REMEDIATION SYSTEM EVALUATION

BAYOU BONFOUCA SUPERFUND SITE
SLIDELL, LOUISIANA

Report of the Remediation System Evaluation,
Site Visit Conducted at the Bayou Bonfouca Superfund Site
February 20-21, 2001

Final Report Submitted to Region 6
June 29, 2001

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) and the United States Army Corps of Engineers (USACE) for the U.S. Environmental Protection Agency (U.S. EPA). Work conducted by GeoTrans, including preparation of this report, was performed under Dynamac Contract No. 68-C-99-256, Subcontract No. 91517. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This document (EPA 542-R-02-008f) may be downloaded from EPA's Technology Innovation Office website at www.epa.gov/tio or www.cluin.org/rse.

EXECUTIVE SUMMARY

The 54 acre Bayou Bonfouca Superfund Site, located at the western edge of Slidell, Louisiana, is impacted by creosote contamination from a wood-treating plant that operated between 1872 and1970. Surface water bordering the site on the downgradient sides also was affected by creosote. Source removal operations costing approximately $140 million began in November 1993 and were completed in July 1995. These operations included excavation of the plant process area, dredging of the bayou and Eastern Drainage Channel, and onsite incineration and storage of the recovered materials. A pump-and-treat system, initially installed in July 1991 and modified between 1997 and 2000, remains at the site to reduce or eliminate the potential for ingestion of carcinogens in groundwater and control the migration of polyaromatic hydrocarbon (PAH) contamination in the Shallow Artesian Aquifer.

During the site visit for the Remediation System Evaluation (RSE), the site managers indicated that their primary focus has been to remove the non-aqueous phase liquid (NAPL) to the extent practicable, although it should be noted that one of the three extraction well arrays, while designed to potentially remove freephase product, is operated primarily for control of dissolved constituents.

This pump-and-treat system, consisting of 44 wells that collectively extract approximately 16 gallons of total fluid per minute, collects nearly 6000 gallons of creosote per year in addition to dissolved phase PAHs. After ten years of operation under EPA oversight, this site will be turned over to the State of Louisiana on July 11, 2001. As specified in the National Contigency Plan (NCP) and the Superfund State Contract, the State is required to continue O&M activities at the site for a minimum of 30 years during which time the EPA will continue to provide regulatory oversight.

The Remediation System Evaluation (RSE) team found a smoothly running treatment system and an extremely well-operated and maintained site. The following recommendations are suggested to improve system effectiveness:

- Containment of the free and dissolved phase contamination has not been rigorously evaluated at the site and may in fact be impossible to evaluate and/or achieve because of the extent of the contaminant plumes, the transient nature of pumping, and the limitation of extraction rates that are implemented in order to control subsidence. Lack of containment would be inconsistent with the ROD objective to "control the migration of PAH contamination in the shallow artesian aquifer and other aquifers". An expanded groundwater monitoring program with additional monitoring wells is strongly recommended to help evaluate containment, delineate the plume, and determine cleanup progress over time. Suggestions are provided for locations of additional wells; however, it should be noted that while the recommended sampling can help evaluate capture, it is not sufficient to determine if the remedy, especially that portion addressing the offsite plume, is consistent with the ROD objective of controlling contaminant migration.

- Because of the potential for site contaminants to discharge from the subsurface to the bayou over time, the RSE team recommends that the site managers review the State sampling program for surface water, benthics, and fish to determine 1) the effectiveness of this sampling program in detecting site-related contamination and 2) the effectiveness of the remedial action in limiting migration of site-related contaminants into the bayou. In addition, the RSE team recommends that "no swimming" signs be displayed at appropriate locations along the bayou to indicate the current swimming advisory posed on the State website (http://www.deq.state.la.us/surveillance/mercury/fishadvi.htm).

These recommendations might require approximately $15,000 in capital costs and might increase annual costs by approximately $6,500 per year.

The following recommendations are suggested to reduce life-cycle costs:

- The sampling of contaminants in four extraction wells can be eliminated without sacrificing effectiveness as this current sampling program does not delineate the plume or reveal the progress toward cleanup (potential savings of $10,800 per year).

- The plant operator should reinvestigate the recycling of recovered creosote which could save disposal costs of $22,600 annually. Obstacles may include meeting product specifications and/or reluctance to take material from a Superfund site; however, the option should nevertheless be pursued to see if the obstacles can be overcome. Indemnification of the facility that takes the material or incentives may help avoid these obstacles.

These savings could offset the extra costs associated with recommendations to improve system effectiveness.

Finally, the RSE revealed that the ROD does not provide a clear exit strategy. Given that the ROD stipulates cleanup with the pump-and-treat system to the lowest technically feasible limit, consideration should be given to the fate of the system when the recovery rate of NAPL contamination is significantly and consistently lower than the present rate. Even with minimal recovery of freephase product, it is likely that NAPL remaining in the subsurface could serve as continuing source of dissolved phase contamination, and the system may or may not need to continue operating to contain this dissolved phase plume.

A summary of recommendations, including estimated costs and/or savings associated with those recommendations is presented in Section 7.0 of the report.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump-and-treat systems at Superfund sites that are “Fund-lead” (i.e., financed by USEPA). RSEs are to be conducted for up to two systems in each EPA Region with the exception of Regions 4 and 5, which already had similar evaluations in a pilot project.

The following organizations are implementing this project.

Organization	Key Contact	Contact Information
USEPA Technology Innovation Office (USEPA TIO)	Kathy Yager	2890 Woodbridge Ave. Bldg. 18 Edison, NJ 08837 (732) 321-6738 Fax: (732) 321-4484 yager.kathleen@epa.gov
USEPA Office of Emergency and Remedial Response (OERR)	Paul Nadeau	1200 Pennsylvania Avenue, NW Washington, DC 20460 Mail Code 5201G phone: 703-603-8794 fax: 703-603-9112 nadeau.paul@epa.gov
GeoTrans, Inc. (Contractor to USEPA TIO)	Rob Greenwald	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728 (732) 409-0344 Fax: (732) 409-3020 rgreenwald@geotransinc.com
Army Corp of Engineers: Hazardous, Toxic, and Radioactive Waste Center of Expertise (USACE HTRW CX)	Dave Becker	12565 W. Center Road Omaha, NE 68144-3869 (402) 697-2655 Fax: (402) 691-2673 dave.j.becker@nwd02.usace.army.mil

The project team is grateful for the help provided by the following EPA Project Liaisons.

Region1	Darryl Luce and Larry Brill	**Region 6**	Vincent Malott
Region 2	Diana Cutt	**Region 7**	Mary Peterson
Region 3	Kathy Davies	**Region 8**	Armando Saenz and Richard Muza
Region 4	Kay Wischkaemper	**Region 9**	Herb Levine
Region 5	Dion Novak	**Region 10**	Bernie Zavala

They were vital in selecting the Fund-lead P&T systems to be evaluated and facilitating communication between the project team and the Remedial Project Managers (RPM's).

TABLE OF CONTENTS

List of Tables

List of Figures

1.0 INTRODUCTION

1.1 PURPOSE

In the *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy, dated July 7,2000*, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead pump-and-treat systems. To fulfill this commitment, the US Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR), through a nationwide project, is assisting the ten EPA Regions in evaluating their Fund-lead operating pump-and-treat systems. This nationwide project is a continuation of a demonstration project in which the Fund-lead pump-and-treat systems in Regions 4 and 5 were screened and two sites from each of the two Regions were evaluated. It is also part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems.

This nationwide project identifies all Fund-lead pump-and-treat systems in EPA Regions 1 through 3 and 6 through 10, collects and reports baseline cost and performance data, and evaluates up to two sites per Region. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the United States Army Corps of Engineers (USACE), using a process called a Remediation System Evaluation (RSE), which was developed by USACE. The RSE process is meant to evaluate performance and effectiveness (as required under the NCP, i.e., and “five-year" review), identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and an exit strategy, and verify adequate maintenance of Government owned equipment.

The Bayou Bonfouca Superfund Site was chosen based on initial screening of the pump-and-treat systems managed by USEPA Region 6 and discussions with the Project Liaison for that Region. This site has relatively high operation costs and a long projected operating life relative to other Fund-lead P&T systems in the Region. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

A report on the overall results from the RSEs conducted at Bayou Bonfouca and other Fund-lead P&T systems throughout the nation will also be prepared and will identify lessons learned and typical costs savings.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Frank Bales, Chemical Engineer, USACE, Kansas City District
Rob Greenwald, Hydrogeologist, GeoTrans, Inc.
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

1.3 DOCUMENTS REVIEWED

Author	Date	Title/Description
US EPA	3/31/1987	Record of Decision, Bayou Bonfouca Superfund Site, Slidell, LA, March 31, 1987
US EPA	2/5/1990	Explanation of Significant Differences
USACE, Kansas City District	9/1990	Section 01810 Groundwater Operation and Maintenance
M.C. Anthon Waterwell Contractor	1990	Well installation logs. Well no 2-1 through 2-23
M.C. Anthon Waterwell Contractor	1990	Well installation logs. Well no SM-1 through SM-9
US EPA	7/20/1995	Amendment to the Record of Decision, Bayou Bonfouca Superfund Site, Slidell, LA, July 1995
US EPA	9/1996	Groundwater Remedial Action, Five-Year Review, Bayou Bonfouca Superfund Site, Slidell, LA
CH2M Hill	9/29/1997	Response Action Contract, US EPA Regioin 6, Performance Evaluation Report for Shallow Artesian Aquifer Remediation
US EPA	9/30/1997	Preliminary Close Out Report, Bayou Bonfouca Superfund Site, Slidell, LA
USACE, Tulsa and New Orleans Districts	12/1999	95% Design Submittal, Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana
IT Corporation	12/2000	Bayou Bonfouca Groundwater Remediation Monthly Operational Report, November 1, 2000 through November 30, 2000

IT Corporation	12/2000	Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, LA, Draft Final Report
IT Corporation	1/2001	Bayou Bonfouca Groundwater Remediation Monthly Operational Report, December 1, 2000 through December 31, 2000
??	??	Daily Maintenance Checklist

1.4 PERSONS CONTACTED

The following individuals were presetn for the site visit:

Lee Guillory, Construction Manager, USACE, New Orleans District
Jim Montegut, Project Engineer, USACE New Orleans District
Alan Gradet, Project Manager, The IT Group
Rick Tibbs, Plant Operator, The IT Group
Rich Johnson, Louisiana Department of Environmental Quality
Katrina Coltrain, RPM, EPA Region 6

Vincent Malott, EPA Region 6, served as the project liaison for the Region.

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The site is located off West Hall Avenue in Slidell, Louisiana, which is approximately 50 miles northeast of New Orleans. The site occupies about 54 acres and is bounded by Bayou Bonfouca to the south, drainage channels to the east and west, and West Hall Avenue to the north. Lake Ponchartrain is approximately 7.5 miles downstream of the site. Zones of free and dissolved phase creosote have been observed and are being extracted from the Shallow Artesian Aquifer below the site and below private property on the opposite shore of the bayou. The site layout is shown on Figure 1-1 which illustrates estimated zones of contamination.

1.5.2 POTENTIAL SOURCES

The Bayou Bonfouca Superfund Site addresses contamination resulting from a creosote works facility that operated from 1872 to 1970 when a fire destroyed the plant. Numerous spills of creosote onto the plant property and into the bayou occurred through the years of operation, and a large spill occurred with the fire in 1970. The site remedy included dredging and onsite incineration of the contaminated sediments of the bayou, and extraction and treatment of the contaminated groundwater. Creosote is present in the groundwater in the former process area due to previous handling processes that likely included drip pads, wastewater lagoons, storage and application areas. Creosote was also discharged to the Eastern and Western Drainage Channels and NAPL now exists in the groundwater to the west of the Bayou. Based on site investigation, both onsite and offsite areas have enough NAPL present to warrant pumping. Three additional areas of dissolved and free phase creosote (see Figure 1-3 of the 1997 Performance Evaluation Report) were located in the surficial water bearing zone during site activities. Creosote is not being removed from these areas due to lesser volumes.

1.5.3 HYDROGEOLOGIC SETTING

Groundwater occurs in perched water tables in surficial sediments (2 to 9 feet in thickness), due to infiltration from rainfall, and permanently in four other distinct zones: the upper cohesive unit (10 to 20 feet in thickness), Shallow Artesian Aquifer (9 to 16 feet in thickness), lower cohesive unit (8 to 28 feet in thickness), and Deep Artesian Aquifer (more than 10 feet in thickness). Materials range from clay in the cohesive units to silt and medium-grained sand in the aquifers. The cohesive units function as aquitards due to their reduced permeabilities and groundwater flow occurs through the Shallow and Deep Artesian Aquifers toward the bayou. Without pumping, the water table is generally within 10 feet of the surface and varies up to a foot with tidal fluctuations in the bayou. A cross section showing the stratigraphy is presented in Figure 1-2. The majority of the free and dissolved phase creosote occurs in the Shallow Artesian Aquifer, which has reported hydraulic conductivities ranging from approximately 1 to 20 feet per day. Groundwater velocities in the Shallow Artesian Aquifer are estimated at 7 to 35 feet per year toward the bayou and drainage channels.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

Free and dissolved phase creosote occurs in the Shallow Artesian Aquifer directly below the process area, adjacent to the eastern drainage channel, and across the bayou underneath private property. The estimated zones of contamination are shown in Figure 1-1. Sampling for PAHs to the east of the property has not likely occurred since the initial Remedial Investigation. Also, because the monitoring and extraction wells in the offsite plume to the west of the bayou are located for creosote removal, they are not in the position and are not intended to delineate the boundaries of the plume.

During the Remedial Investigation, no contamination was found in the Deep Artesian Aquifer. The current extent of free and dissolved product beneath the bayou is unknown. The dredging and excavation of the bayou that occurred between 1993 and 1995 stopped at a predetermined depth of about 6 inches into the upper cohesive unit or at the depth where the interpolated PAH concentration (from prior investigations) was less than 1,300 ppm. Crushed limestone backfill was then placed in the bayou to return it to its original depth. Sampling of the bayou sediments and water are conducted by the State of Louisiana and is not part of the site activities.

During the Remedial Investigation free and dissolved phase creosote were detected in the surficial water bearing zone at two points along the Western Drainage Channel and at one point downstream along the bayou. These were not addressed in the ROD and are not affected by the treatment system.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The first objective of the pump-and-treat system is to recover free phase creosote from beneath the site in the Shallow Artesian Aquifer by extracting oil bearing groundwater from recovery wells and pumping this contaminated water through the treatment system. A second objective is to recover dissolved and free phase creosote oil from the offsite area across the bayou. As groundwater is extracted, offsite surface subsidence is avoided by maintaining the groundwater elevation at or above 4 feet below mean sea level (-4 feet MSL). Recovered creosote is disposed at a TSD facility. The treated groundwater is discharged to the bayou.

The system is comprised of the following components:

- extraction well Arrays 1a, 2, and 3 (a total of 44 extraction wells)
- treatment building
- collection system piping and underground conduits
- groundwater and free phase treatment system (chelating agent, oil/water separator, solids removal filters, organic removal filter, associated tankage)
- air compressor for plant and recovery pumps
- control system for recovery system and treatment system

2.2 EXTRACTION SYSTEM

The original on-site groundwater remediation system at the Bayou Bonfouca Superfund Site included two networks of extraction wells, Array 1 and Array 2, installed in July of 1991. The location of the Array 1 network was within the landfill location required for the source removal action. Array 1 wells were removed during the soils remedial action. Array 2, which consists of 22 wells, remains in place and is operating. After the 1997 investigation, it was recommended that another array of extraction wells be installed to take the place of Array 1. Array 1a, which consists of 12 wells, was installed in 2000 downgradient of the creosote plume underneath the onsite landfill. Array 3, which consists of 10 wells, was also installed to capture recoverable free phase oil and dissolved phase contaminants in the off-site area across the bayou. All three of the current extraction-well arrays pump from the Shallow Artesian Aquifer. Figure 1-1 shows the locations of the three current extraction-well arrays.

2.3 TREATMENT SYSTEM

The pump-and-treat system treats the extracted groundwater, sand filter backwash water, and stormwater that collects inside the treatment system containment area. Treated water is then discharged to the bayou. The treatment system removes free-phase and dissolved-phase creosote to below established discharge limits.

The system is designed to operate at up to 50 gpm. The average pumping rate from the extraction system is around 15 gpm. The treatment plant operates in a batch mode, treating groundwater and free phase oil at 25 gpm.

Major components of the treatment system include an oil/water separator, filter-feed tank, sand filtration vessels, oleophilic-media filter, granular activated carbon vessels, backwash tank, recovered oil tank, post aeration tank, stormwater sump, air compressors, air dryer system, and air blower.

The treatment system operates in the following manner:

- the extracted groundwater and free phase oil enter the oil/water separator at 16 gpm;
- the recovered oil is stored in a recovery tank and is then disposed off site;
- the water from the oil/water separator discharges to the filter feed tank; and
- in a semi-batch mode, the water in the filter feed tank is pumped at about 25 gpm through the sand filters, oleophilic-media filter, carbon vessels, post aeration tank, and then to the Western Drainage Channel.

2.4 MONITORING SYSTEM

The monitoring program consists of measuring water levels in 10 monitoring wells and sampling of site contaminants in four of the 44 extraction wells. The water levels are measured daily to ensure drawdown does not fall below -4 feet MSL. Of the 10 monitoring wells used for this purpose five are located onsite in various locations and five are located offsite near Array 3. Sampling for site contaminants in the four extraction wells is to determine the concentrations of contaminants in the extracted groundwater.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The goal of the remediation action, as documented in the ROD, is to

- reduce or eliminate the potential for ingestion of carcinogens in groundwater, surface soils, and in the food chain;

- control the migration of PAH contamination in the Shallow Artesian Aquifer and other aquifers; and

- reduce or eliminate the direct contact threat posed by bayou sediments and onsite surficial creosote wastes.

The initial source control action of dredging and excavation primarily addressed the first and last objectives while the current pump-and-treat system is designed to address the first and second objectives. The objectives targeted by the pump-and-treat system could be achieved through containment and/or cleanup of the creosote. The site managers recognize the preference of Superfund for permanent solutions and primarily focus on removing as much free product as possible (although one of the extraction well arrays designed to recovery NAPL primarily operates to control dissolved contamination). It is likely, however, that some NAPL will remain in the subsurface as a continuing source of dissolved phase contamination.

The ROD also mentions that 3.1 ng/L is the drinking water standard for PAHs (unclear if this is for total or individual PAHs) but mentions the groundwater treatment system is, in essence, a pilot study and only will reach a cleanup level that is technically feasible. The target level, however, will be based on the 10^{-4} or 10^{-6} level (presumably cancer risk). The ROD also notes that Bayou Bonfouca falls under the Resource Conservation and Recovery Act (RCRA) and therefore monitoring must continue for 30 years after system shutdown to ensure adequate closure of the site.

3.2 TREATMENT PLANT OPERATION GOALS

The current contract for operations calls for the plant to operate 24 hours per day, seven days a week while treating water from all designated active extraction wells. A plant operator and a maintenance person attend the facility 44 hours per week including visits on weekends and holidays.

3.3 ACTION LEVELS

The ROD states that remedial actions must attain legally applicable or relevant and appropriate Federal and state standards. The effluent or discharge levels reflected by these standards are provided in Table 3-1 for a sample of the contaminants of concern noted at Bayou Bonfouca.

Table 3-1. Required discharge levels for the groundwater treatment system.

Contaminant	Effluent Levels
TOC	35 mg/L
Oil and Grease	15 mg/L
TSS	45 mg/L
Acenapthene	47 ppb
Anthracene	47 ppb
Benzo(a)anthracene	47 ppb
Chrysene	47 ppb
Fluoranthene	54 ppb
Fluorene	47 ppb
Napthalene	47 ppb
Phenanthrene	47 ppb
Pyrene	48 ppb
2,4 Dimethylphenol	47 ppb
Arsenic	0.05 mg/L

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The RSE team found a smoothly running treatment system and an extremely well-operated and maintained site. The Performance Evaluation Report for Shallow Artesian Aquifer Remediation conducted in 1997 provided a thorough review of the site and resulted in tremendous improvements in the system effectiveness. The observations and recommendations given below are not intended to imply a deficiency in the work of either the designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

The extraction system operates smoothly with infrequent shutdowns. Installation of the new controllerless pumps have eliminated the problems previously encountered with the controllers of the original pumps. Occasional freezing during the winter, and extremely low recharge levels cause pumping to be reduced temporarily or shut down. While the extraction rates for each of the arrays can be determined automatically with flow meters, the pumping rates and oil recovery of individual extraction wells cannot be determined automatically. Rather each well may be monitored manually by discharging the pump into a bucket and observing volume of water and oil.

The operator compiles monthly operational reports from monitoring data. These reports include detailed charts on the pumping status for each of the extraction wells, monthly and cumulative volumes of extracted water and oil, groundwater elevations, and laboratory results from water quality sampling.

4.2.1 WATER LEVELS

The contractors have rigorously monitored and controlled drawdown levels near the extraction well arrays to minimize the effect of subsidence on the onsite landfill or private pads adjacent to the site. A minimum groundwater elevation of -4 feet MSL is allowed, and this limit is based on experience of long-term pumping at the site. Pumping at maximum capacity would exceed this level; therefore, only a portion of the wells in each array are pumped at a given time. For example, often odd pumps are run on one day and even pumps are run on the next day. In addition to this cycling, individual pump rates are controlled by adjusting air exhaust rates. Pumping may be shut down or significantly reduced during low periods of rainfall.

4.2.2 CAPTURE ZONES

While monitoring water levels for subsidence is routinely conducted, monitoring to ensure containment of the contaminants of concern is not. During the Performance Evaluation in 1997, simulated potentiometric surfaces were created for a range of conditions using limited available data and modeling. There are no monitoring well clusters placed between known areas of contamination and the bayou; thus, containment of the freephase creosote and dissolved PAHs is not confirmed. Consequently, the operator has no knowledge as to the groundwater levels that must be achieved in order to maintain containment and capture of the plumes.

4.2.3 CONTAMINANT LEVELS

Extraction wells 2-18 through 2-23 are good producers of oil for Array 2. The remaining wells in this array are meant to prevent contaminant migration to the Eastern Drainage Channel. Since the addition of the two new extraction well Arrays (1a and 3) in 2000, oil production has doubled. This is attributed to Array 3, in which all wells are good producers of oil. Array 1a produces almost no oil as expected and is meant to prevent flow of dissolved contamination to the bayou.

Groundwater is only sampled for contaminants from four of the extraction wells and the inlet to the oil water separator. This allows the operator to tabulate recovered contaminants but does not provide information about the extent of the contamination, including whether or not contaminants exist beyond the capture zones of the extraction-well arrays and are migrating toward the drainage channels or the bayou. Furthermore, since the original Remedial Investigation, the bayou water and sediments have not been sampled as part of site activities for PAHs or oil and grease. The State of Louisiana conducts sampling in the bayou, but these data have not been easily accessible to site managers and therefore were not reviewed by the RSE team. Thus, it could not be determined if the bayou is contaminated (with freephase or dissolved product), and if it is, whether the contamination results from current migration from contaminated portions of the subsurface or from residual product left in the bayou after dredging.

4.3 COMPONENT PERFORMANCE

A Performance Evaluation Report for Shallow Artesian Aquifer Remediation was developed and finalized in September 1997. This report thoroughly evaluated the system and its performance. It made several recommendations to enhance operation of the system as well as methods to improve site restoration. These Phase 2 changes were completed in September 2000. The treatment system is simply and effectively designed. The main operator-labor functions are well pump cycling and manual sand filter backwashes (the filters are designed to allow automatic backwashes) and site upkeep. While similar systems are operated with 20 or less hours of attention, the subsidence issue and excellent site maintenance needed and achieved at this location require more time.

The system has effectively met effluent goals reducing total BNA (Base Neutral/Acid extractable organics, which includes the PAHs of concern) levels from 6602 ug/L (prior to the sand filter) to 23.6 ug/L in the December 2000 sample. The arsenic effluent limit of 50 ug/L has also been met with the system reducing influent concentrations of 114 ug/L to non-detect levels in December 2000. Iron concentrations at the site are above commonly used standards. There is no current discharge standard set for iron at this site, but a chelating agent is used to sequester it and prevent coloration of the plant discharge.

4.3.1 WELLS AND PUMPS

The location of extraction-well Arrays 1a, 2, and 3 are shown in Figure 1-1. The recovery wells are not monitored individually to determine the quantity of oil recovered. They are, however, periodically checked, and the plant operator has found that Arrays 2 and 3 are recovering free product and Array 1a is not recovering free product.

4.3.1.1 ARRAY 2

The Array 2 extraction well network was installed in 1991 and has operated continuously since that time. Array 2 extraction pumps were replaced (1999) in order to maintain the operation and reliability of the network over the life of the remediation effort.

The selected pump was a CEE AutoPump Model AP-4/BL Short, which is a submersible air-displacement, controllerless, bottom-loading pump that

- requires a regulated source of compressed air,
- self-adjusts the discharge flow rate automatically to match the well yield,
- uses air only when discharging fluid,
- pumps particles up to 1/8 inch in diameter,
- can operate on contaminated air, and
- can pass 90-weight gear oil without fouling the air valve.

Replacement of the pumps in Array 2 began in September 1999. Redevelopment of each well to remove fine sand that had accumulated in the wells was completed as part of the process of pump replacement. New air regulators, check valves, and exhaust needle valves were also installed with the new pumps. Five of the wells were overdrilled and reinstalled. The remaining structures, piping, vaults, and valving associated with each of the Array 2 wells were not replaced.

4.3.1.2 ARRAY 1A

Array 1a extraction well network is located adjacent to the existing landfill and consists of 12 extraction wells aligned along the southern and western perimeters of the landfill. The Array 1a wells were drilled and completed in March 2000. These wells were completed in the Shallow Artesian Aquifer. The CEE Model AP-4/BL pumps were installed in Array 1a.

The new extraction wells associated with Array 1a were completed below grade in aluminum vaults with locking covers. The construction of wells below existing grade may lead to occasional inundation from sheet flow runoff. The design of the extraction well vaults included a sump and check valve that allows water accumulation in the well vault to flow into the well. Since the extraction wells continually remove fluid, the water is evacuated to the GWTS. The vaults were completed approximately one inch above grade to minimize the infiltration of surface water.

4.3.1.3 ARRAY 3

The Array 3 extraction network is located on private property in the Chamale Cove Subdivision on the western shore of Bayou Bonfouca and consists of ten extraction wells manifolded together in a north-south alignment. The Array 3 wells were drilled and completed in March 2000. These new extraction wells were completed in the Shallow Artesian Aquifer and include the CEE Model AP4/BL pumps. Five additional monitoring wells were installed in the Array 3 area. The purpose of the new monitoring wells was to provide continuous measurement of groundwater levels in support of the subsidence monitoring program. Each monitoring well contains a level transducer to measure water level. The signal is transmitted to the data logger and computer located at the groundwater treatment plant.

The Array 3 well vaults are similar to the Array 1a vaults.

4.3.1.4 SUBSIDENCE

Each monitoring well contains a level indicator that is electronically transmitted to the control system. The control point is set to maintain groundwater elevation at or above -4 feet MSL. The set point of -4 feet MSL is somewhat arbitrary.

4.3.2 AIR COMPRESSORS

Two rotary screw air compressors are used to supply air to extraction well pumps, the pneumatic control valves, and filter air scour. These compressors are water cooled using treated groundwater for the primary heat transfer fluid. Water exiting the carbon vessels is passed through the compressors for cooling. In the event that process water can not adequately cool the compressors, city water is introduced as makeup to-maintain a constant flow rate of 14.5 gpm to the compressors.

Excessive quantities of city water were used prior to increasing the quantity of water being recovered in the three Arrays. The new pumps have increased the quantity of recovered water; thereby reducing the need for make up city water.

4.3.3 OIL/WATER SEPARATOR

Extracted groundwater and free phase creosote is pumped to the oil/water separator from the extraction wells. The influent passes through a surge column to reduce the velocity surges characteristic of pneumatic well pumps so that the flow can be accurately metered. Creosote settles in the oil /water separator hopper, where it is manually pumped on a monthly basis to the recovered oil tank. The oil/water separator is equipped with a floating oil skimmer, but the skimmed oil tank has been removed due to a lack of oil to be skimmed. The collected oil is disposed of at a TSD facility. The system currently operates at about 15 gpm.

Oil is still recovered in significant quantities; therefore, this unit is still vital to plant operations. This unit has been evaluated recently and is functional.

4.3.4 FILTER FEED TANK

Oil/water separator effluent flows by gravity into the sand filter feed tank. This tank serves as a holding basin to supply the filter feed pumps. The tank is equipped with a level controller to monitor fluid inlet and outlet flow rates. The system currently is run in semi-batch mode at a flow rate set by the operator. The current flowrate through the system is about 25 gpm.

4.3.5 SAND FILTERS

From the filter feed tank influent is pumped through one of two sand filter vessels. Only one filter is on line at a time, except during a switch over. These filters remove residual oil and suspended solids that are not removed in the oil/water separator. The sand filter units can be air scoured and backwashed. These operations are fully automated, with the backwash sequence being initiated by a high differential pressure across the filter beds (indicating a fouled filter), by a timer sequence (initially set at once per day), or by manual initiation. Current practice is to manually initiate a backwash three times per week (Monday, Wednesday and Friday).

4.3.6 OLEOPHILIC FILTER

The oleophilic filter media removes residual oil that may pass through the sand filter. The primary purpose of this unit operation is to protect the carbon filters. This filter can be manually backwashed, but no set backwash schedule or criteria have been followed. The filter has not been backwashed and the nonexistent differential of TOC in the influent and effluent of this filter suggest it has been fouled.

The media is scheduled for replacement by USACE and IT Group prior to turnover of the plant to the State of Louisiana. Sampling of the media for effectiveness, potentially with total organic carbon (TOC) measurements, should continue.

4.3.7 GRANULAR ACTIVATED CARBON UNITS

Four granular activated carbon (GAC) vessels (each containing 3,000 pounds) are provided to remove dissolved-phase creosote compounds from the water leaving the oleophilic filter. The GAC vessels can be operated in series or in parallel. Currently, the water travels through three of the vessels in series. Each GAC vessel can be manually backwashed. Backwashing of the GAC vessels removes accumulated solids and biological growth that may decrease the flow rate through the vessels. Effluent from the GAC vessels is routed to a once through cooling system for the air compressors. When the effluent water flow rate is too low to provide adequate cooling to the air compressor, city water is introduced automatically to the cooling water stream. The carbon was replaced in December 1999. Prior to this, the operator estimated that GAC replacement has only been necessary every 3 years. The next scheduled replacement is scheduled to take place before the system is turned over to the State of Louisiana in July 2001.

4.3.8 POST AERATION TANK

After passing through the air compressor cooling coils, the GAC effluent is discharged to the post aeration tank. A blower supplies low-pressure air through a coarse air diffuser to aerate the effluent before discharge. Effluent overflows to the bayou through a gravity discharge line. The post-aeration tank also provides a source of water for backwashing filter vessels. Prior to backwashing, aeration for the post-aeration tank can be discontinued in order to minimize air entrainment and backwash pump cavitation.

4.3.9 BACKWASH TANK

The backwash tank is used to contain the water resulting from backwashing any of the filter vessels. Backwash water stored in this tank is metered into the treatment process upstream of the oil/water separator with the backwash solids pumps. Metering of backwash water can be done manually or through an automatic procedure. As mentioned earlier, it is currently done manually on Mondays, Wednesdays, and Fridays.

4.3.10 RECOVERED AND SKIMMED OIL TANK

The recovered oil tank is used to store "heavy" oil recovered in the oil/water separator. It is equipped with outlets in the tank side wall to allow for removal of water floating on the oil and disposal of a recovered product with a high oil-to-water ratio. On a periodic basis (two to three times per year), the tank is emptied into a tank truck for offsite disposal.

4.3.11 STORMWATER SUMP

The stormwater sump is used primarily for the collection and containment of rainwater until conditions allow for the treatment of this water through the treatment system. In addition, this sump also receives treatment area spills and tank cleanouts and overflows. The stormwater sump pump can be operated either in manual or automatic mode. Automatic mode operates the sump pump by level within the stormwater sump. Manual operation disables the level control. Operation of the sump pump is typically in the automatic mode.

4.3.12 TOTAL ORGANIC CARBON (TOC) SAMPLER

The performance of the groundwater treatment plant is currently monitored on a monthly basis by collecting samples from various points within the treatment process and testing them with a Shimadzu TOC-4000 . Samples are currently collected from the sand filter inlet, oleophilic filter inlet, GAC filter inlet, GAC 80% throughput point, and GAC effluent. The purpose of the TOC monitoring system is to expand the number of sample points, provide automatic on-site testing, and to monitor the groundwater treatment plant performance. The plant operator changes carbon vessels when the TOC at the 80% throughput point measures 76 mg/L (the discharge criteria is 35 mg/L) although no clear guideline was ever instituted. Given that the influent to the carbon units is approximately 35 mg/L, the 76 mg/L action limit will likely never occur.

The automated TOC analysis system includes a sample collection system, a sample manifold box, an automated combustion infrared TOC analyzer, and a spent sample collection and disposal system. The resulting TOC data is recorded and logged in the new data acquisition computer that is also used for the subsidence monitoring program. The analyzer calibrates itself with standards every 40^{th} sample.

4.3.13 AIR DRYER SYSTEM

All air that exits the compressors is dried using a dual column, regenerative air dryer, designed to prevent the accumulation of condensation in the air lines and pneumatic valves.

4.3.14 AIR BLOWER

The air blower delivers air to the post-aeration tank to raise the dissolved oxygen content of the effluent before discharge to the bayou. The amount of air going to the post-aeration tank can be valved to supply more or less air, depending on specific aeration needs.

4.3.15 SEQUESTERING/CHELATING AGENT

In order to minimize iron fouling of the treatment system and reduce coloration of the discharge, a chelating agent is added to the groundwater. A metering pump and associated tankage is located at the end of Array 2. The chelating agent is metered into the influent line to the system. By injecting at the end of Array 2, the agent has plenty of residence time to ensure proper mixing prior to entering any unit operations.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF COSTS

The State of Louisiana is currently preparing a package for bid for the operation and maintenance of this facility; therefore, costs will only be discussed in general terms. Monthly costs are approximately $30,000 to $35,000 (i.e., annual costs of approximately $400,000).

4.4.1 UTILITIES

The current utilities to operate the plant should remain approximately the same for the foreseeable future. By maintaining higher volumes of recovered groundwater, the need for city water should be diminished. Average utility costs are approximately $3,000 per month ($36,000 per year).

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Disposal of recovered oils costs approximately $22,600 annually, and carbon costs approximately $11,500 annually.

4.4.3 LABOR

The plant is currently staffed by a plant operator and maintenance technician (44 hours per week each). Both staff members work Monday through Friday and visually check the system on Saturday and Sunday. Additional project management costs are also incurred.

4.4.4 CHEMICAL ANALYSIS

Chemical analysis is currently only conducted on four recovery wells and not at any of the monitoring wells. The analytical costs for these four samples is approximately $900 per month.

4.4.5 OTHER COSTS

Over $3 million has been spent on upgrading and operating the plant and expanding the extraction system in accordance with the 1997 report recommendations. Upgrades themselves cost approximately $1 million to $1.5 million and have increased plant operations costs and also made the system much more protective.

4.5 RECURRING PROBLEMS OR ISSUES

The upgrade in plant equipment as discussed above has remedied most recurring problems.

4.6 REGULATORY COMPLIANCE

The treatment plant does not exceed the regulatory criteria for treatment and disposal.

4.7 TREATMENT PROCESS EXCURSIONS AND UPSETS, ACCIDENTAL CONTAMINANT/REAGENT RELEASES

Based on information made available to the team, there have been no controlled releases of contaminated water within the facility during operation of the plant. The only mention of a contaminant release referred to an offsite spill by an unknown party in which an unknown constituent traveled through one of the drainage channels or the creek to the bayou. Within a few weeks, the observable effects of the spill had abated.

4.8 SAFETY RECORD

The plant appears to have had an excellent safety record.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

PAH concentrations are only measured in four of the extraction wells; therefore, PAH concentrations in the groundwater are relatively unknown. While the Remedial Investigation noted that there was no contamination of the Deep Artesian Aquifer, PAH concentrations of this formation have not been measured since that initial investigation.

Groundwater from the contaminated Shallow Artesian Aquifer is not used for public consumption near the site. According to the ROD, with the exception of one offsite well at a depth of 100 feet, the seven existing wells sampled during the Remedial Investigation were between 1,000 and 2,300 feet deep. These wells were not contaminated with PAHs and are expected to be unaffected by the site contamination. Thus, the only avenue of human exposure to site related PAHs is through surface water of the drainage channels and the bayou, which receives water from both the surficial deposits and the Shallow Artesian Aquifer. However, the current sampling program cannot indicate if contaminated groundwater is discharging to the surface water.

5.2 SURFACE WATER

Surface water in the area consists of the bayou and the Western and Eastern Drainage Channels. Sampling of the bayou water and sediments is conducted by the State of Louisiana. This sampling is not part of the site activities and is not provided to the site managers for analysis. It is possible that PAHs may currently discharge into the bayou via the groundwater of the Shallow Artesian Aquifer or via the Western Drainage Channel where pockets of PAH contamination were found in the surficial deposits during the Remedial Investigation.

Surface water presents the only current likely human exposure to the site-related PAHs. Two avenues are of particular interest. The first is the use of the bayou for fishing or swimming. The plant operator indicated that people fish there on a regular basis and likely eat what they catch. People were observed on the bulkhead fishing in the bayou near the entrance of the Eastern Drainage Channel the first day of RSE visit. In addition, a “no swimming” advisory is posted on the State website (http://www.deq.state.la.us/surveillance/mercury/fishadvi.htm), but no signs regarding the advisory are posted near the site. The second avenue of possible exposure is through a constructed wetland on the Perkins property along the western boundary of the bayou. This constructed wetland pumps water from the bayou when conditions are dry. No sheen or other visual evidence of contamination was present in this constructed wetland during the RSE visit.

5.3 AIR

Air is an unlikely exposure avenue of PAHs at the site.

5.4 SOILS

The surface contamination identified in the ROD have been removed under previous operable units.

5.5 WETLANDS AND SEDIMENTS

Contaminated sediments in the wetlands surrounding the bayou and the creek to the east of the site were previously excavated. Drain slots are cut into the sheet-pile bulkhead walls every 200 to 300 feet to allow intertidal flow to the existing wetland.

Excavation of the bayou sediments extended to the depth where the interpolated concentration of PAHs was 1,300 ppm. The degree of contamination below this line of interpolation is unknown; however, uncontaminated crushed limestone was backfilled into the bayou to cover the remaining contaminated sediments and to restore the bayou to its original depth. The effect of PAHs on the wetlands in the Western Drainage Channel are unknown as pockets of contamination were found in the surficial deposits along two portions of the channel. These pockets were found during the Remedial Investigation, were not addressed by the source control, and have not been sampled since that initial investigation.

6.0 RECOMMENDATIONS

The Bayou Bonfouca Superfund Site is anticipated to be turned over to the State of Louisiana on July 11, 2001. At the time of the RSE visit, the Louisiana Department of Environmental Quality was preparing the announcement for bids to operate the plant. As a result, cost and cost savings are estimated by the RSE team for the purpose of this report.

The role of the EPA after site turnover was not clearly ascertained during the site visit. The EPA role should be made clear to the site RPM, state regulator, and site contractor before turnover.

6.1 RECOMMENDED STUDIES TO ENSURE EFFECTIVENESS

6.1.1 DELINEATE PLUME AND EVALUATE CAPTURE ZONE OF EXTRACTION WELL ARRAYS

The plume extent and the capture zones of the extraction-well arrays have not accurately been determined. Due to the large extent of NAPL and dissolved phase contamination and the proximity to residences to the west of the bayou, plume delineation may be difficult or impossible. In addition, due to tidal fluctuations and the temporal variation in pumping, the capture zone may be difficult to determine. However, controlling the migration of site-related contaminants in the Shallow Artesian Aquifer and other aquifers is an objective of the ROD, and this control cannot be adequately evaluated without delineation of the contaminant plumes and evaluation of capture provided by the extraction system.

Analysis of the 10 water-level measurements collected for monitoring associated with subsidence control and water-level measurements from other site-related sampling points including the bayou itself would improve the understanding groundwater flow both on and offsite. These measurements could also be used to update the groundwater flow model created as part of the 1997 Performance Evaluation Report.

In addition, sampling of site-related contaminants at multiple sampling points should be used to help delineate portions of the plume and evaluate plume capture. Although these sampling results will not determine the capture zone, trends in contaminant concentrations may help determine if capture is adequate. The 1997 Performance Evaluation Report (Sections 2.4.2 and 6.4.3.2) suggested semi-annual sampling of site-related contaminants in wells F-2, G-2, OW-1B, 1-12, 1-18, C-2, N, and 2-1. The RSE team concurs with this recommendation as many of these wells are well placed for evaluating capture. However, the 2000 System Modifications Report, which documents the implementation of changes recommended by the 1997 Performance Evaluation Report, shows that many if not all of these have been abandoned due to degraded well vaults.

To evaluate capture associated with Arrays 1a and 2, the RSE team recommends installing five new monitoring wells that screen the Shallow Artesian Aquifer. Water levels should be measured in these new wells, and samples should be collected from these new wells semi-annually and analyzed for BNAs. The following locations are suggested (see Figure 1-1 for these recommended locations):

- near the location of abandoned well G-2;
- near the location of abandoned well OW-3B;
- near the location of abandoned well OW-1B;
- approximately 200 feet due east of extraction well 1A-8 (i.e., up to 50 feet east of the edge of the estimated dissolved phase plume);
- and downgradient of abandoned well C-2.

Water levels from these wells should be compared to those from the bayou and the extraction wells. For adequate capture provided by Array 1a and portions of Array 2, these water levels should indicate flow toward the extraction wells and away from the bayou. In addition, for adequate capture provided by Array 1a and portions of Array 2, samples from these wells should indicate consistently decreasing or undetectable concentrations of site-related contaminants. As mentioned in the 1997 Performance Evaluation Report, if NAPL is found in a sample, the volume of NAPL should be recorded and compared to previous findings and lab analysis is not required.

If the locations of these wells are within the site boundaries, installation costs should be approximately $5,000 per well for a total capital cost of $25,000, and analytical costs associated with sampling five wells twice per year should be less than $6,000 per year.

It should be noted that the recommendation adjustments to the monitoring program will not completely delineate the plume or assure capture by Arrays 1a and 2. This program would, however, provide a strong indicator if capture is not provided. Furthermore, this recommended monitoring program does not address the offsite NAPL plume. As this offsite plume is not fully delineated and capture offered by the Array-3 wells has not been analyzed, the remedy is potentially inconsistent with the ROD objective requiring control of migration of PAH contamination Shallow Artesian Aquifer and other aquifers.

6.1.2 SAMPLING OF SURFACE-WATER, SEDIMENT, BENTHICS, AND FISH

The bayou and drainage channels provide the most likely avenues of human exposure to PAHs and other contaminants of concern. Sampling of the bayou water and sediments is conducted by the State of Louisiana, but analysis of this sampling is not part of site activities. Given the use of these waters for public fishing and possible consumption of these fish, a comprehensive analysis of the surface water, sediments, fish, and benthics should be conducted. In addition, the results of this analysis should be used to evaluate the effectiveness of the current pump-and-treat remedy.

EPA Region 6 stated that efforts are currently being planned in coordination with EPA Headquarters to evaluate the effectiveness of the source removal actions conducted in the bayou prior to operation of the pump-and-treat system. While this evaluation would provide a “snap shot” of the extent (if any) of site-related contamination in the bayou, it would not provide the trend in contamination (if any) that would help indicate the effectiveness of the pump-and-treat system of protecting the bayou from migration of subsurface contamination (i.e., over time increasing or steady but significant contaminant concentrations may indicate subsurface migration of contaminants into the bayou).

As a result, it is recommended that the site managers review on an annual basis the sampling conducted by the State of Louisiana. Furthermore, if the State sampling program does not provide sufficient information to evaluate the effectiveness of the pump-and-treat system to protect the bayou from migrating subsurface contamination, additional sampling and analysis may be required as part of the site activities. This is especially important given the use of the bayou for fishing and the possible consumption of those fish.

Finally, in visiting the State of Louisiana website, the RSE team identified a “no swimming” advisory for Bayou Bonfouca; however, no signs indicating this advisory were posted along the bayou near the site. The RSE team recommends such signs be posted.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

6.2.1 ELIMINATE SAMPLING PROGRAM OF CURRENT EXTRACTION WELLS

The quantitative monthly sampling of contaminants from the four extraction wells provides little or no information regarding the extent of the plume or the progress of cleanup beyond the sample of the composite system influent. Therefore, sampling of these wells can be eliminated to reduce costs without further compromising effectiveness. Sampling from the additional monitoring wells mentioned in Recommendation 6.1.3 will provide the necessary information regarding the extent of contamination. Eliminating this monthly sampling of the four extraction wells would save approximately $900 per month or $10,800 per year in analytical costs.

6.2.2 REINVESTIGATE RECYCLING OF COLLECTED CREOSOTE

The plant operator mentioned that he had investigated potential receptors of the collected creosote. This should be reinvestigated. The collected creosote is likely still useable and can be recycled. Obstacles may include meeting product specifications of potentially accepting facilitiesand/or reluctance to take material from a Superfund site. However, the option should nevertheless be pursued to see if the obstacles can be overcome. Indemnification of the facility that takes the material or incentives may help avoid these obstacles. This would reduce the cost of disposal which is estimated at $22,600 annually.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 PERIODIC CHECKS AND REPORTING OF NAPL RECOVERY IN INDIVIDUAL WELLS

The plant operator already conducts qualitative periodic checks of the NAPL recovered from each of the wells. Making these checks quantitative and less frequently would demonstrate the performance of each extraction well over time. At the time of the RSE all extraction wells were cycled on and off at various times. Identifying the extraction wells that produced the most NAPL would help the site managers determine which wells should run continually and which wells can be cycled on and off without sacrificing NAPL recovery. NAPL recovery by pumping from select wells, however, should not be increased if capture is compromised.

6.3.2 MONTHLY EVALUATION OF DATA

Monthly reports are prepared that compile the pumping logs, water and oil recovery, subsidence monitoring, and monthly sampling. Including a short summary of the data that highlights significant parameters would facilitate the reviewing of these reports by EPA and State managers. In addition, writing these summaries may help the operator and/or contractor identify any anomalies or trends in the system operation or performance.

6.3.3 CLARIFY ROLE OF TOC MEASUREMENTS FOR CARBON CHANGE OUT

A Shimadzu TOC-4000 automatically provides TOC measurements at the inlets to the sand filters, oleophilic filter, and primary carbon as well as 80% of the distance through the primary carbon and the effluent. The differential between the last two measurements are used to determine when carbon change out should occur. TOC at the first three measurement points are typically around 35 mg/L and the fourth and fifth are typically near 0 mg/L. The plant operator mentioned he would change the carbon vessels when the fourth measurement reads 76 mg/L. Given that the influent is well below this action level, the carbon will never be switched. This action level should be revisited.

6.3.4 INVESTIGATE INCREASED EXTRACTION RATES

Extraction rates for the three extraction arrays are controlled to maintain groundwater elevation at or above -4 feet MSL to minimize subsidence in the area. During the RSE visit, the site managers indicated that this control level (-4 feet MSL) is somewhat arbitrary. Because this control level reduces the extraction rates below the capacity of the system, it is recommended that the a more relaxed control level be investigated. This can be achieved by conducting consolidation tests of the subsurface soils to determine how much the effective stress can be increased before damaging consolidation occurs. An approximate cost for conducting and interpreting such tests is $30,000. This analysis will include an evaluation as to whether or not oil recovery rates would likely increase with additional pumping. If higher extraction rates could be accomplished without creating subsidence problems, the recovery of NAPL would increase thereby potentially reducing the duration of the current system.

6.4 MODIFICATIONS INTENDED TO GAIN SITE CLOSE-OUT

6.4.1 ESTABLISH EXIT STRATEGY AND CLOSURE CRITERIA

There is no clear exit strategy. The main objectives of the pump-and-treat system are to control the migration of PAH contamination in the Shallow Artesian Aquifer and other aquifers and reduce or eliminate the potential for ingestion of carcinogens in groundwater, surface soils, and shellfish. The ROD recognizes the Clean Water Act levels of 3.1 ng/L for PAHs in drinking water but states, “The technical feasibility of cleaning the groundwater to this level is unknown. The groundwater treatment system currently envisioned will extract and treat to the extent technologically practicable". Thus, there is no clear point at which the pump-and-treat system can be shutdown. Without such a predetermined point, operation may continue long beyond the point of diminishing returns. As such, a clear exit strategy should be developed. This strategy should demonstrate protection of human and ecological health based on data including that obtained from the recommended sampling program that includes surface water, sediment, and additional monitoring wells (Recommendations 6.1.1 and 6.1.2). After continual operation of the current pump-and-treat system, alternative remediation strategies may provide improved protection of human and ecological health at a reduced cost. The performance of the pump-and-treat system and the availability of such strategies should be evaluated on a regular basis to determine the most appropriate time for shutdown of the current system.

7.0 SUMMARY

In general, the RSE team found a smoothly running treatment system and an extremely well-operated and maintained site. The Performance Evaluation Report for Shallow Artesian Aquifer Remedation conducted in 1997 provided a thorough review of the site and resulted in tremendous improvements in the system effectiveness. The observations and recommendations mentioned are not intended to imply a deficiency in the work of either the designers or operators but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations have the obvious benefit of the operational data unavailable to the original designers.

Several recommendations are made to assure system effectiveness, reduce future operations and maintenance costs, improve technical operation, and gain site close out. The recommendations to improve effectiveness include an improving the sampling program to help delineate the plume, evaluate the capture zone of the current extraction well arrays, and determine if surface water and sediments have harmful PAH concentrations. The recommendations for cost reduction include potentially recycling the recovered creosote to eliminate disposal costs, and eliminating laboratory analysis of samples taken monthly from the extraction wells. The recommendations for technical improvement include determining which extraction wells are the most productive NAPL producers, analyzing and summarizing data in the monthly reports, clarifying the role of total organic carbon (TOC) measurements, and investigating potentially higher extraction rates. Finally, development of a clear exit strategy that ensures protection of human and ecological that is based on the new sampling program is advised.

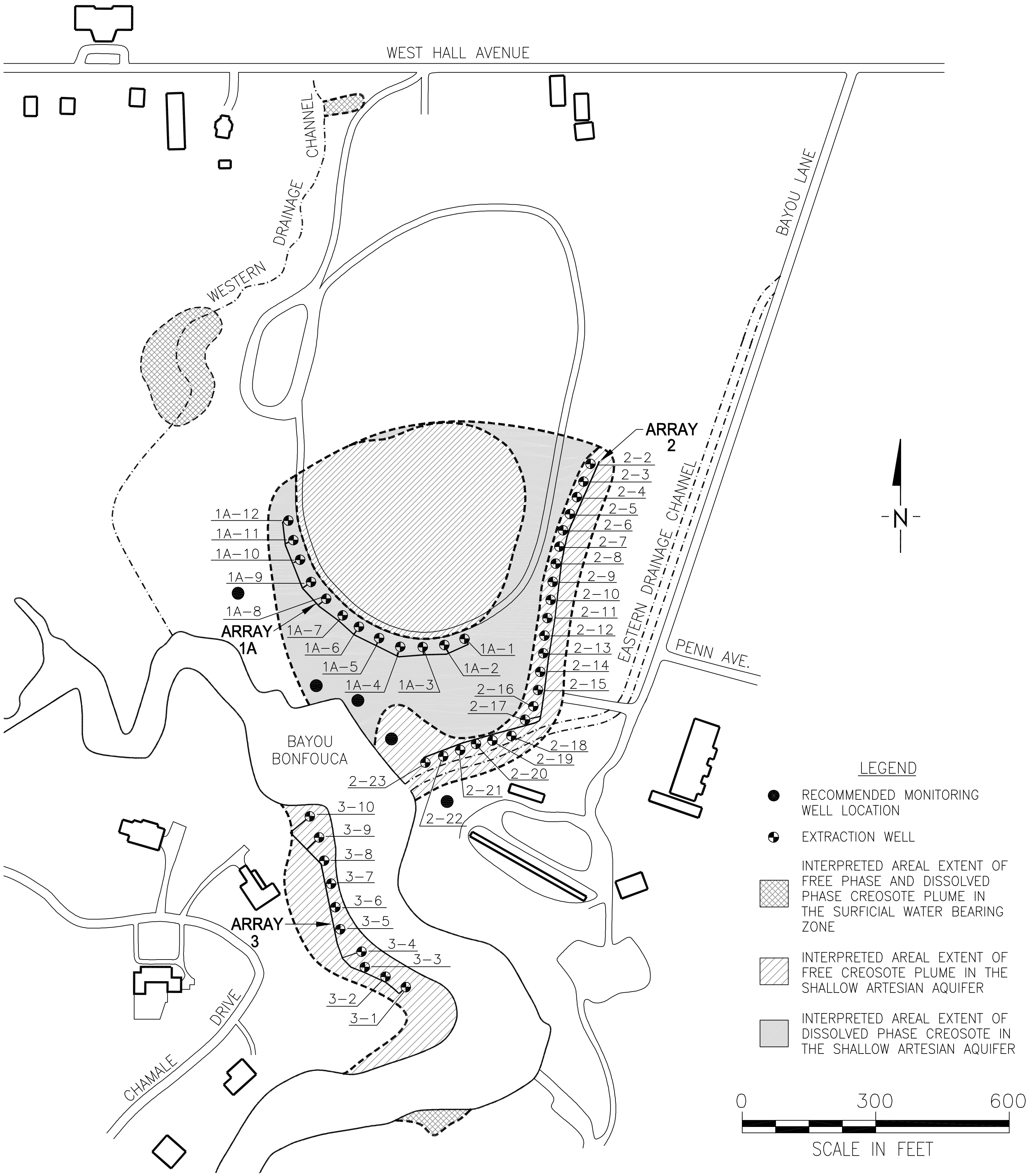
Table 7-1. Cost Summary Table

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Lifecycle Costs*	Lifecycle Costs**
Delineate plume and evaluate capture zone	Effectiveness	$25,000	$6,000	$205,000	$122,000
Review results from current State and future EPA sampling of surface water and sediments	Effectiveness	$0	$500	$15,000	$8,000
Eliminate analysis of samples from four extraction wells	Cost reduction	$0	($10,800)	($324,000)	($174,000)
Recycle Creosote	Cost reduction	$0	($22,600)	($678,000)	($365,000)
Sample each extraction well for NAPL (no lab analysis)	Technical improvement	$0	$0	$0	$0
Monthly Evaluation of Data	Technical improvement	$0	$2,000	$60,000	$32,000
Clarify role of TOC samples	Technical improvement	$0	$0	$0	$0
Investigate effect of higher extraction rates on subsidence	Technical improvement	$30,000	$0	$30,000	$30,000
Develop exit strategy	Gain close out	$50,000	$0	$50,000	$50,000

Costs in parentheses imply cost reductions.
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 5% and no discounting in the first year

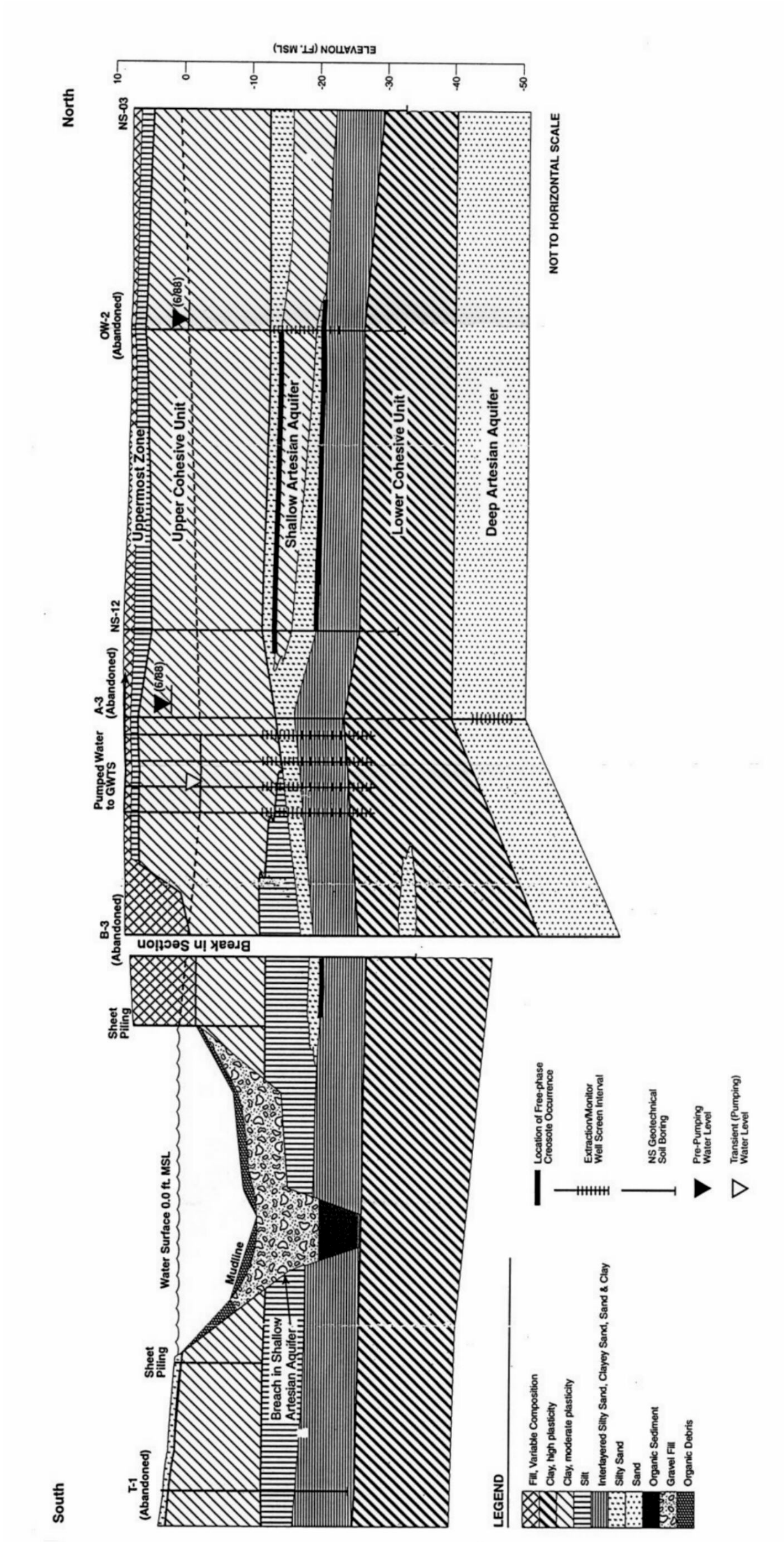
FIGURES

FIGURE 1-1. SITE LAYOUT SHOWING AREAS OF CONTAMINATION AND EXTRACTION WELL LOCATIONS.



NOTE: This figure is based on Figure 2-11a from the 1997 Performance Evaluation Report for Shallow Artesian Aquifer Restoration, CH2M Hill, Inc. and Sheet reference number AB-G4 from the 2000 Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, IT Corporation. The estimated extent and location of the free creosote plume from Figure 2-11a have been adjusted to be consistent with findings that no free creosote was found during installation of Array 1a.

FIGURE 1-2. PROFILE OF BAYOU AND STRATIGRAPHY.
(Taken from Performance Evaluation Report for Shallow Artesian Aquifer Restoration, Prepared for Bayou Bonfouca Superfund Site, September 1997, CH2M Hill, Inc.)



Solid Waste and
Emergency Response
(5102G)

542-R-02-008f
October 2002
www.clu-in.org/rse
www.epa.gov/tio

U.S. EPA National Service Center
for Environmental Publications
P.O. Box 42419
Cincinnati, OH 45242-2419