	J	-	UJ	-	UJ
O-CRESOL	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M/P-CRESOL	-	UJ	-	UJ	68.00	J	-	UJ	-	UJ	-	UJ
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	65.00	R	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	70.00	J	54.00	J	73.00	J	24.00	R	17.00	R	22.00	R
2,4-DICHLOROPHENOL	84.00	J	63.00	J	-	UJ	-	UJ	-	UJ	-	UJ
4-CHLORO-3-METHYLPHENOL	97.00	J	160.00	J	30.00	J	12.00	R	9.00	UJ	12.00	R
2,4,5/6-TRICHLOROPHENOL	68.00	J	61.00	J	38.00	J	3.00	R	-	UJ	-	UJ
2,4-DINITROPHENOL	-	UJ	51.00	J	-	UJ	32.00	R	-	R	-	R
4-NITROPHENOL	83.00	J	59.00	J	87.00	J	-	UJ	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	30.00	J	39.00	J	61.00	J	-	UJ	22.00	R	-	UJ
4,6-DINITRO-2-METHYLPHENOL	71.00	J	101.00	J	83.00	J	-	UJ	-	UJ	-	UJ
PENTACHLOROPHENOL	2100.00	J	3400.00	J	2800.00	J	17.00	R	21.00	R	33.00	R

FIELD SAMPLE NUMBER:	SW-03-SW-001		SW-03-SW-002	
EPA SAMPLE NUMBER:	QF0197		QF0196	
DEPTH				
SAMPLE TYPE	ORIGINAL		COLOCATED	
VOA ANALYTES (20)	µg/L	Q	µg/L	Q
VINYL CHLORIDE	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ
BROMOFORM	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ
PAH ANALYTES (20)	QF0197	Q	QF0196	Q
	µg/L		µg/L	
NAPHTHALENE	-	UJ	-	UJ
ACENAPHTHYLENE	-	UJ	-	UJ
ACENAPHTHENE	-	UJ	-	UJ
FLUORENE	-	UJ	-	UJ
PHENANTHRENE	-	UJ	-	UJ
ANTHRACENE	-	UJ	-	UJ
FLUORANTHENE	-	UJ	-	UJ
PYRENE	-	UJ	-	UJ
BENZ(A)ANTHRACENE	-	UJ	-	UJ
CHRYSENE	-	UJ	-	UJ
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ
BENZO(A)PYRENE	-	UJ	-	UJ
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	-	UJ	-	UJ
B(A)P Equivalence Conc.	0		0	
Total PAHs	0		0	
PHENOL ANALYTES (50)	QF0197	Q	QF0196	Q
	µg/L		µg/L	
PHENOL	-	R	-	R
2-CHLOROPHENOL	-	UJ	-	UJ
O-CRESOL	-	UJ	-	UJ
M/P-CRESOL	-	UJ	-	UJ
2-NITROPHENOL	-	UJ	-	UJ
2,4-DIMETHYLPHENOL	-	UJ	-	UJ
2,4-DICHLOROPHENOL	-	UJ	-	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ
2,4,5/6-TRICHLOROPHENOL	-	UJ	-	UJ
2,4-DINITROPHENOL	-	R	-	R
4-NITROPHENOL	-	UJ	-	UJ
2,3,4,6-TETRACHLOROPHENOL	-	UJ	-	UJ
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ
PENTACHLOROPHENOL	68.00	J	-	UJ

~~002302~~

TABLE 5-1. SUMMARY OF QTM DATA FOR SPLIT AND COLOCATED SAMPLES (continued).

FIELD SAMPLE NUMBER: EPA SAMPLE NUMBER: DEPTH SAMPLE TYPE	BH-06-SS-002 QF0273 20' ORIGINAL		BH-06-SS-004 QF0277 20' SPLIT		BH-06-SS-006 QF0281 20' COLOCATED		BH-06-SS-001 QF0271 0-12' ORIGINAL		BH-06-SS-003 QF0275 0-12' SPLIT		BH-06-SS-005 QF0279 0-12' COLOCATED	
VOA ANALYTES (40)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	7.90	J	8.00	J	-	UJ	4.00	J	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	6.10	J	7.10	J	-	UJ	20.00	J	9.30	J	6.80	J
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	14.00	J	67.00	J	38.00	J
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	4.30	J	-	UJ	-	UJ	32.00	J	37.00	J	26.00	J
O-XYLENE	-	UJ	-	UJ	-	UJ	22.00	J	6.80	J	14.00	J
PAH ANALYTES (330)	QF0274 µg/Kg	Q	QF0278 µg/Kg	Q	QF0282 µg/Kg	Q	QF0272 µg/Kg	Q	QF0276 µg/Kg	Q	QF0280 µg/Kg	Q
NAPHTHALENE	180.00	J	120.00	J	650.00	R	30000.00	J	25000.00	J	37000.00	J
ACENAPHTHYLENE	-	UJ	-	UJ	100.00	J	2700.00	J	1300.00	J	3300.00	J
ACENAPHTHENE	170.00	J	84.00	J	830.00	J	35000.00	J	27000.00	J	34000.00	J
FLUORENE	140.00	R	80.00	R	720.00	R	34000.00	R	25000.00	R	35000.00	R
PHENANTHRENE	550.00	J	240.00	J	2500.00	J	44000.00	J	39000.00	J	64000.00	J
ANTHRACENE	64.00	J	-	UJ	240.00	J	-	UJ	330.00	R	25000.00	J
FLUORANTHENE	35.00	J	82.00	J	1200.00	J	47000.00	J	36000.00	J	54000.00	J
PYRENE	30.00	J	84.00	J	610.00	J	44000.00	J	31000.00	J	54000.00	J
BENZ(A)ANTHRACENE	67.00	J	-	UJ	190.00	J	13000.00	J	6600.00	J	18000.00	J
CHRYSENE	58.00	J	-	UJ	170.00	J	11000.00	J	6300.00	J	16000.00	J
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ	60.00	J	4000.00	J	2100.00	J	6000.00	J
BENZO(A)PYRENE	-	UJ	-	UJ	44.00	J	3400.00	J	1800.00	J	4900.00	J
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ	-	UJ	1500.00	J	650.00	J	370.00	J
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ	-	UJ	260.00	J	-	UJ	-	UJ
BENZO(G,H,I)PERYLENE	-	UJ	-	UJ	-	UJ	910.00	J	470.00	J	1300.00	J
B(A)P Equivalence Conc.	7		0		71		5620		2798		7497	
Total PAHs	1294		690		7314		270770		202550		352870	
PHENOL ANALYTES (1700)	QF0273 µg/Kg	Q	QF0277 µg/Kg	Q	QF0281 µg/Kg	Q	QF0271 µg/Kg	Q	QF0275 µg/Kg	Q	QF0279 µg/Kg	Q
PHENOL	6600.00	J	6800.00	J	5500.00	R	1800.0	J	1700.0	J	1600.0	J
2-CHLOROPHENOL	340.00	J	-	UJ	310.00	R	-	UJ	-	UJ	-	UJ
O-CRESOL	1900.00	J	1900.00	J	1500.00	R	550.0	J	590.0	J	500.0	J
M/P-CRESOL	6500.00	R	6400.00	R	5100.00	R	1800.0	R	2100.0	R	1700.0	R
2-NITROPHENOL	-	R	-	R	-	R	-	R	-	R	-	R
2,4-DIMETHYLPHENOL	1100.00	R	1100.00	R	870.00	R	820.0	R	990.0	R	780.0	R
2,4-DICHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ	55.0	J	-	UJ
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	93.00	R	2600.0	J	3400.0	J	180.0	J
2,4,5/6-TRICHLOROPHENOL	-	UJ	-	UJ	-	UJ	210.0	J	690.0	J	390.0	J
2,4-DINITROPHENOL	-	UJ	-	UJ	-	UJ	2000.0	J	10000.0	J	5700.0	J
4-NITROPHENOL	190.00	J	180.00	J	180.00	R	1600.0	UJ	380.0	J	220.0	J
2,3,4,6-TETRACHLOROPHENOL	89.00	J	110.00	J	170.00	R	13000.0	J	8400.0	J	7100.0	J
4,6-DINITRO-2-METHYLPHENOL	92.00	J	130.00	J	120.00	R	2400.0	J	6100.0	J	3200.0	J
PENTACHLOROPHENOL	1700.00	J	1800.00	J	3000.00	R	300000.0	J	200000.0	J	180000.0	J

TABLE 5-2. SUMMARY OF QTM DATA FOR DECONTAMINATION, FIELD, AND TRIP BLANK SAMPLES.

FIELD SAMPLE NUMBER:	ER-001		ER-002		ER-003		ER-004		FB-001		FB-002		TB-001		TB-002		TB-003		TB-004	
EPA SAMPLE NUMBER:	QF0191		QF0225		QF0235		QF0267		QF0192		QF0226		QF0172		QF0185		QF0202		QF0204	
DEPTH																				
VOA ANALYTES (20)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
VINYL CHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ	4.80	R	-	UJ	-	UJ	-	UJ	6.80	R	-	UJ	-	UJ	2.60	J	2.00	J
CARBON TETRACHLORIDE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,2-DICHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TRICHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
BROMODICHLOROMETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TOLUENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
TETRACHLOROETHENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
CHLOROBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
ETHYLBENZENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	20.00	R
BROMOFORM	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
M,P-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ
O-XYLENE	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	-	UJ	20.00	R
PAH ANALYTES (20)	QF0191	Q	QF0225	Q	QF0241	Q	QF0268	Q												
	µg/L		µg/L		µg/L		µg/L													
NAPHTHALENE	-	UJ	-	UJ	20.00	R	20.00	J												
ACENAPHTHYLENE	-	UJ	-	UJ	20.00	R	20.00	J												
ACENAPHTHENE	-	UJ	-	UJ	20.00	R	20.00	J												
FLUORENE	-	UJ	-	UJ	20.00	R	20.00	J												
PHENANTHRENE	-	UJ	-	UJ	3.10	R	8.20	J												
ANTHRACENE	-	UJ	-	UJ	20.00	R	20.00	J												
FLUORANTHENE	-	UJ	-	UJ	20.00	R	20.00	J												
PYRENE	-	UJ	-	UJ	20.00	R	20.00	J												
BENZ(A)ANTHRACENE	-	UJ	-	UJ	20.00	R	20.00	J												
CHRYSENE	-	UJ	-	UJ	20.00	R	20.00	J												
BENZO(B)/(K)FLUORANTHENE	-	UJ	-	UJ	20.00	R	20.00	J												
BENZO(A)PYRENE	-	UJ	-	UJ	20.00	R	20.00	J												
INDENO(1,2,3-CD)PYRENE	-	UJ	-	UJ	20.00	R	20.00	J												
DIBENZ(A,H)ANTHRACENE	-	UJ	-	UJ	20.00	R	20.00	J												
BENZO(G,H,I)PERYLENE	-	UJ	-	UJ	20.00	R	20.00	J												
B(A)P Equivalence Conc.	0		0		46		46													
Total PAHs	0		0		283		288													
PHENOL ANALYTES (50)	QF0191	Q	QF0225	Q	QF0235RE	Q	QF0267	Q												
	µg/L		µg/L		µg/L		µg/L													
PHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
2-CHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
O-CRESOL	-	UJ	-	UJ	-	UJ	-	UJ												
M/P-CRESOL	-	UJ	-	UJ	-	UJ	-	UJ												
2-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
2,4-DIMETHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
2,4-DICHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
4-CHLORO-3-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
2,4,5/6-TRICHLOROPHENOL	-	R	-	UJ	-	UJ	-	UJ												
2,4-DINITROPHENOL	-	R	-	R	-	UJ	-	R												
4-NITROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
2,3,4,6-TETRACHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
4,6-DINITRO-2-METHYLPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												
PENTACHLOROPHENOL	-	UJ	-	UJ	-	UJ	-	UJ												

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TABLE 5-2. SUMMARY OF QTM DATA FOR DECONTAMINATION, FIELD, AND TRIP BLANK SAMPLES (continued).

FIELD SAMPLE NUMBER:	TB-005	
EPA SAMPLE NUMBER:	QF0236	
DEPTH		
VOA ANALYTES (20)	µg/L	Q
VINYL CHLORIDE	-	UJ
1,1-DICHLOROETHENE	-	UJ
TRANS-1,2-DICHLOROETHENE	-	UJ
1,1-DICHLOROETHANE	-	UJ
CIS-1,2-DICHLOROETHENE	-	UJ
CHLOROFORM	-	UJ
1,1,1-TRICHLOROETHANE	-	UJ
CARBON TETRACHLORIDE	-	UJ
BENZENE	-	UJ
1,2-DICHLOROETHANE	-	UJ
TRICHLOROETHENE	-	UJ
BROMODICHLOROMETHANE	-	UJ
TOLUENE	-	UJ
TETRACHLOROETHENE	-	UJ
CHLOROBENZENE	-	UJ
1,1,2,2-TETRACHLOROETHANE	-	UJ
ETHYLBENZENE	-	UJ
BROMOFORM	-	UJ
M,P-XYLENE	-	UJ
O-XYLENE	-	UJ
PAH ANALYTES		
NAPHTHALENE		
ACENAPHTHYLENE		
ACENAPHTHENE		
FLUORENE		
PHENANTHRENE		
ANTHRACENE		
FLUORANTHENE		
PYRENE		
BENZ(A)ANTHRACENE		
CHRYSENE		
BENZO(B)/(K)FLUORANTHENE		
BENZO(A)PYRENE		
INDENO(1,2,3-CD)PYRENE		
DIBENZ(A,H)ANTHRACENE		
BENZO(G,H,I)PERYLENE		
B(A)P Equivalence Conc.		
Total PAHs		
PHENOL ANALYTES		
PHENOL		
2-CHLOROPHENOL		
O-CRESOL		
M/P-CRESOL		
2-NITROPHENOL		
2,4-DIMETHYLPHENOL		
2,4-DICHLOROPHENOL		
4-CHLORO-3-METHYLPHENOL		
2,4,5/6-TRICHLOROPHENOL		
2,4-DINITROPHENOL		
4-NITROPHENOL		
2,3,4,6-TETRACHLOROPHENOL		
4,6-DINITRO-2-METHYLPHENOL		
PENTACHLOROPHENOL		

5.2 SPLIT AND COLOCATED QA/QC ANALYSIS

The split and colocated sample data was analyzed for laboratory precision and sample homogeneity by using a statistical technique known as Relative Percent Difference (RPD). RPD is calculated using the following formula:

$$\text{RPD} = \frac{D_1 - D_2}{(D_1 + D_2)/2}$$

Where RPD = relative percent difference
D_1 = the larger of the two values
D_2 = the smaller of the two values

To calculate RPD values for samples that had parameter concentration reported as undetected in either the original or split sample, and above one-half the detection limit in the other sample, a value of the detection limit was used in the calculation for the value of the sample that went undetected. An RPD value of 0% was assigned for parameters that were not detected above one-half the detections limit in both the original and the split sample.

A duplicate control sample limit of 35 percent RPD was used for all split or colocated soil and sediment samples. Split soil and sediment samples with RPD values greater than 35 percent for a given parameter suggest inadequate laboratory precision and may indicate that values reported for this parameter on other samples collected and analyzed within the same batch may be uncertain. Colocated soil and sediment samples with RPD values greater than 35 percent could result from a significant degree of non-homogeneity (heterogeneity) of the material at the sample location.

A more stringent duplicate control limit (DCL) of 20 percent RPD was used for all water samples as compared to 35 percent for soil samples, because water samples are more likely to be homogeneous at a given sampling location. Samples with parameter RPD values exceeding the 20 percent RPD limit may indicate that values reported for these parameters for other samples collected and analyzed in the same batch may be uncertain. Table 5-3 presents the results of split and colocated QA/QC analysis of parameters that did not pass the DCL of 20 percent for water samples and 35 percent for soil samples.

5.2.1 SPLIT SOIL SAMPLE QA/QC ANALYSIS

A total of four soil and sediment samples were collected as split samples and analyzed for VOAs, PAHs, and phenols using the methods presented in the QTM statement of work. A total of 80 VOA parameters, 60 PAH parameters, and 56 phenolparameters were checked to determine if the DCL of 35 percent was exceeded. The DCL was not exceeded in any of the 80 tests for VOAs for a 100% success rate. The DCL was exceeded in 24 of the 60 tests for PAHs for a 60 percent success rate. The DCL was exceeded in 4 of the 56 tests for phenols for a 93 percent success rate. For the purpose of estimating relative concentrations of contaminants, the VOA, PAH, and phenol data analyzed by QTM is useable.

A total of two soil and sediment samples were collected as split samples and analyzed for VOAs, PAHs, phenols, metals, and dioxin/furans, using Special Analytical Services (SAS) by SW-846 methodology. Samples analyzed for VOAs, PAHs, and phenols using SAS were intended as a check on QTM methods. Comparisons of SAS and QTM analysis are discussed in Section 5.5. A total of 16 VOA, 32 PAH, 28 phenol, 50 metals, and 34 dioxin/furan parameters were checked to determine if the DCL of 35 percent was exceeded. The DCL was exceeded in 0 of the 16 tests for VOAs for a 100 percent success rate, 15 of the 32 tests for PAHs for a 53 percent success rate, 0 of the 28 tests for phenols for a 100 percent success rate, 13 of the 50 tests for metals for a 74 percent success rate, and 5 of the 34 tests for dioxins/furans for a 85 percent success rate. The PAH RPD analysis has a low success rate probably due in part to sample heterogeneity and poor laboratory precision. For the purpose of this investigation, these data are acceptable.

TABLE 5-3

SOIL AND WATER SPLIT AND COLOCATED SAMPLES EXCEEDING RPD LIMITS OF 35 PERCENT FOR SOILS AND 20 PERCENT FOR WATERS

Sample	Analyte	RPD%
QTM Split Soil		
SS-05-SS-003	Naphthalene	42
	Fluorene	103
	Phenanthrene	59
	Anthracene	133
	Benzo(a)Pyrene	46
	Benzo(a)Anthracene	40
	Dibenzo(a,h)Anthracene	36
SD-03-SD-003	Phenanthrene	64
	Pyrene	38
	Benzo(a)Anthracene	38
	Chrysene	45
BH-06-SS-005	Phenanthrene	37
	Anthracene	195
	Benzo(a)Anthracene	40
	Chrysene	37
	Benzo(b/k)Fluoranthene	40
	Benzo(a)Pyrene	36
	Indeno(1,2,3-CD)Pyrene	121
	2,4-Dinitrophenol	96
	2,3,4,6-Tetrachlorophenol	59
	Pentachlorophenol	50
BH-06-SS-006	Naphthalene	65
	Acenaphthene	86
	Fluorene	74
	Phenanthrene	128
	Fluoranthene	105
	Pyrene	60

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TABLE 5-3

SOIL AND WATER SPLIT AND COLOCATED SAMPLES EXCEEDING RPD LIMITS OF 35 PERCENT FOR SOILS AND 20 PERCENT FOR WATERS

Sample	Analyte	RPD%
QTM Colocated Soils		
SS-05-SS-002	Naphthalene	60
	Acenaphthene	43
	Fluoranthene	40
	Pyrene	58
	Chrysene	43
	Benzo(b/k)Fluoranthene	37
	Indeno(1,2,3-CD)Pyrene	36
	Benzo(g,h,i)Perylene	39
	Phenol	66
	Pentachlorophenol	47
SD-03-SD-002	Acenaphthene	36
	Pyrene	128
BH6-SS-003	Acenaphthylene	70
	Benzo(a)Anthracene	65
	Chrysene	64
	Benzo(b/k)Fluoranthene	46
	Benzo(a)Pyrene	61
	Indeno(1,2,3-CD)Pyrene	79
	Benzo(g,h,i)Perylene	63
	2,4-Dinitrophenol	133
	2,3,4,6-Tetrachlorophenol	43
	4,6-Dinitro-2-Methylphenol	87
	Pentachlorophenol	40
BH6-SS-004	Phenanthrene	50
SAS Split Soil		
SS-05-SS-003	Aluminum	44

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TABLE 5-3

SOIL AND WATER SPLIT AND COLOCATED SAMPLES EXCEEDING RPD LIMITS OF 35 PERCENT FOR SOILS AND 20 PERCENT FOR WATERS

Sample	Analyte	RPD%
	Chromium	39
	Magnesium	38
	Nickel	41
	Potassium	40
	Thallium	45
	Zinc	48
	Acenaphthylene	67
	Anthracene	161
	Benzo(a)Anthracene	39
	Benzo(a)Pyrene	47
	Benzo(g,h,i)Perylene	40
	Chrysene	50
	Dibenzo(a,h)Anthracene	58
	Naphthalene	67
	Phenanthrene	161
SD-03-SD-003	Barium	58
	Lead	49
	Magnesium	57
	Manganese	42
	Nickel	41
	Strontium	59
	Acenaphthene	46
	Benzo(g,h,i)Perylene	46
	Dibenzo(a,h)Anthracene	76
	Fluoranthene	37
	Fluorene	57
	Pyrene	55
SAS Colocated Soil		
SS-05-SS-002	Cadmium	42

TABLE 5-3

SOIL AND WATER SPLIT AND COLOCATED SAMPLES EXCEEDING RPD LIMITS OF 35 PERCENT FOR SOILS AND 20 PERCENT FOR WATERS

Sample	Analyte	RPD%
	Copper	47
	Nickel	65
	Potassium	50
	Anthracene	92
	Benzo(g,h,i)Perylene	53
	Benzo(k)Fluoranthene	62
	Chrysene	154
	Phenanthrene	92
SD-03-SD-001	Aluminum	55
	Barium	180
	Calcium	175
	Chromium	49
	Iron	125
	Sodium	122
	Phosphorus	48
	Strontium	179
	Acenaphthene	90
	Benzo(a)Anthracene	55
	Benzo(a)Pyrene	176
	Benzo(g,h,i)Perylene	57
	Chrysene	120
	Fluoranthene	42
	Fluorene	56
	Indeno(1,2,3-CD)Pyrene	99
	Pyrene	43
SAS Split Ground Water		
MW3-GW-002	Thallium	28
	Phosphorus	26
	Naphthalene	166

TABLE 5-3

SOIL AND WATER SPLIT AND COLOCATED SAMPLES EXCEEDING RPD LIMITS OF 35 PERCENT FOR SOILS AND 20 PERCENT FOR WATERS

Sample	Analyte	RPD%
	Benzene	118
MW5-GW-002	Aluminum	67
	Arsenic	21
	Chromium	48
	Anthracene	27
	Phenanthrene	27
	Naphthalene	32
	Fluorene	23
	Fluorenthene	104
SAS Colocated Surface Water		
SW3-SW-002	Aluminum	154
	Chromium	32
	Copper	66
	Iron	64
	Potassium	38
	Thallium	44
	Phosphorous	58

5.2.2 COLOCATED SOIL SAMPLE QA/QC ANALYSIS

Four soil and sediment samples were collected as colocated samples and analyzed for VOAs, PAHs, and phenols using the QTM methods. A total of 80 VOA parameters, 60 PAH parameters and 56 phenol parameters were checked to determine if the DCL limit of 35 percent was exceeded. The DCL was exceeded in 18 of the 60 tests for PAHs for a 70 percent success rate, 6 of the 56 tests for phenols for an 89 percent success rate, and 0 of the 80 tests for VOAs for a 100 percent success rate. This data shows that the colocated soil analysis for the samples analyzed by the QTM methods are acceptable.

Two colocated samples were analyzed for VOAs, PAHs, phenols, metals, and dioxins/furans using SAS. Samples analyzed for VOAs, PAHs, and phenols were intended as a check on the QTM methods and a comparison of results for SAS and QTM methods is presented in Section 5.5. A total of 16 parameters for VOAs, 32 parameters for PAHs, 28 parameters for phenols, 50 parameters for metals, and 34 parameters for dioxins/furans were checked to determine if the DCL limit of 35 percent was exceeded. The DCL was exceeded in 0 of the 16 tests for VOAs for a 100 percent success rate, 14 of the 32 tests for PAHs for a 56 percent rate, 0 of the 28 tests for phenols for a 100 percent success rate, 13 of the 50 tests for metals for a 74 percent success rate, and 0 of the 34 tests for dioxins/furans for a 100 percent success rate. The low success rate for PAHs is due in part to the inherent variability in matrix at this site. All other data for colocated QC analysis are acceptable.

5.2.3 SPLIT GROUNDWATER QA/QC ANALYSIS

Two groundwater samples were collected as split samples and analyzed for VOAs, PAHs, phenols, and metals using SAS and SW-846 methodology. A total of 16 parameters for VOAs, 32 parameters for PAHs, 28 parameters for phenols, and 50 parameters for metals were checked to determine if the DCL of 20 percent was exceeded. The DCL was exceeded in 1 of the 16 tests for VOAs for a 94 percent success rate, 6 of the 32 tests for PAHs for an 81 percent success rate, 0 out of 28 tests for phenols for a 100 percent success rate, and 5 of the 50 tests for metals for a 90 percent success rate. The RPD analysis for split groundwater samples show that these data are acceptable.

5.2.4 COLOCATED SURFACE WATER QA/QC ANALYSIS

One surface water sample was collected with a colocated QC sample and analyzed for VOAs, PAHs, phenols, and metals using SAS and SW-846 methods. A total of 8 parameters for VOAs, 15 parameters for PAHs, 14 parameters for phenols, and 25 parameters for metals were checked to determine if the DCL of 20 percent was exceeded. The DCL was exceeded in 0 of the 8 tests for VOAs for a 100 percent success rate, 0 of the 15 tests for PAHs for a 100 percent success rate, 0 of the 14 tests for phenols for a 100 percent success rate, and 7 of the 25 tests for metals for a 72 percent success rate. For the purpose of estimating relative concentrations of contaminants at the American Creosote site, these data are acceptable.

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5.3 DECONTAMINATION BLANKS AND FIELD BLANKS

A total of six decontamination blanks and three field blank were collected during the field program. Four of the decontamination blanks and two of the field blanks were analyzed by QTM methods (Table 5-2). The remaining decontamination and field blanks were analyzed by SAS (Appendix D). High Performance Liquid Chromatography (HPLC) water was used as the decontamination water. The samples were analyzed for VOAs, PAHs, and phenols using QTM methods and VOAs, PAHs, phenols, and metals using SAS by SW-846 methods. Volatile organics, PAHs, and phenols were not detected in the blank QC samples above the reporting limit. Decontamination procedures were adequate.

5.4 TRIP BLANK QA/QC ANALYSIS

Eight trip blanks were analyzed for volatile organics during the field investigation (five by QTM and three by SAS). A positive detection for toluene was reported for TB-0015 and a positive detection for toluene and xylene was reported for TB-0025. Probable sources of contamination are the site ambient conditions including vehicle exhaust or potential cross contamination. No positive detections of volatiles were reported above the detection limit for the rest of the trip blanks.

5.5 QTM CONFIRMATION SAMPLE ANALYSIS

Approximately one in 10 samples analyzed for volatile organics, PAHs, and phenols by the QTM program were split and analyzed using Special Analytical Services (SAS) by SW-846 methodology as a check of the accuracy of QTM results. Table 5-4 presents comparisons between QTM and SAS methods for volatile organics and PAHs. The phenol data was not included in the table because phenols were not detected using SW-846 method 8040. Data validation has not been completed for these analyses. Previous site investigation data have indicated the presence of phenols at the site. A significant portion of the phenol QTM data have undergone a complete CLP data validation as well as an electronic validation. All phenol QTM data that have been found to be useable or provisional are used for the purpose of estimating phenol concentrations at the site.

A quantitative comparison between QTM and SAS data for volatile organics and PAHs is not appropriate in that different analytical methods were used. In addition, comparison of volatile compound and PAH analysis results is difficult because QTM methodology is designed as a screening method and the SAS methods are designed to be much more accurate when quantifying concentrations of contaminants. RPD calculations are of limited value due to the differences in detection limit between the two methods. Alternatively a side by side comparison was used to determine if the relative concentrations of compounds found in like samples were qualitatively comparable.

As the concentration of contaminants in the samples increases, the variability between the two methods increases as well. Variation can be contributed to the differences between the methods

TABLE 5-4
COMPARISON OF DATA OBTAINED BY QTM AND SAS LABORATORIES ON SPLIT SAMPLES

FIELD SAMPLE NUMBER:	SS-05-SL-001				SS-05-SL-002				SS-05-SL-003				BH-03-SS-001				BH-09-SS-001			
EPA SAMPLE NUMBER:	QF0213		SF 2490		QF0214		SF 2491		QF0215		SF 2492		QF0291		SF 2523DL		QF0253		SF 2514	
DEPTH													0.5-6'		0.5-6'		5'			
METHOD	QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS	
VOA ANALYTES (40/20)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
DILUTION FACTOR			1.000				1.000				1.000				250.000				1.000	
BENZENE	-	UJ	0.20	U	-	UJ	0.10	U	-	UJ	0.10	U	63.00	J	41.90	U	-	UJ	0.16	U
CHLOROBENZENE	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	51.60	U	-	UJ	0.19	U
ETHYLBENZENE	-	UJ	0.10	U	-	UJ	0.10	U	-	UJ	0.10	U	870.00	J	2430.00	D	-	UJ	0.09	U
TOLUENE	-	UJ	0.10	U	-	UJ	0.10	U	-	UJ	0.10	U	520.00	J	410.00	D	-	UJ	0.12	U
XYLENES	0.00		0.30	U	0.00		0.30	U	0.00		0.30	U	1240.00		6210.00	D	0.00		0.33	U
PAH ANALYTES (330/20)	QF0213	Q	SF 2490DL	Q	QF0214	Q	SF 2491DL	Q	QF0215	Q	SF 2492DL	Q	QF0292	Q	SF 2523DL	Q	QF0254	Q	SF 2514	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
DILUTION FACTOR			400.000				400.000				200.000				2000.000				1.000	
NAPHTHALENE	650.0	J	6952.5	DU	350.0	J	6888.6	DU	1000.0	J	3452.2	DU	-	UJ	4660000	D	-	UJ	18.5	U
ACENAPHTHYLENE	700.0	J	6952.5	DU	450.0	J	6888.6	DU	980.0	J	3452.2	DU	4900	J	38700	UD	-	UJ	18.5	U
ACENAPHTHENE	630.0	J	6234.1	D	510.0	J	4845.0	D	580.0	J	4951.0	D	2900	R	728000	D	-	UJ	12.7	P
FLUORENE	2300.0	J	7960.6	D	2700.0	J	5970.1	D	730.0	J	6114.0	D	10000	R	1800000	D	-	UJ	65.3	P
PHENANTHRENE	9200.0	J	3997.7	D	11000.0	J	10792.2	D	5000.0	J	37497.0	D	-	R	666000	D	-	UJ	50.9	P
ANTHRACENE	20000.0	J	3997.7	D	22000.0	J	10792.2	D	4000.0	J	37497.0	D	-	UJ	666000	D	-	UJ	50.9	P
FLUORANTHENE	15000.0	J	8377.8	D	10000.0	J	7182.5	D	14000.0	J	6301.0	D	740	R	232000	D	140.0	J	113.0	P
PYRENE	16000.0	J	5110.1	D	8800.0	J	4292.8	D	17000.0	J	5895.0	D	-	UJ	181000	D	170.0	J	92.3	P
BENZ(A)ANTHRACENE	10000.0	J	4797.2	D	7000.0	J	6755.5	D	15000.0	J	3201.0	D	21000	J	75800	D	80.0	J	50.3	P
CHRYSENE	7600.0	J	3661.6	D	4900.0	J	471.9	D	8700.0	J	2196.0	D	6700	R	70800	D	100.0	J	31.8	P
BENZO(B)/(K)FLUORANTHENE	19000.0	J	11031.3		13000.0	J	17262.9		27000.0	J	11089.0		1300	R	66400		330.0	J	118.4	
BENZO(A)PYRENE	6900.0	J	8088.1	D	5200.0	J	7590.1	D	11000.0	J	4998.0	D	3100	R	37300	D	110.0	J	60.0	P
INDENO(1,2,3-CD)PYRENE	8200.0	J	6767.1	D	5700.0	J	6808.3	D	11000.0	J	4757.0	D	-	UJ	3870	UD	210.0	J	39.4	P
DIBENZ(A,H)ANTHRACENE	3400.0	J	6208.0	D	2600.0	J	6370.0	D	4900.0	J	3401.0	D	-	UJ	12900	UD	0.0	J	60.9	P
BENZO(G,H,I)PERYLENE	7000.0	J	3951.3	D	4700.0	J	6819.7	D	9500.0	J	2612.0	D	460	R	3870	UD	0.0	J	29.4	P
B(A)P Equivalence Conc.	14096.0		16592.3		10419.0		17047.5		21287.0		10325.7		5397		52228		173.0		142.0	
Total PAHs	126580.0		80182.6		98910.0		95953.2		130390.0		130509.0		51100		9183300		1140.0		775.3	

TABLE 5-4

COMPARISON OF DATA OBTAINED BY QTM AND SAS LABORATORIES ON SPLIT SAMPLES (cont)

FIELD SAMPLE NUMBER:	MW-01A-SS-001				MW-01A-SS-002				MW-02-SS-001				MW-02-SS-002				MW-02A-SS-002			
EPA SAMPLE NUMBER:	QF0298		SF 2538		QF0297		SF 2539		QF0233		SF 2507		QF0269		SF 2516		QF0206		SF 2475DL	
DEPTH	0-10'		0-10'				20'		31-35'				51'				15'			
METHOD	QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS	
VOA ANALYTES (40/20)	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q	µg/Kg	Q
DILUTION FACTOR			1.000				1.000				1.000				1.000				10.000	
BENZENE	-	UJ	0.16	U	-	UJ	0.16	U	-	UJ	0.17	U	-	UJ	0.17	U	-	UJ	1.60	UD
CHLOROBENZENE	-	UJ	0.19	U	-	UJ	0.20	U	-	UJ	0.21	U	-	UJ	0.21	U	-	UJ	1.90	UD
ETHYLBENZENE		UJ	0.09	U		UJ	0.10	U		UJ	0.11	U		UJ	0.10	U		R	4.40	D
TOLUENE	-	UJ	0.12	U	-	UJ	0.13	U	-	UJ	0.13	U	-	UJ	0.13	U	5.00	UJ	4.10	D
XYLENES	-		0.33	U	-		0.34	U	-		0.36	U	-		0.35	U	100.00		29.40	D
PAH ANALYTES (330/20)	QF0299	Q	SF 2538	Q	QF0300	Q	SF 2539DL	Q	QF0234		SF 2507DL		QF0270	Q	SF 2516	Q	QF0206	Q	SF 2475DL	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg	
DILUTION FACTOR			1.000				1.000	UD			10.000				1.000				100.000	
NAPHTHALENE	-	UJ	18.5	U	-	UJ	190.0	UD	-	R	3830.0	D	-	UJ	19.6	U	25000.0	J	5213.2	D
ACENAPHTHYLENE	-	UJ	18.5	U	-	UJ	190.0	UD	-	R	197.0	DU	-	UJ	19.6	U	1100.0	J	1827.0	DU
ACENAPHTHENE	-	UJ	3.1	U	-	UJ	31.6	UD	-	R	1680.0	D	200.0	J	3.3	U	22000.0	J	3812.4	D
FLUORENE	-	UJ	3.1	U	-	UJ	31.6	UD	910.0	R	7490.0	D	-	R	24.7		27000.0	J	12302.1	D
PHENANTHRENE	-	UJ	1.2	U	-	UJ	12.6	UD	6700.0	R	2520.0	D	-	UJ	26.0	P	85000.0	J	803.9	D
ANTHRACENE	-	UJ	1.2	U	-	UJ	12.6	UD	4600.0	R	2520.0	D	-	UJ	26.0	P	9000.0	J	803.9	D
FLUORANTHENE	-	UJ	6.2	U	-	UJ	63.2	UD	3000.0	R	2200.0	D	-	UJ	31.9	P	41000.0	J	3739.3	D
PYRENE	-	UJ	6.2	U	-	UJ	63.2	UD	1600.0	R	792.0	D	-	UJ	6.5	U	28000.0	J	1012.2	D
BENZ(A)ANTHRACENE	-	UJ	1.8	U	-	UJ	19.0	UD	460.0	R	500.0	D	-	UJ	12.3		7100.0	J	814.9	D
CHRYSENE	-	UJ	1.8	U	-	UJ	19.0	UD	480.0	R	354.0	D	-	UJ	5.9		6100.0	J	601.7	D
BENZO(B)/(K)FLUORANTHENE	-	UJ	8.0		-	UJ	82.2		120.0	R	278.0		-	UJ	42.6		5200.0	J	689.4	
BENZO(A)PYRENE	-	UJ	3.1	U	-	UJ	31.6	UD	81.0	R	127.0	D	-	UJ	22.1		2600.0	J	421.4	D
INDENO(1,2,3-CD)PYRENE	-	UJ	1.8	U	-	UJ	19.0	UD	-	R	19.7	DU	-	UJ	22.1		1500.0	J	182.7	DU
DIBENZ(A,H)ANTHRACENE	-	UJ	6.2	U	-	UJ	63.2	UD	-	R	65.8	DU	-	UJ	15.4		800.0	J	609.0	DU
BENZO(G,H,I)PERYLENE	-	UJ	1.8	U	-	UJ	19.0	UD	-	R	19.7	DU	-	UJ	6.1	P	1300.0	J	182.7	DU
B(A)P Equivalence Conc.	0.0		0.8		0.0		8.2		143.8		208.3		0.0		45.3		4841.0		577.8	
Total PAHs	0.0		8.0		0.0		82.2		17951.0		22291.0		200.0		235.1		262700.0		30214.4	

TABLE 5-4

COMPARISON OF DATA OBTAINED BY QTM AND SAS LABORATORIES ON SPLIT SAMPLES (cont)

FIELD SAMPLE NUMBER:	MW-07-SS-001				SD-03-SD-001				SD-03-SD-002				SD-03-SD-003				SW-03-SW-001			
EPA SAMPLE NUMBER:	QF0303		SF 2527		QF0193		SF 2451		QF0194		SF 2452		QF0195		SF 2453		QF0197		SF 2454	
DEPTH	0-10'		0-10'																	
METHOD	QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS		QTM		SAS	
VOA ANALYTES (40/20)		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/L		µg/L	
DILUTION FACTOR			1.000				1.000				1.000				1.000				1.000	
BENZENE	-	UJ	0.15	U	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	0.13	U
CHLOROBENZENE	-	UJ	0.19	U	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	0.20	U	-	UJ	0.16	U
ETHYLBENZENE	-	UJ	0.09	U	-	UJ	0.10	U	-	UJ	0.10	U	-	UJ	1.10		-	UJ	0.08	U
TOLUENE	-	UJ	0.12	U	-	UJ	0.10	U	-	UJ	0.10	U	-	UJ	0.80		-	UJ	0.10	U
XYLENES	0.00		0.32	U	0.00		0.40	U	0.00		0.30	U	0.00		2.70		0.00		0.27	U
PAH ANALYTES (330/20)	QF0304	Q	SF 2527DL	Q	QF0193RE	Q	SF 2451DL	Q	QF0194RE	Q	SF 2452DL	Q	QF0195RE	Q	SF 2453DL	Q	QF0197	Q	SF 2454	Q
	µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/Kg		µg/L		µg/L	
DILUTION FACTOR			10.000				20.000				20.000				20.000				1.000	
NAPHTHALENE	-	UJ	177.0	D	270.0	J	419.0	DU	88.0	J	380.7	DU	300.0	J	434.8	DU	-	UJ	0.450	U
ACENAPHTHYLENE	-	UJ	177.0	UD	52.0	J	419.0	DU	58.0	J	380.7	DU	31.0	J	434.8	DU	-	UJ	0.450	U
ACENAPHTHENE	-	UJ	217.0	D	460.0	J	199.7	D	660.0	J	525.4	D	460.0	J	320.3	D	-	UJ	0.075	U
FLUORENE	-	UJ	966.0	D	570.0	J	571.2	D	760.0	J	318.5	D	670.0	J	1031.9	D	-	UJ	0.075	U
PHENANTHRENE	38.0	R	92.3	UD	1700.0	J	68.2	D	1300.0	J	60.7	D	3300.0	J	76.8	D	-	UJ	0.030	U
ANTHRACENE	-	UJ	92.3	D	270.0	J	68.2	D	310.0	J	60.7	D	460.0	J	76.8	D	-	UJ	0.030	U
FLUORANTHENE	180.0	J	934.0	D	1700.0	J	821.2	D	2300.0	J	538.1	D	2800.0	J	566.7	D	-	UJ	0.150	U
PYRENE	220.0	J	642.0	D	1500.0	J	340.8	D	300.0	J	218.3	D	2200.0	J	194.2	D	-	UJ	0.150	U
BENZ(A)ANTHRACENE	140.0	J	532.0	D	450.0	J	255.6	D	560.0	J	145.9	D	660.0	J	337.7	D	-	UJ	0.045	U
CHRYSENE	180.0	J	537.0	D	480.0	J	41.9	DU	580.0	J	165.0	D	760.0	J	43.5	DU	-	UJ	0.045	U
BENZO(B)/(K)FLUORANTHENE	190.0	J	799.0		670.0	J	304.0		790.0	J	258.9		880.0	J	287.8		-	UJ	0.195	
BENZO(A)PYRENE	110.0	J	507.0	D	370.0	J	173.2	D	370.0	J	11.2	D	420.0	J	184.1	D	-	UJ	0.075	U
INDENO(1,2,3-CD)PYRENE	-	UJ	276.0	D	250.0	J	111.7	D	280.0	J	38.1	DU	310.0	J	118.3	D	-	UJ	0.045	U
DIBENZ(A,H)ANTHRACENE	-	UJ	246.0	D	68.0	J	183.0	D	78.0	J	126.9	DU	83.0	J	82.2	D	-	UJ	0.150	U
BENZO(G,H,I)PERYLENE	-	UJ	99.0	D	230.0	J	69.4	D	230.0	J	38.1	DU	280.0	J	110.9	D	-	UJ	0.045	U
B(A)P Equivalence Conc.	144.8		919.1		579.8		423.3		616.8		53.3		695.6		340.7		0.000		0.020	
Total PAHs	1058.0		6024.3		9040.0		3166.2		8664.0		2302.7		13614.0		3387.7		0.000		0.195	

TABLE 5-4

COMPARISON OF DATA OBTAINED BY QTM AND SAS LABORATORIES ON SPLIT SAMPLES (cont)

FIELD SAMPLE NUMBER:	SW-03-SW-002				SW-08-SW-001			
EPA SAMPLE NUMBER:	QF0196		SF 2455		QF0224		SF 2499	
DEPTH								
METHOD	QTM		SAS		QTM		SAS	
VOA ANALYTES (40/20)	µg/L	Q	µg/L	Q	µg/L	Q	µg/L	Q
DILUTION FACTOR			1.000				1.000	
BENZENE	-	UJ	0.13	U	-	UJ	0.13	U
CHLOROBENZENE	-	UJ	0.16	U	-	UJ	0.16	U
ETHYLBENZENE	-	UJ	0.08	U	-	UJ	0.08	U
TOLUENE	-	UJ	0.10	U	-	UJ	0.10	U
XYLENES	0.00		0.27	U	0.00		0.27	U
PAH ANALYTES (330/20)	QF0196 µg/L	Q	SF 2455 µg/L	Q	QF0224 µg/L	Q	SF 2499 µg/L	Q
DILUTION FACTOR			1.000				1.000	
NAPHTHALENE	-	UJ	0.450	U	-	UJ	1.200	
ACENAPHTHYLENE	-	UJ	0.450	U	-	UJ	0.450	U
ACENAPHTHENE	-	UJ	0.075	U	-	UJ	0.900	
FLUORENE	-	UJ	0.075	U	-	UJ	0.578	
PHENANTHRENE	-	UJ	0.030	U	-	UJ	0.060	
ANTHRACENE	-	UJ	0.030	U	-	UJ	0.060	
FLUORANTHENE	-	UJ	0.150	U	-	UJ	1.910	
PYRENE	-	UJ	0.150	U	-	UJ	0.150	U
BENZ(A)ANTHRACENE	-	UJ	0.045	U	-	UJ	0.720	
CHRYSENE	-	UJ	0.045	U	-	UJ	0.045	U
BENZO(B)/(K)FLUORANTHENE	-	UJ	0.195		-	UJ	0.195	
BENZO(A)PYRENE	-	UJ	0.075	U	-	UJ	0.075	U
INDENO(1,2,3-CD)PYRENE	-	UJ	0.045	U	-	UJ	0.045	U
DIBENZ(A,H)ANTHRACENE	-	UJ	0.150	U	-	UJ	0.150	U
BENZO(G,H,I)PERYLENE	-	UJ	0.045	U	-	UJ	0.045	U
B(A)P Equivalence Conc.	0.000		0.020		0.000		0.092	
Total PAHs	0.000		0.195		0.000		5.623	

as well as inherent variation of the samples due to heterogeneity. Concentrations of contaminants are generally within the same order of magnitude when comparing QTM and SAS data.

Although the variability between the QTM and the SAS data appears great, compound identification was acceptable as well as the general ratio of concentrations in compounds detected. QTM data that has been found to be useable or provisional can be used for the determination of presence/absence of contamination in various matrices and locations at the site.

5.6 REVIEW OF LABORATORY QA/QC

The soil and water samples were subject to two types of analyses. The screening method used per the QTM Statement of Work was performed on all samples take during the field investigation for the RI and were analyzed for volatile organics, PAHs, and phenols. Approximately ten percent of the groundwater, surface water, soil, and sediment samples were subject to analysis of metals, dioxin/furan, PAH, volatile organics, and phenols, using SW-846 methodology. Methods are specified in the Field Sampling Plan (CDM 1992).

At the time this report was produced, EPA data validation was not complete. Approximately fifty percent of the QTM data and thirty percent of the SAS data have undergone a complete CLP data validation by the U.S. EPA Region VI Sample Control Center (RSCC) in Houston, Texas. All of the QTM data have undergone an electronic validation by the Computer Aided Data Review and Evaluation (CADRE) program.

Values for PAHs, volatile organics, and phenols reported by QTM laboratories are qualified as estimated or rejected in all cases. Additionally, analyte concentrations were frequently reported which were one or two orders of magnitude below the stated detection level. Reasons for QTM data qualifiers include the following:

- Some laboratory control sample (LCS) recoveries were outside acceptable criteria. LCS recovery is an indication of laboratory accuracy.

- System monitoring compound (SMC) recoveries were occasionally outside acceptable criteria. SMC recovery is an indication laboratory accuracy.
- Compounds were not identified and quantified correctly on numerous occasions.
- The system calibration was outside acceptable criteria. Calibration of instrumentation assures accurate identification and quantitation of compounds.

Although the data are considered qualified, this does not preclude the useability of the data for determination of presence/absence and relative abundance of contamination in various matrices and locations at the site. Description of the sampling results presented in this report does not differentiate between data considered as acceptable, estimated, or rejected as a result of the partial validation conducted to date. However, appropriate qualifying flags have been added to the summary tables provided. These data are considered suitable for the evaluation and selection of a conceptual site remedy.

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Section 6.0

6.0 CONTAMINANT FATE AND TRANSPORT

6.1 CONTAMINANT PROPERTIES

Data collected at the American Creosote wood-treating site and an evaluation of the nature and extent of contaminants based on those data are presented in Section 4.0. Contaminants of concern are developed based on human health and ecological risk considerations discussed in Section 7.0. The contaminants of concern are polynuclear aromatic hydrocarbons (PAHs), phenols, and volatile organic compounds. Dioxins/furans are present in site surface soil at 2,3,7,8-TCDD equivalent concentrations of approximately 5 μg/kg (see Section 4.0). Based on information from the Centers for Disease Control (May, 1987), EPA Region VI has determined that soils containing concentrations of 2,3,7,8-TCDD equivalents not exceeding 10 μg/kg should not pose a significant health hazard if covered with 12 inches of clean soil. Therefore, dioxins/furans are not discussed further in this section, under the assumption that EPA will cover dioxin-containing soil at the site with a soil/vegetative cover.

The fate and transport of the contaminants found at the site are functions of numerous factors including physical and chemical characteristics of the matrix, organic carbon content of the soil, solubility of the chemical, and vapor pressure of the chemical, in addition to other factors such as specific gravity of the formulated wood-treatment fluid. Table 6-1 summarizes some physical and chemical characteristics of the contaminants of concern. A brief explanation of select parameters from Table 6-1 follows.

Vapor Pressure reflects equilibrium conditions of a chemical between its gaseous and liquid forms. Chemicals with low vapor pressures tend not to be readily released to the air; therefore, these chemicals are more likely to be persistent in near-surface soils. In contrast, chemicals with high vapor pressure volatilize easily and are less persistent in near-surface soils.

TABLE 6-1

PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED CONTAMINANTS[a]

Compound	No. of Rings	Molecular Weight (g/mole)	Specific Gravity[b]	Water Solubility (mg/l @ 20° C)	Vapor Pressure (mm Hg @ 20° C)	Log[c] K_{ow}	K_{oc}[d] (ml/g)	Henry's Constant (H)
PAHs								
Naphthalene	2	128	1.02	31.7	4.9×10^{-2}	3.37	1,300	1.04×10^{-2}
Acenaphthylene	3	152	0.9	3.93	2.9×10^{-2}	4.07	2,500	6.04×10^{-2}
Acenaphthene	3	154	1.02	3.42	1.5×10^{-3}	4.33	4,600	3.7×10^{-3}
Flourene	3	116	1.20	1.9	10^{2} to 10^{-3}	4.18	14,000	4.7×10^{-2} to 10^{3}
Phenanthrene	3	178	1.03	1.29	6.8×10^{-4}	4.45	26,000	1.02×10^{-3}
Anthracene	3	178	1.25	0.073	1.9×10^{-4}	4.45	26,000	1.02×10^{-3}
Flouranthene	4	202	1.25	0.2	10^{4} to 10^{-6}	5.33	38,000	6.46×10^{-6}
Pyrene	4	202	1.27	0.132	2.5×10^{-6}	5.32	63,000-84,000	5.04×10^{-6}
Benzo(a)anthracene	4	228	---	0.014	2.2×10^{-8}	5.61	1,380,000	1.16×10^{-6}
Chrysene	4	228	1.27	0.0018	6.3×10^{-9}	5.61	200,000	1.05×10^{-9}
Benzo(b)flouranthene	5	252	---	0.0012	10^{-11}	6.57	---	1.16×10^{-9}
Benzo(k)flouranthene	5	252	---	0.0008	9.59×10^{-11}	6.84	---	1.05×10^{-9}
Benzo(a)pyrene	5	252	1.35	0.0038	5.0×10^{-9}	6.04	4,510,650	----
Dibenzo(a,h)anthracene	5	276	---	0.0005	10^{-10}	5.97	2,029,000	----
Benzo(g,h,i)perylene	6	278	---	0.00026	10^{-10}	7.23	---	----
Ideno(1,2,3-cd)pyrene	6	276	---	0.0002	10^{-10}	7.66	---	----

TABLE 6-1

PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED CONTAMINANTS[a]

Compound	No. of Rings	Molecular Weight (g/mole)	Specific Gravity[b]	Water Solubility (mg/l @ 20° C)	Vapor Pressure (mm Hg @ 20° C)	Log[c] K_{ow}	K_{oc}[d] (ml/g)	Henry's Constant (H)
Phenols								
Phenol	1	94	1.1	93,000	.34	1.46	10-100	4.54×10^{7}
2,4,6-Trichlorophenol	1	197	—	800	—	3.38	—	—
Pentachlorophenol	1	266	1.97	14	2.0×10^{4}	5.01	4.92	2.08×10^{4}
Volatile Organic Compounds								
Benzene	1	78	0.79	1,780	76	2.13	1.92	0.18
Toluene	1	92	0.9	520	22	2.28	2.07	0.21
Xylene	1	106	0.88	175	5	3.68	2.43	0.16

[a] Sources are Weast 1973; Perry and Chilton 1973; Callahan, et al. 1979; and Verschueren 1983.

[b] Specific gravity at 20° C relative to water at 4° C.

[c] Log Octanol/Water Partition Coefficient.

[d] Organic carbon partition coefficient.

— No value for this characteristic or property is available.

Octanol/Water Partition Coefficient (K_{ow}) is the ratio of a chemical's concentration in the organic phase (octanol) to that in the aqueous phase (water). The K_{ow} value is used to estimate the tendency of the chemical to partition itself between an organic phase and an aqueous phase. Large K_{ow} values indicate the chemical will tend to be adsorbed to an organic phase (e.g., the organic carbon in the soil).

Organic Carbon Partition Coefficient (K_{oc}) is an estimate of the extent to which an organic chemical will partition itself between the soil organic carbon and the aqueous phase of saturated or unsaturated soil, runoff or sediment. Large K_{oc} values indicate the chemical will tend to be adsorbed on soil organic materials and thus be rendered less mobile. Values of K_{oc} are proportional to K_{ow} values for individual chemicals.

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Henry's Law Constant (H) is used to estimate the rate at which an organic chemical will volatilize from a chemical/water solution and is expressed as a unit-less constant. The concentration of the chemical in air is that which is observed directly above the water in the gas-liquid equilibrium phase. The higher the value of H, the greater the amount of the chemical which will volatilize from the solution. Values of H are usually proportional to vapor pressure.

Creosote/coal tar mixtures used in wood-treatment processes typically have a density of 1.03 to 1.18 g/cm^3. Solutions of PCP and diesel may have densities either greater or less than 1.0 g/cm^3, depending upon the quantity of PCP and the type of diesel used, but typically have densities less than 1.0 g/cm^3. Solutions denser than water (i.e., density greater than 1.0 g/cm^3) tend to sink in water until they reach an impermeable boundary such as bedrock or a continuous clay lens. In this case, contaminant migration is governed by gravity and follows the gradient of the impermeable boundary. Solutions with densities of less than 1.0 g/cm^3 will tend to float on the water-table surface. Non-aqueous phase liquids, with densities both greater than and less than water, have been observed at the American Creosote site.

6.2 CONTAMINANT PERSISTENCE AND DEGRADATION

6.2.1 POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

6.2.1.1 Soils Persistence

In surface soils, the persistence of polycyclic aromatic hydrocarbons (PAHs) is dependent on both the properties of the PAH and the conditions within the soil. As seen in Table 6-1, those PAHs with two and three rings tend to have significantly higher vapor pressures and solubilities and significantly lower log K_{ow} and K_{oc} values than PAHs with four, five, and six rings. These values indicate that lower molecular weight PAHs (two and three rings) would have a greater tendency to volatilize from surface soils or be dissolved in an aqueous phase within the soils, while the higher molecular weight PAHs (four, five, and six rings) would have a greater tendency to become adsorbed to soil and organic material within the soil.

The volatilization and dissolution potential for all the PAHs is also dependent on soil conditions. Disturbed and well-aerated soils will increase volatilization, while compacted and poorly aerated soils will decrease volatilization. Dissolution of PAHs is dependent upon the presence of water within the soil. However, it should be noted that none of the PAHs are highly soluble and that volatilization of higher molecular weight PAHs is insignificant.

6.2.1.2 Surface Water Persistence

In surface water, the persistence of PAHs is very low due to their affinity for sorption to suspended particulates, volatilization, and photolytic and biological degradation. The majority of PAHs entering surface waters are rapidly sorbed to suspended particulates and subsequently deposited in bottom sediments. PAHs adsorbed to surface water sediments can be remobilized and transported during erosional events. Much of the PAHs remaining in solution is subject to volatilization and degradation leaving a very small percentage of the original PAH concentrations in solution.

PAHs occurring as phase-separated free product in surface water will tend to flow along the bottom of the stream channel or lake, collecting in depressions. Sorption to bottom sediments will occur to the point of saturation. Migration of phase-separated PAHs to groundwater from the creek bed is possible. Some dissolution of the lower molecular weight PAHs will also occur. Phase-separated PAHs are moderately persistent while submerged, depending on the levels of microbial activity, sunlight, and oxygen in the surface-water system.

6.2.1.3 Groundwater Persistence

As with surface water, the persistence of PAHs in groundwater is very low. The majority of PAHs entering a groundwater system are rapidly sorbed to the soil matrix. Some of the lower molecular weight PAHs may remain in solution and some low-level continuous desorption will occur. However, even low-level desorption can result in significant health risks under a drinking water scenario. Any PAHs in solution may also be subject to biodegradation, if conditions are suitable for microbial growth.

Any free-phase PAHs remaining after saturation of the matrix would migrate downward under the force of gravity until reaching an impermeable boundary. Free-phase PAHs could then migrate down any slope present on the impermeable surface. Phase-separated PAHs are moderately to highly persistent depending on levels of microbial activity and oxygen in the groundwater system. Free-phase PAHs would only exist in conjunction with the carrier oils used with the wood-treating chemicals.

6.2.1.4 Degradation

There are two known pathways of PAH degradation, photolysis, and biotransformation (Moore and Ramamoorthy, 1984). All PAHs are susceptible to photo-degradation and biodegradation. However, the half-life of an individual PAH can vary greatly depending upon its chemical structure and the pathway of degradation.

PAHs sorbed to particulates are more susceptible to photo-oxidation than those in solution. Also, the oxidative pathway is different, yielding quinones. The photo-degradation of PAHs is dependent on oxygen concentrations (the half-life decreases with increasing oxygen levels), temperature (exponentially increasing with temperature), and extent of solar radiation.

Microorganisms present in both soils and water are capable of degrading PAHs. Metabolites vary depending upon the PAH and organism involved. Effective biodegradation is dependent upon the presence of oxygen, the molecular weight of the PAH (higher weights generally degrade more slowly), and the presence of a bacterial population which is acclimated to local conditions. Under anaerobic conditions, biodegradation would typically occur much more slowly than under aerobic conditions. In some areas of the site, anaerobic conditions may occur.

6.2.2 PHENOLS

6.2.2.1 Soils Persistence

In soils, the persistence of phenols and chlorinated phenols is dependent on the properties of both the compound and the soil matrix. Table 6.1 lists the chemical properties of the compounds which together determine the persistence of the phenols in soils.

The high log K_{ow} of the chlorinated phenols (particularly pentachlorophenol) indicates that these compounds tend to be adsorbed to the soil. However, under the soil pH conditions observed at the American Creosote site, only a small percentage of the PCP present would be adsorbed by the soil. This is because the pH of the soil at this site is expected to exceed the pKa (the acid dissociation constant) of PCP by at least two pH units, creating an approximately 100-to-1 distribution of charged and uncharged species (Olsen and Davis, 1990). Charge repulsion of the charged species would limit adsorption and the charged species would remain in solution with soil moisture. The low vapor pressure and Henry's Law constant of PCP also indicate that very little volatilization would occur when exposed to air.

Non-chlorinated simple phenol, however, exhibits many nearly opposite characteristics. Its relatively high vapor pressure and low log K_{ow} and K_{oc} indicate that simple phenol would be subject to volatilization and would not strongly sorb to soil or organic matter. The high solubility and low Henry's constant values for simple phenol indicate a high affinity for aqueous solution. If moisture were present in soils contaminated with phenols, as is often the case at this site, then simple phenols would tend to be concentrated in soil moisture, not the soil itself.

6.2.2.2 Surface Water Persistence

In surface water, the chlorinated phenols would be expected to sorb strongly to suspended solids due to high K_{ow} and low solubility values. However, the literature indicates that this is only the case under acidic conditions (pH less than the pKa) (Olsen and Davis, 1990). At the American Creosote site, the pH of ground and surface waters exceeds the pKa of pentachlorophenol (PCP) by at least two pH units. This situation would produce an approximate ratio of 100-to-1 of charged to uncharged species. Uncharged PCP would exhibit the strong tendency toward adsorption that would be expected from PCP's log K_{ow} and K_{oc} values. However, charged species of PCP remain in solution due to charge repulsion. Therefore, a high percentage of the PCP entering the surface water at the American Creosote site would remain in solution, and would be subject to biodegradation, oxidation, and photolysis. Degradation of PCP in solution would determine persistence in surface water at this site. Factors such as oxygenation, amount of sunlight, and presence of an acclimated microbial population would determine the rate of PCP degradation.

The non-chlorinated phenols demonstrate a very high solubility in water, while at the same time having a very low pH value. These factors indicate that non-chlorinated phenols would have a tendency to remain in aqueous solution. This would link the persistence of non-chlorinated phenols in surface water at this site with the same degradation conditions that determine the persistence of PCPs; however, non-chlorinated phenols would typically degrade more rapidly than PCP due to their higher biological degradation rates.

6.2.2.3 Groundwater Persistence

The persistence of phenols in groundwater at this site is analogous to the persistence of phenols in surface water as described above. However, due to a lower potential for aeration in groundwater than in surface waters, the relative importance of volatilization in groundwater is reduced.

6.2.3 VOLATILE ORGANIC COMPOUNDS

6.2.3.1 Soils Persistence

The persistence of volatile organics in soils is dependent on both the physical and chemical properties of the volatile organic compounds and soil conditions. The physical and chemical properties of the volatile organic compounds found at this site (benzene, toluene, ethylbenzene, and xylene [BTEX]) are listed in Table 6-1. Low log K_{ow} and K_{oc} values indicate that little adsorption of BTEX compounds occurs. In soils, BTEX compounds would be expected to occur as free-phase products, vapors, and in aqueous solution. High vapor pressures and Henry's Law constant suggest that, in soils exposed to air, BTEX compounds would readily volatilize.

6.2.3.2 Surface Water Persistence

In surface waters, BTEX compounds would be expected to volatilize rapidly from solution, as indicated by relatively high values for Henry's Law constant. The rate of volatilization would be directly proportional to increasing agitation and mixing of surface waters. The low log K_{ow} and K_{oc} values for the BTEX compounds indicate that little adsorption to suspended sediments would occur.

6.2.3.3 Groundwater Persistence

In groundwater, BTEX compounds would be expected to be present as aqueous solutions or as a free product at the air/water interface. In the presence of air, volatilization of BTEX compounds would be expected. However, soil conditions at this site are not conducive to aeration of groundwater, and volatilization would not be expected to any significant degree. Low log K_{oc} and K_{ow} values indicate that very little sorption to the soil matrix would occur.

6.2.3.4 Degradation

The literature indicates that biodegradation is the only significant degradation pathway for the BTEX compounds (Moore and Ramamoorthy, 1984). The rate of degradation is dependent upon oxygenation, moisture content, pH, and the adaptations of the local microorganisms. Optimum conditions are: maximum oxygen saturation, 70-percent soil saturation, pH 7.5, and highly specialized local microorganisms. Oxidation hydrolysis and photo-degradation of these compounds are minimal.

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6.3 CONTAMINANT TRANSPORT

6.3.1 AIR

6.3.1.1 Polycyclic Aromatic Hydrocarbons

PAHs at this site could be transported in the air either through volatilization or by adsorption to particulates and subsequent entrainment by wind. The most likely method of air transport of PAHs at this site would be through wind-borne particulates. Volatilization would occur only in the lower molecular weight PAHs and even then to a limited extent.

6.3.1.2 Phenols

Phenols at this site would be transported in air to a minimal extent by adsorption to wind-borne particulates. The low vapor pressures and Henry's Law constant for all of the phenols present at the site would also limit volatilization in significant proportions.

6.3.1.3 Volatile Organics

The volatile organics at this site would be transported in air by volatilization. Low log K_{ow} and K_{oc} values for these compounds limit their adsorption to wind-borne particulates.

6.3.2 SURFACE WATER

6.3.2.1 Polycyclic Aromatic Hydrocarbons

At this site, PAHs would be transported in surface water along local drainage pathways while adsorbed to suspended sediments. Low molecular weight PAHs would also be transported in aqueous solution to a minimal extent. The distance of transport would be directly correlated to flow velocity and suspended sediment loads. Phase-separated PAHs would flow along surface drainage pathways under the force of gravity, potentially migrating into groundwater through permeable sediments.

6.3.2.2 Phenols

At this site, chlorinated phenols would be transported as dissolved anions in solution. Non-chlorinated phenol also has a tendency to remain in aqueous solution, as evidenced by its low Henry's constant value, and would be transported along surface water drainages until degraded by oxidation, photolysis, or biodegradation.

6.3.2.3 Volatile Organics

At this site, volatile organic compounds would be transported along surface-water drainages until completely volatilized and/or biodegraded.

6.3.3 GROUNDWATER

6.3.3.1 Polycyclic Aromatic Hydrocarbons

At this site, PAHs would be transported (in aqueous solution) in the direction of the hydraulic gradient. The distance of transport would be directly correlated to groundwater flow with a large retardation effect due to sorption/desorption rates. Phase-separated PAHs associated with carrier oils would sink to the confining unit beneath the aquifer and could subsequently flow under the force of gravity down the slope of the confining unit surface.

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6.3.3.2 Phenols

At this site, chlorinated phenols would be transported as dissolved anions. Non-chlorinated phenols would also tend to be transported in aqueous solution as indicated by their very high solubility and low log K_{ow} and K_{oc} values. Transport rates would be dependent on groundwater flow velocity and a very minor retardation factor.

6.3.3.3 Volatile Organics

At this site, volatile compounds would be transported as solutes in groundwater. The rate of transport would be governed by groundwater flow rates with a slight retardation factor due to sorption and desorption.

Section 7.0

7.0 DEVELOPMENT OF ACTION LEVELS

7.1 INTRODUCTION

Action levels are the concentrations of chemicals allowed as residue in various environmental media after remediation. These levels must be both technologically feasible and cost effective. Risk managers develop action levels using several sources of information, including risk-based preliminary remediation goals (PRGs). Generally, risk-based remediation goals are estimated from information presented in the baseline Risk Assessment (RA). Because of the streamlined nature of the RI/FS for the American Creosote site, risk-based PRGs were developed, using EPA guidance, to assist in the preparation of the FS and the RD. Action levels are not based solely on PRGs. Risk managers also take into account the implementability of remediation which is not considered when evaluating health-based risks. This section and the RA, which will be provided under separate cover, focus on remediation goals that are very protective of human health and the environment. A short discussion of current EPA Region VI action levels is included in this section.

The action levels discussed in this section are preliminary in nature and were developed for the purpose of examining remedial alternatives. The levels may be adjusted for the Record of Decision (ROD) upon completion of the site-specific risk assessment.

7.2 POTENTIAL CHEMICALS OF CONCERN

Potential chemicals of concern are chemicals present onsite that may have an effect on human health and the environment. Potential chemicals of concern detected in surface soil and groundwater samples from the site include phenols, polynuclear aromatic hydrocarbons (PAHs), dioxins/furans, and volatile organic compounds. Specific chemicals of concern include cresols, phenol, chlorophenol, dichlorophenol, tetrachlorophenol, pentachlorophenol (PCP), acenaphthene, anthracene, fluoranthene, fluorene, naphthalene, pyrene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(a)-anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indo(1,2,3-c,d)pyrene, 2,3,7,8 tetrachlorodibenzo-p-dioxin equivalents (TCDD), benzene, ethylbenzene, toluene, and xylenes.

Phenolic compounds consist of an aromatic ring and a hydroxyl group. These hydroxyaromatic compounds may have several groups substituted for one or more of the carbon-hydrogen bonds including chlorine groups, nitrogen groups, and methyl groups. Pentachlorophenol and 2,4,6-trichlorophenol are both classified by the EPA as B2 carcinogens. This classification means that the compounds are probable human carcinogens based on sufficient evidence of carcinogenicity in animal studies. The other phenolic compounds identified as potential chemicals of concern may result in noncarcinogenic human health effects upon exposure. At high doses, some phenolic compounds may affect the central nervous system. In animal studies, chronic exposure to some of the phenolic compounds have been shown to have effects on the skin, lungs, liver, spleen, and pancreas in animal studies. Although other phenolic compounds will be considered in the RA, only pentachlorophenol will be considered for development of action levels.

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Polynuclear aromatic hydrocarbons (PAHs) are compounds that consist of two or more fused aromatic rings. Of the over 100 different PAH compounds, only a few have been characterized in terms of their effects on human health and the environment. Some of the PAHs, especially those with four or more aromatic (benzene) rings, have demonstrated carcinogenicity in animal studies. The most thoroughly studied carcinogenic PAH is benzo(a)pyrene. To evaluate the potential carcinogenic risks associated with PAHs, carcinogenic PAHs are compared in potential carcinogenic potency to benzo(a)pyrene. The comparison results in a benzo(a)pyrene equivalency factor that is then used by risk assessors to evaluate potential risks associated with carcinogenic PAHs. In addition to the carcinogenic PAHs, several other PAHs have been shown to have potential toxic effects on the liver and kidneys. Although these effects will be examined in the RA, they will not be considered further in developing action levels as part of this section.

Benzo(a)pyrene equivalents are developed using an EPA Region VI interim policy. Relative potency as determined by EPA is based on a study by Chu and Chen (1984) and on a memorandum from the Office of Toxic Substances to the Office of Emergency and Remedial Response (EPA, 1989a). Relative potencies for PAHs, as developed by Region VI EPA, are as follows:

Compound	Region VI Interim Relative Policy
Benzo(a)pyrene	1.0
Dibenzo(a,h)anthracene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Indo(1,2,3-c,d)pyrene	0.1

Using the PAH equivalency assumes that the effects of PAHs are additive and that noncarcinogenic PAHs do not contribute to carcinogenic effects of the mixture.

Polychlorinated dibenzo-p-dioxins (PCDDs) are a family of 75 congeners. Polychlorinated dibenzo-furans (PCDFs) are a family of 135 compounds. Dioxins and furans are considered together because of their similar toxic effects. These compounds do not occur naturally and are not production organics, although they are produced as contaminants during chemical production. 2,3,7,8-TCDD is the single most potent dioxin congener and the best studied. In addition to causing chloracne, TCDD effects the immune system and may result in birth defects. TCDD is considered carcinogenic by EPA. The EPA has approved a method to assess the carcinogenicity of other dioxin and furan isomers by applying toxicity equivalency factors (TEFs) to the isomers. The concentrations of the isomers are multiplied by the TEF to derive a TCDD equivalent for each sample. These equivalent concentrations are then used to estimate risks. Table 7-1 presents the congeners of dioxins/furans and their respective toxicity equivalency factors.

TABLE 7-1

TOXICITY EQUIVALENCY FACTORS FOR CHLORINATED DIBENZO-P-DIOXINS AND -DIBENZOFURANS[a]

Compound	TEF
Mono, Di, and TriCDDs	0
2,3,7,8-TCDD Other TCDDs	1 0
2,3,7,8 - PeCDD Other PeCDDs	0.5 0
2,3,7,8 - HxCDD Other HxCDDs	0.1 0
2,3,7,8 - HpCDD Other HpCDDs	0.01 0
OCDD	0.001
Mono, Di-, and TriCDFS	0
2,3,7,8 - TCDF Other TCDFs	0.1 0
1,2,3,7,8 - PeCDF 2,3,4,7,8 - PeCDF Other PeCDFs	0.05 0.5 0
2,3,7,8 - HxCDF Other HxCDFs	0.1 0
2,3,7,8 - HpCDF Other HpCDFs	0.01 0
OCDF	0.001

[a] EPA 1989b. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs) and 1989 Update. EPA/625/3-89/016.

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7.3 DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS

Preliminary remediation goals (PRGs) provide long-term targets resulting in residual risks that fully satisfy the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requirements for human health and the environment. These goals are not to be considered cleanup levels as they are based on potential risks to human health with no consideration of feasibility. The PRGs for the American Creosote site were calculated using Risk Assessment Guidance for Superfund: Volume I-Human Health Evaluation Manual, Part B: "Development of Risk Based Preliminary Remediation Goals" (OSWER Directive 9285.7-01B) (RAGS Part B) (EPA, 1991a). The OSWER Directive gives the option of developing preliminary remediation goals using either a residential scenario or an industrial scenario. EPA Region VI elected to develop PRGs for the American Creosote site based on the more conservative residential scenario. Exposure parameters and the derivation of risk equations used to develop the PRGs are the standardized default exposure parameters consistent with OSWER Directive 9285.6-03 (EPA 1991b). If RAGS Part B used default parameters that were not available in the OSWER Directive, references are cited in Part B and in the present discussion as well. It should be remembered that these equations are based on standard default assumptions that may or may not reflect site-specific conditions.

7.3.1 GROUNDWATER PRGS

The equation used to calculate the concentrations based on carcinogenic effects of chemicals in residential water, as stated in the RAGs, Part B (EPA, 1991a) are as follows:

$$TR = \frac{SF_o \ x \ C \ x \ IR_w \ x \ EF \ x \ ED}{BW \ x \ AT \ x \ 365 \ days/yr} + \frac{SF_i \ x \ C \ x \ K \ x \ IR_a \ x \ EF \ x \ ED}{BW \ x \ AT \ x \ 365 \ days/yr}$$

$$= \frac{EF \ x \ ED \ x \ C \ x \ [(SF_o \ x \ IR_w + (SF_i \ x \ K \ x \ IR_a)]}{BW \ x \ AT \ x \ 365 \ days/yr}$$

$$C\ (mg/l;\ risk\text{-}based) = \frac{TR \times BW \times AT \times 365\ days/yr}{EF \times ED \times [SF_i \times K \times IR_a) + SF_o \times IR_w]}$$

Where:

Parameters	Definition (units)	Default Value
C	Chemical concentration in water (mg/L)	--
TR	Target excess individual lifetime cancer risk (unitless)	10^{-6}
SF_i	Inhalation cancer slope factor [$(mg/kg\text{-}day)^{-1}$]	chemical specific
SF_o	Oral cancer slope factor [$(mg/kg\text{-}day)^{-1}$]	chemical specific
BW	Adult body weight (kg)	70 kg
AT	Averaging time (yr)	70 yr
EF	Exposure frequency (days/yr)	350 days/yr
ED	Exposure duration (yr)	30 yr
IR_a	Daily indoor inhalation rate (m^3/day)	15 m^3/day
IR_w	Daily water ingestion rate (R/day)	2 l/day
K	Volatilization factor (unitless)	0.0005 x 1000 l/m^3 (Andelman, 1990)

Using the above default values, the equation for calculating the PRG concentrations can be further reduced to:

$$PRG\ (mg/L) = \frac{1.7 \times 10^{-4}}{2\ (SF_o) + 7.5\ (SF_i)}$$

The equation used to calculate the concentrations of the PRGs based on the noncarcinogenic effects in residential water as stated in RAGS, Part B (EPA, 1991a) are as follows:

$$THI = \frac{C \times IR_w \times EF \times ED}{RfD_o \times BW \times AT \times 365\ days/yr} + \frac{C \times K \times IR_a \times EF \times ED}{RfD_i \times BW \times AT \times 365\ days/yr}$$

$$= \frac{EF \times ED \times C \times [(1/RfD_o \times IR_w) + (1/RfD_i \times K \times IR_a)]}{BW \times AT \times 365\ days/yr}$$

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$$C\ (mg/l) = \frac{THI \times BW \times AT \times 365\ days/yr}{EF \times ED \times [(1/RfD_i \times K \times IR_a) + (1/RfD_o \times IR_w)]}$$

Where:

Parameters	Definition (Units)	Default Value
C	Chemical concentration in water (mg/L)	--
THI	Target hazard index (unitless)	1
RfD_a	Oral chronic reference dose (mg/kg-day)	chemical specific
RfD_i	Inhalation chronic reference dose (mg/kg-day)	chemical specific
BW	Adult body weight (kg)	70 kg
AT	Averaging time (yr)	30 yr
EF	Exposure frequency (days/yr)	350 days/yr
ED	Exposure duration (yr)	30 yr
IR_a	Daily indoor inhalation rate (m^3/day)	15 m^3/day
IR_w	Daily water ingestion rate (l/day)	2 l/day
K	Volatilization factor (unitless)	0.005 x 1000 l/m^3 (Andelman 1990)

Using the above default values, the equation for calculating the PRG concentrations can be further reduced to:

$$PRG = \frac{73}{[7.5/RfDi + 2/RfD_o]}$$

Table 7-2 presents the potential chemicals of concern found in the groundwater at the American Creosote site, as wells as the information necessary to calculate the PRGs as described above. The last column presents the chemical-specific PRGs calculated from the reduced equations shown above.

TABLE 7-2

RISK BASED PRGs FOR GROUNDWATER AT THE AMERICAN CREOSOTE SITE

Chemical	Carcinogenic Weight of Evidence (Source)	Slope Factor Oral/Inhalation (mg/kg-day)$^{-1}$	Reference Dose Oral/Inhalation (mg/kg-day)$^{-1}$	Risk-based Preliminary Remediation Goal (μg/L)
Polynuclear Aromatic Hydrocarbons (Benzo(a)pyrene equivalents)	B_2 (IRIS, 1992)	5.8	NA	0.015
Pentachlorophenol	B_2 (IRIS, 1992)	1.2 x 10^{-1}	NA	0.7
Benzene	A (IRIS, 1992)	2.9 x 10^{-2}/2.9 x 10^{-2}	NA	0.6
Toluene	D (IRIS, 1992)	NC	2 x 10^{-1}/6 x 10^{-1}	3 x 10^{3}
Xylenes	NC	NC	2/8.5 x 10^{-2}	8 x 10^{2}
Ethylbenzenes	NC	NC	1 x 10^{-1}/2.8 x 10^{-1}	1.6 x 10^{3}

NA = Not available
NC = Noncarcinogenic
A = Human Carcinogen
B_2 = Probable Human Carcinogen
D = Not classifiable as to human carcinogenicity

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The equation used to calculate the concentrations based on carcinogenic effects of chemicals in soils as stated in RAGS, Part B (EPA, 1991a) are as follows:

$$TR = \frac{SF_o \; x \; C \; x \; 10^{-6} \; kg/mg \; x \; EF \; x \; IF}{AT \; x \; 365 \; days/yr}$$

$$C = \frac{TR \; x \; AT \; x \; 365 \; days/yr}{SF_o \; x \; 10^{-6} \; kg/mg \; x \; EF \; x \; IF \; soil/adj}$$

Where:

Parameters	Definition (units)	Default Value
C	Chemical concentration in soil (mg/kg)	--
TR	Target excess individual lifetime cancer risk	10^{-6}
SF_o	(unitless)	chemical specific
AT	Oral cancer slope factor [(mg/kg-day)$^{-1}$]	70 yr
EF	Averaging time (yr)	350 days/yr
$IF_{soil/adj}$	Exposure frequency (days/yr)	114 mg-yr/kg-day
	Age-adjusted ingestion factor (mg-yr/kg-day)	(Andelman 1990)

The age-adjusted soil ingestion factor was developed using the following equation as described in RAGS, Part B:

$$If \; soil/adj \; (mg\text{-}yr/kg\text{-}day) = \frac{IR \; soil/age \; 1\text{-}6 \; x \; ED \; age \; 1\text{-}6}{BW \; age \; 1\text{-}6}$$

$$+ \frac{IR \; soil/age \; 7\text{-}31 \; x \; ED \; age \; 7\text{-}31}{BW \; age \; 7\text{-}31}$$

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Where:

Parameter	Definition	Default Value
$IF_{soil/adj}$	Age-adjusted soil ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day
$BW_{age\ 1\text{-}6}$	Average body weight from ages 1-6 (kg)	15 kg
$BW_{age\ 7\text{-}31}$	Average body weight from ages 7-31 (kg)	70 kg
$ED_{age\ 1\text{-}6}$	Exposure duration during ages 1-6 (yr)	6 yr
$ED_{age\ 7\text{-}31}$	Exposure duration during ages 7-31 (yr)	24 yr
$IR_{soil/age\ 1\text{-}6}$	Ingestion rate of soil during ages 1-6 (mg/day)	200 mg/day
$IR_{soil/age\ 7\text{-}31}$	Ingestion rate of soil for all other ages (mg/day)	100 mg/day (Andelman 1990)

Using the above default values, the equation for calculating the PRG concentrations can be further reduced to:

$$PRG = \frac{0.64}{SF_o}$$

The equation used to calculate the concentrations based on non-carcinogenic effects of chemicals in soils as stated in RAGS, Part B (EPA, 1991a) are as follows:

$$THI = \frac{C \times 10^{-6}\ kg/mg \times EF \times IF_{soil_{adj}}}{RfD_o \times AT \times 365\ days/yr}$$

$$C\ (mg/kg;\ risk\text{-}based) = \frac{THI \times AT \times 365\ days/yr}{1/RfD_o \times 10^{-6}\ kg/mg \times EF \times IF_{soil_{adj}}}$$

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Where:

Parameters	Definition (units)	Default Value
C	Chemical concentration in soil (mg/kg)	--
THI	Target hazard index (unitless)	1
RfD_o	Oral chronic reference dose (mg/kg-day)	chemical-specific
AT	Averaging time (yr)	30 yr
EF	Exposure frequency (days/yr)	350 days/yr
$IF_{soil/adj}$	Age-adjusted ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day

Using the above default values, the equation for calculating the PRG concentrations can be further reduced to:

$$PRG = 2.75 \times 10^5 \ (RfD_o)$$

Table 7-3 presents the PRGs for soils calculated using the above default formulas.

TABLE 7-3

RISK BASED PRGS FOR SOILS AT THE AMERICAN CREOSOTE SITE

Chemical	Carcinogenic Weight of Evidence (Source)	Slope Factor Oral $(mg/kg\text{-}day)^{-1}$	Reference Dose Oral (mg/kg-day)	Risk-based Preliminary Remediation Goal (mg/kg)
Polynuclear Aromatic Hydrocarbons (benzo(a)pyrene equivalents)	B2 (IRIS, 1992)	5.8	NA	0.11
Pentachlorophenol	B2 (IRIS, 1992)	1.2×10^{-1}	3×10^{-2}	5
TCDD Equivalents	B2 (HEAST)	1.5×10^{5}	NA	4×10^{-6}

NA = Not available
B_2 = Probable human carcinogen

7.3.2 SEDIMENT PRGS

To develop risk-based PRGs for potential chemicals of concern in sediment, it was assumed that sediments, were ingested and that chemicals were absorbed through dermal contact with sediments. In accordance with EPA guidance it is inappropriate to use the oral slope factor to evaluate risks associated with dermal exposure for compounds such as benzo(a)pyrene which cause skin cancer through direct action. Because the carcinogenic effects of dermal exposure to PAHs are not considered quantitatively the risk based PRG may not be conservative.

Assumptions used to develop the ingestion scenario, and dermal contact scenario where appropriate, for sediments in the creek were recommended by EPA Region VI and are as follows:

Parameter	Definition	Default Value
IR	Ingestion rate (mg/day)	50
SA	Surface area (cm^2)	4,538
EF	Exposure frequency (days/yr)	39
ED	Exposure duration (yrs)	9
BW	Body weight (kg)	70
AT	Averaging time (days)	
	carcinogenic	25,550
R	Target excess individual lifetime cancer risk	10^{-6}
ABS	Absorption rate	chemical specific
	pentachlorophenol	0.5

Using the assumptions listed above, a concentration of pentachlorophenol of approximately 20 mg/kg would result in an increased individual lifetime cancer risk of 10^{-6} when considering both oral and dermal exposure to sediments. Using the same assumptions, a concentration of benzo(a)pyrene equivalents of approximately 20 mg/kg would result in an increased individual lifetime cancer risk of 10^{-6} when considering only oral exposure to sediments.

7.4 HISTORICAL RISK-MANAGEMENT DECISIONS

EPA Region VI has investigated and developed Records of Decision (RODs) for many wood-treating facilities. Experience at previous sites has led to the development of remediation goals for chemicals that commonly occur at wood-treatment facilities. Because PAHs are found together as contaminants of concern, Region VI has determined that by establishing a remediation goal of 100 mg/kg total PAH, the benzo(a)pyrene equivalents are remediated to acceptable levels. This remediation goal is based on the assumption that benzo(a)pyrene equivalents represent only a minor portion of total PAHs present onsite. Additionally, EPA Region VI has determined that phenols are colocated with PCP, and remediation of soils to 5 mg/kg PCP would remediate other phenols in soils to acceptable risk levels for all phenols. Finally, based on information from the Centers for Disease Control (CDC), EPA Region VI has determined that subsurface soils containing concentrations of 2,3,7,8-TCDD equivalents not exceeding 10 ppb should not pose a significant health hazard if covered with 12 inches of clean soil (CDC, 1987).

The remediation goals for dioxins/furans are based on TCDD equivalency factors. The following recommendations were provided by the Director of the Centers for Disease Control in a memorandum dated May 8, 1987: For residential sites where TCDD equivalents exceed 1 ppb in surface soils, the addition of one foot of clean soil will be sufficient. Recreational sites should have two feet of clean soils above soil containing 5-10 ppb TCDD equivalents; At industrial sites in areas where worker contact to contaminated soil does not occur, dioxin levels up to 20 ppb would be acceptable.

7.5 SUMMARY

To ensure the streamlined nature of the Remedial Investigation/Feasibility Study for the American Creosote site, preliminary action levels were developed. These preliminary action levels may be adjusted for the ROD upon completion of the site-specific risk assessment. The action levels presently considered by EPA Region VI are soil level of 100 mg/kg for total PAHs, 5 mg/kg PCP and 10 ppb TCDD if covered by 12 inches of soil. Groundwater preliminary action levels are based on Maximum Contaminant Levels and will be discussed in Section 9.0. Risk-based preliminary remediation goals for sediments were developed for both benzo(a)pyrene equivalents and PCP and the resulting concentration was approximately 20 mg/kg for both potential chemicals of concern.

Section 8.0

8.0 SUMMARY OF RI RESULTS

Sources and areas of environmental contamination at the American Creosote proposed NPL site have been identified based on the evaluation of historical information such as aerial photographs, and the analysis of data from the current and previous site investigations.

Contamination by organic compounds has been detected in surface and subsurface soils, surface water and sediments, and in groundwater. Primary contaminants detected are:

- Polynuclear Aromatic Hydrocarbons (PAHs) – including naphthalene, phenanthrene, fluorene, anthracene, benzo[a]pyrene, and others
- Volatile Organic Compounds (VOCs) – particularly benzene, ethyl benzene, toluene, and xylenes
- Phenols – including pentachlorophenol, phenol, 2,3,4,6-tetrachlorophenol, 2,3,5,6-trichlorophenol, and cresols.

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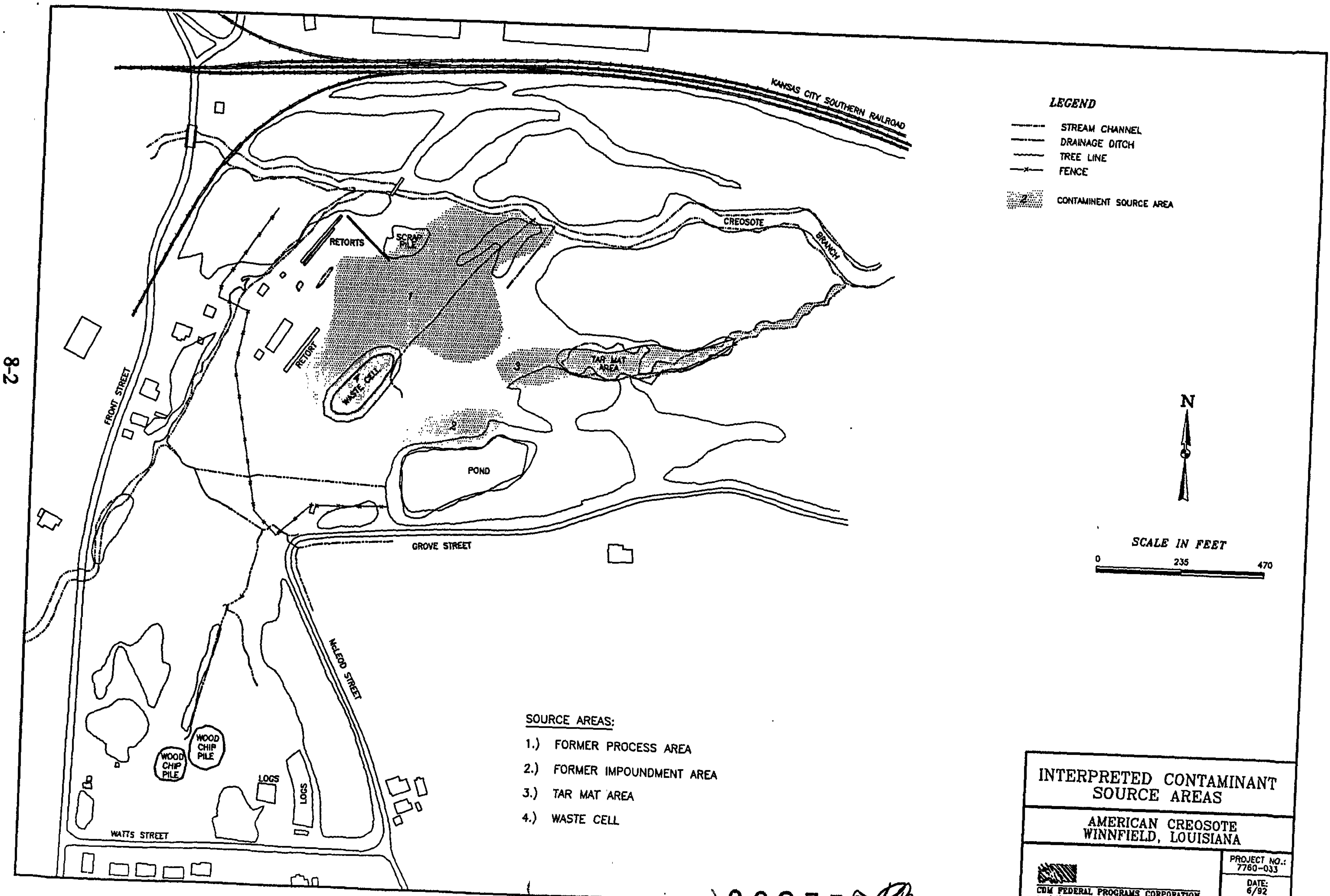
Dioxins/furans, pesticides, and metals were detected in samples collected onsite but were found less consistently or were at generally low concentrations compared to the above mentioned contaminants. The sources of the primary organic contaminants as well as the dioxins/furans are the mixtures of creosote (a coal tar distillate), petroleum, and pentachlorophenol used as wood preservatives during site operations.

Some portions of the site are more heavily contaminated than others and can be considered as source areas or points of release. These source areas, identified on the basis of historical aerial photographs, visual evidence, and analytical laboratory data, are illustrated on Figure 8–1 and are described below. Site history is discussed in Section 1.0.

- The former process area – This is the area where wood preservatives were stored and wood-treating operations occurred. It also includes the drainage area immediately to the north between the process area and Creosote Branch. Surface and subsurface



SOURCE AREAS:

1.) FORMER PROCESS AREA
2.) FORMER IMPOUNDMENT AREA
3.) TAR MAT AREA
4.) WASTE CELL

INTERPRETED CONTAMINANT SOURCE AREAS

AMERICAN CREOSOTE
WINNFIELD, LOUISIANA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PROJECT NO.: 7760-033
DATE: 6/92
FIGURE NO.: 8-1

contamination in this area is probably the result of surface spills of wood-preservative solutions from storage tanks and piping, and spills or discharges of waste fluids from retorts or containment areas.

- The former impoundment area – Based on interpretation of historical aerial photographs, four impoundments were operated at various times in an area east of the process area. These impoundments were used to hold waste fluids, generated as a result of the wood-treating process, including waste preservatives, tree sap, and water derived from moisture in the wood. Fluids disposed of in these impoundments migrated to underlying soils and groundwater. Evidence gathered during subsurface investigations indicates that the impoundments were closed by backfilling with bark and wood chips to absorb fluids, followed by burial with native soils.

- The tar mat area – This area lies along a natural drainage immediately east of the former process area. Runoff, spills, and possibly discharges from the process area and the impoundment area flowed through the tar mat area for much of the site's 80-year operational history. Historical aerial photographs taken in 1973 reveal the first appearance of the extensive black layer which characterizes the tar mat. A discharge from an impoundment may have created this feature sometime between 1970 and 1973.

- The waste cell – The waste cell immediately south of the former process area was constructed during the 1989 EPA removal action at the site, and occupies the location of former Impoundment 3. The waste cell contains sludges and contaminated soils from the former process area which were stabilized by the EPA using a combination of rice hulls and fly ash. Polyethylene sheeting was used as a liner material both above and below the stabilized wastes. Maximum thickness of the waste materials in the cell is about 20 feet. However, boreholes drilled through the lower liner continued to encounter grossly contaminated material below this depth.

Surface soil sampling results from the current and previous investigations at the American Creosote site demonstrate that the above-described source areas are also the portions of the site with the highest concentrations of surficial contaminants (Section 4.3). These analytical data support visual evidence of the distribution of contaminants in surface soils. However, significant levels of some contaminants, particularly PAHs, were detected in surface soil samples which did not appear contaminated. These samples confirmed the presence of surficial contamination as isolated "hot spots" in the southern and northern portions of the site. These "hot spots" appear to be related to previous storage of treated wood in these portions of the site, evident in historical aerial photographs (Figure 1-2). Subsurface soil sampling data from these same locations demonstrate that contaminant concentrations decline rapidly with depth, and are generally much lower than those found in the previously described source areas.

The surface water and sediment investigation provided evidence of the impact site contamination on Creosote Branch (Section 4.3). Sediment contamination is visually apparent along this stream adjacent to the site. Black hydrocarbon fluids can be seen seeping from the stream bank and directly into the water north of the former process area (Figure 4-1). Sediments were found to be visibly stained at nearly every location sampled within and downstream of the site. A second, unrelated source of surface water contamination was tentatively identified approximately one mile downstream of the site. Laboratory analytical data demonstrate that the primary contaminants in Creosote Branch sediment samples are PAHs and phenols. Trace concentrations of phenols were also detected in some water samples from this stream. Creosote Branch sediments upstream of the site were found to contain phenol compounds in concentrations similar to those found in onsite sediment samples. No PAHs or PCP were detected upstream of the site. The source of phenols detected upstream of the site is unknown but the data may indicate an offsite source. Surface water and sediment samples collected from the onsite fire protection pond contained 2,3,4,6-tetrachlorophenol at 140 μg/kg and 62 μg/kg, respectively, at this location.

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Subsurface soils beneath much of the north-central portion of the site are contaminated with phenols, PAHs, and to a lesser extent, volatile organic compounds (Section 4.4.3). Gross subsurface soil contamination generally coincides with the source areas depicted in Figure 8-1. Subsurface soil adjacent to these areas is typically contaminated to a lesser degree.

A deep boring, BH-16, was drilled immediately north of the former process area, considered to be one of the most contaminated portions of the site. Visual evidence of contamination was noted to a depth of 40 feet in this borehole. Laboratory data confirmed the presence of contamination at 37 feet while no contaminants were detected the a sample collected at 47 feet. Subsurface soil contamination was also detected by analytical methods in aquifer materials collected from deep wells installed at the site at depths exceeding 50 feet. Concentrations at these depths were significantly lower than those detected in shallow subsurface soils. Contaminants present at depths exceeding 50 feet consisted primarily of phenols with little or no PAHs. Notably, these contaminants were present in similar concentrations in subsurface soils both upgradient and downgradient of the source areas based on current groundwater flow conditions. While these data might imply an upgradient source offsite, the possibility of historical changes in groundwater flow directions or sample cross–contamination cannot be ruled out.

Maps were constructed to illustrate the horizontal and vertical extent of subsurface soil contamination at the site based on visual evidence and/or analytical results (Figure 4-5, 4-6, and 4-7). Based on these maps, the estimated volume of grossly contaminated subsurface soils within 10 feet of the surface is 106,000 cubic yards. The total volume of contaminated subsurface soils is estimated to be 269,000 cubic yards.

Groundwater samples collected from monitoring wells constructed onsite confirm gross contamination by PAHs within the source areas illustrated in Figure 8–1 (see Section 4.5.3). Additionally, LNAPLs and DNAPLs were observed during development, purging, and sampling of MW-4 and MW-6. These shallow wells are located north of the former process area and near the former impoundment area, respectively. As noted earlier, drilling logs from BH-16 indicate that DNAPLs are present to a depth of 40 feet north of the former process area. Soil and groundwater samples collected below this depth contained no detectable organic contamination. A map was developed illustrating the estimated areal extent of groundwater contamination at the site (Figure 4-9). Samples collected from the Red Hill water supply well one mile from the site demonstrated no impact by site contaminants.

A site-specific risk assessment based on RI findings will be issued under separate cover. Section 7.0 presents preliminary action criteria to be used in the interim for conceptual remedy evaluation. These action criteria may change in the final risk assessment. The action criteria currently considered by EPA Region VI are soil levels of 100 mg/kg for total PAHs, 5 mg/kg PCP, and 100 ppb TCDD equivalent concentration assuming a 12 inch cover of clean soil. Groundwater preliminary action criteria are based on Maximum Contaminant Levels established under the Safe Drinking Water Act. Risk-based preliminary remediation goals developed for benzo(a)pyrene equivalents and PCP in sediments are 20 mg/kg for each.

Laboratory analytical data presented and interpreted in this report have been subject to varying levels of quality control (QC) review (see Section 5.0). Data generated under the EPA CLP Quick-Turnaround Method (QTM) have been electronically validated using computer software created for this purpose. Description of the sampling results presented in this report does not differentiate between data considered as acceptable, estimated, or rejected as a result of the validation. However, appropriate qualifying flags have been added to the summary tables provided. The SAS data in this report have not yet received a detailed validation by EPA. Notwithstanding, the data generally coincide with visual observations, historical site information, and CDM's knowledge of geologic and hydrologic conditions at the site. Thus, the data are therefore considered to represent the site conditions to the extent required for selection of a conceptual site remedy.

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