

Five-Year Review Report

Second Five-Year Review Report for North Cavalcade Street Houston, Harris County, Texas

September 2003

PREPARED BY:

**CH2M HILL
Contract Number 68-W6-0036
Work Assignment Number 948-FRFE-06ZZ**

PREPARED FOR:

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United States Environmental Protection Agency
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FIVE-YEAR REVIEW
North Cavalcade Street Superfund Site
EPA ID# TXD980873343
Houston, Harris County, Texas

This memorandum documents the United States Environmental Protection Agency's (EPA's) approval of findings, and actions needed, for the North Cavalcade Street Superfund Site second five-year review, including the attached Five-Year Review Report, prepared by EPA with the support of CH2M HILL, Inc. The attached report also summarizes those actions taken since the first five-year review was completed in July 1998, for both Ground Water Operable Unit 1 (OU1) and Soil Operable Unit 2 (OU2).

Summary of Five-Year Review Findings

This second five-year review documents that the actions performed to date at the North Cavalcade site are protective of human health and the environment in the short-term because the contaminated soil has been contained and is inaccessible, and the ground water treatment system continues to address Dense Non-Aqueous Phase Liquid (DNAPL) and affected ground water. Although the deeper affected ground water and DNAPL have not yet been completely defined, there are currently no ground water receptors. The City of Houston continues to provide drinking water onsite and to neighboring residences through its public drinking water system. A determination as to whether the remedies are protective in the long-term is deferred until the completion of additional ground water and DNAPL delineation and re-evaluation of the remedial options and objectives for both ground water and soil.

Land use immediately adjacent to the site will be subject to change in the near future. The Harris County Toll Road Authority plans to extend the Hardy Toll Road along the rail right-of-way along the western boundary of the North Cavalcade Street Site. Workers may have a short term exposure to DNAPL and the ground water contaminants at certain points along that boundary during construction. Precautions should also be taken during construction to ensure that any borings through the shallow impacted zone will not create pathways for the deeper migration of contaminants.

Actions Needed

Further evaluation of the current extent of DNAPL and dissolved ground water contamination is necessary to ensure that there is continued protection of human health and the environment for the long term. The 1988 Record of Decision (ROD) recommended remedial action for the shallow sand aquifer. However, since the first five-year review (July 1998), additional site characterization has confirmed the DNAPL extends to a deeper interbedded sand aquifer at 25 to 40 feet below surface. Further field characterization is planned for January 2004, to define the leading edge of this additional source area and its associated dissolved phase in ground water.

In addition, a quarterly ground water monitoring program will be implemented in October 2003 to document the effectiveness of the current extraction and treatment system. This information, combined with the information obtained from the January 2004 delineation for the interbedded sand, will be used to re-evaluate the existing ground water remedy and objectives currently in place. At that time, EPA and the Texas Commission on Environmental Quality (TCEQ) will revisit the recommendations from the first five-year review, including evaluation of additional natural attenuation or containment options for the contaminated ground water (OU1). If pump and treat continues as part, or all, of the long-term remedy, it is recommended that the current design be evaluated and optimized for long-term efficiency and capacity.

Institutional controls to prevent onsite use of ground water and limit future use of the site to non-residential should also be re-evaluated at this time.

Similarly, it will be necessary to re-evaluate remedial options for final actions for soils (OU2). The 1988 ROD selected onsite biological treatment as the preferred remedial action for soils. Treatment was discontinued in 1998 for failure to reach the modified 30 parts per million (ppm) cleanup level for carcinogenic polycyclic aromatic hydrocarbons (cPAHs). The soil has been consolidated on the northern portion of the site in a temporary containment cell with limited access, pending final action by EPA and TCEQ. Evaluation of other remedial options for these contaminated soils (OU2) is recommended after the ground water (OU1) investigations are completed.

The Operation and Maintenance (O&M) Plan for the site should be updated to include recent modifications to the treatment system, which improved overall efficiency. The system has been modified to more effectively separate out DNAPL and to treat larger volumes of ground water by converting from a batch mode to continuous mode of operation. The O&M plan should also include maintenance procedures to address potential degradation of the protective cover for the stockpile of contaminated soils. Tears in the cover were noted in the five-year review site inspection, but have since been repaired.

The southern portion of the site includes the ground water treatment system and an array of ground water extraction and monitoring wells. Although access to the treatment system is controlled by perimeter fencing, access to the area containing the ground water wells is open on two sides. Access to the extraction wells and ground water monitoring wells should be restricted, and the well covers locked.

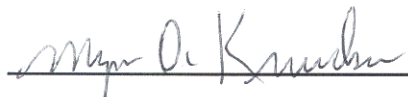
Discussions are ongoing with the Harris County Toll Road Authority and the TCEQ to ensure that protective measures are in place during construction to provide for worker safety and to further prevent the inadvertent, vertical migration of DNAPL to deeper zones. Results from the January 2004 ground water characterization will be coordinated with the Toll Road Authority as that information becomes available.

Determinations

I have determined that the remedy for the North Cavalcade Street Superfund Site in Houston, Texas, is protective of human health and the environment in the short-term, and will remain protective in the future if the action items identified in the Second Five-Year Review Report are addressed as described above.

Myron O. Knudson, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

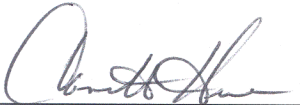
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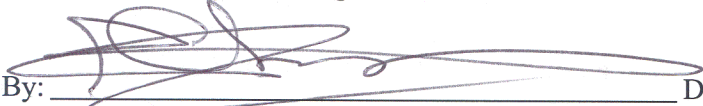



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CONCURRENCES

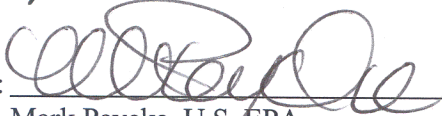
FIVE-YEAR REVIEW
North Cavalcade Street Superfund Site
EPA ID# TXD980873343

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Executive Summary

The second five-year review of the North Cavalcade Superfund Site located in Houston, Harris County, Texas was completed in September 2003. The results of this five-year review indicate that the remedy is expected to be protective of human health in the short-term. However, consideration of additional information is necessary to ensure that the remedy will continue to be protective for the long-term. To further assess the ground water remedy, additional characterization is planned to verify the down-gradient extent of a deeper source area (to approximately 40 feet) and associated ground water contamination. Similarly, the soil remedy will also be re-evaluated. The contaminated soils are currently stockpiled on the northern section of the site pending final action by the U. S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ). Since access is limited and the soils are contained, this temporary staging can be considered protective of human health. Other minor deficiencies noted in this report do not directly impact the short-term protectiveness of the remedy.

The original Record of Decision (ROD), signed June 28, 1988, addressed both ground water and soil contamination. Contaminants of concern for both media included polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (benzene, ethylbenzene, toluene, and xylene), and limited metals with concentrations above background, associated with creosote-based, wood-preserving operations. Pentachlorophenol, another wood-treatment chemical constituent, was not detected at this site. The ROD defined two critical risk exposure pathways: surficial soil and ground water. Cleanup levels were derived accordingly for carcinogenic PAHs (cPAHs) and benzene in soils; benzene in ground water; and included stipulations for the removal of non-aqueous phase liquids (NAPLs) in ground water.

The 1988 ROD required ground water to be extracted and treated onsite using oil/water separation and carbon absorption until all non-aqueous phase liquids (NAPLs) were completely removed and benzene concentrations in ground water did not exceed 5 micrograms per liter ($\mu\text{g/L}$). Recovered NAPLs were to be incinerated offsite. Construction of the ground water extraction and treatment system was completed in December 1993, followed by plant start-up on December 27, 1993. More than 11,500,000 gallons of ground water were treated and 8,000 gallons of creosote (dense non-aqueous phase liquid, or DNAPL)

were recovered from the shallow sand aquifer during two years of operation. The system was suspended in 1995, due in part to problems in handling the unexpected large volumes of DNAPL extracted from the system. The system design was then modified to more effectively separate DNAPL from extracted ground water.

Construction to modify the system began in June 2000. Since start-up of the modified system in August 2001, the TCEQ's contractor, Shaw Environmental & Infrastructure, Inc. (Shaw) has further optimized the system, changing from a batch to continuous mode of operation and subsequently increasing the volume capacity of the system. Since that time, the treatment system has recovered an additional 425 gallons of DNAPL and is processing 7,000 to 10,000 gallons of ground water per day from nineteen extraction wells across the site (**Shaw, 2003b**).

The first five-year review, signed in July 1998, made recommendations for additional characterization to locate the remaining DNAPL, and to evaluate whether the contaminated ground water would attenuate or if additional treatment would be necessary. To address those recommendations, a supplemental ground water field investigation and report were completed November 1998 and March 2000, respectively (**FWEC, 1998b; FWEC, 2000a**), which better defined the DNAPL in the shallow aquifer but also confirmed additional DNAPL in the interbedded sand aquifer from approximately 25 to 40 feet below ground surface (bgs). Additional characterization is planned for January 2004 to verify the down-gradient extent of the interbedded sand DNAPL and associated ground water contamination.

Operation and maintenance (O&M) requirements for the modified treatment system have been in place since May 2001. Shaw submits monthly O&M reports to TCEQ and EPA, as well as weekly summaries by e-mail, to document the status and continued improvements to the system. The onsite O&M manual, however, should be updated to reflect recent changes in the system, including the modification to a continuous mode of operation.

Ground water monitoring wells have been sampled as part of investigation activities, but not on a routine basis. The TCEQ is beginning a quarterly sampling program, starting in October 2004, for all monitoring and extraction wells.

Although the deeper affected ground water and DNAPL have not yet been completely defined, and are not included in the current pump and treat system, the ground water remedy can be considered protective in the short term because there are no completed exposure pathways and currently no known ground water receptors. The City of Houston provides drinking water onsite and to neighboring residences through its public drinking water supply system. However, future protectiveness of the remedy is uncertain until additional information is collected on the nature and extent of the interbedded sand DNAPL source and associated ground water contamination.

The 1988 ROD selected remedy for soils was onsite biological treatment to 1 part per million (ppm) concentration of carcinogenic polyaromatic hydrocarbons (cPAHs). In 1994, EPA modified the soil cleanup level to 30 ppm in an Explanation of Significant Differences (ESD). Construction of the biotreatment facility was completed on April 18, 1996. However, treatment was discontinued in August 1998, for failure to meet the new cleanup level established in the 1994 ESD. The soils were consolidated into a temporary treatment cell at the north end of the site (referred to in this report as the "bio-pile"). This temporary action is still considered protective of human health and the environment, because access is controlled and impacted soils are contained in a liner system. Formal evaluation of remedial options for the soil bio-pile have been temporarily suspended pending further ground water characterization and remedy review.

This five-year review documents that the actions performed to date at the North Cavalcade site are protective of human health and the environment in the short-term, because the contaminated surface soil has been contained and is protected from access, and the ground water treatment system continues to address DNAPLs and affected ground water. Future protectiveness of the ground water remedy is uncertain due to the possibility for offsite migration of the ground water contamination related to the interbedded sand source. This uncertainty will be further evaluated after further investigations are

completed in early 2004 and current remedial options and objectives are re-evaluated. Any new remedial options for either ground water or soils, which were not specified in the 1988 ROD, will be considered through the remedy decision process as a ROD Amendment or Explanation of Significant Differences.

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List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cPAH	carcinogenic Polyaromatic Hydrocarbons
CWA	Clean Water Act
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FWEC	Foster Wheeler Environment Corporation
FR	Federal Register
HCCI	Houston Creosoting Company, Inc.
HDPE	High Density Polyethylene
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NAPL	Non-Aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCP	pentachlorophenol
ppm	parts per million
OSWER	Office of Solid Waste and Emergency Response
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SVOC	Semi-volatile Organic Compound
SDWA	Safe Drinking Water Act
TAG	Technical Assistance Grant
TBCs	To Be Considered
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
VOC	Volatile Organic Compound

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Five-Year Review Summary Form		
SITE IDENTIFICATION		
Site name (from WasteLAN): North Cavalcade Street		
EPA ID (from WasteLAN): TXD980873343		
Region: EPA Region 6	State: Texas	City/County: Houston/Harris County
SITE STATUS		
NPL Status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify):		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Complete		
Multiple OUs? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Construction completion date: not applicable	
Has site been put into reuse? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No [Note: two businesses are clustered on the western boundary; however, a large part of the property is undeveloped].		
REVIEW STATUS		
Reviewing agency: <input checked="" type="checkbox"/> EPA <input checked="" type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency:		
Author: EPA Region 6, with support from RAC6 contractor CH2M HILL, Inc.		
Review period: July 1998 through July 2003		
Date(s) of site inspection: January 6, 2003		
Type of review: <input checked="" type="checkbox"/> Statutory <input type="checkbox"/> Policy <input type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: <input type="checkbox"/> 1 (first) <input checked="" type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify):		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction <input checked="" type="checkbox"/> Actual RA Start <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Recommendation of Previous <input type="checkbox"/> Other (specify): Request from State Five-Year Review Report		
Triggering action date (from WasteLAN): July 8, 1998		
Due date (five years after 1st review signature date): July 8, 2003		

Five-Year Review Summary Form

Issues: Several issues are identified for this site, as described in the following paragraphs.

- Field characterization in 1998 to 2000 confirmed the presence of DNAPL to approximately 40 feet below ground surface (to the top of a regional clay), below the shallow sand aquifer being remediated under the current pump and treat system. Currently, ground water in this 40 foot interval is not being used onsite or within a one-mile radius of the site; drinking water is provided by the City of Houston public water supply system. Therefore, the remedy can still be considered protective in the short-term. However, there is some uncertainty as to how far the dissolved phase plume and DNAPL, associated with the interbedded sand, have migrated. As a result, there remains some uncertainty that the remedy will continue to be protective of human health and the environment in the future. Exposure pathways will need to be re-evaluated after the down-gradient edge of the interbedded sand aquifer is delineated. Similarly, institutional controls may also need to be evaluated to prevent future exposure.

- The pending Hardy Toll Road expansion, adjacent to the site, may impact affected ground water and/or soil; this concern will be addressed through additional ground water and DNAPL characterization scheduled for January 2004, and through communication with the City of Houston and the Harris County Toll Road Authority.

- Efforts to bioremediate the contaminated soils were discontinued in August 1998, due to the inability of the implemented remedial method to reach the 30 ppm cleanup goal for cPAHs. The soils were consolidated into a temporary treatment cell at the north end of the site (the "bio-pile") and covered with an impermeable HDPE liner awaiting a final disposition decision by EPA and TCEQ. Some degradation of the cover (tears and encroaching vegetation) was observed during the five-year review site inspection in February 2003. TCEQ reported to EPA that in April 2003, all holes larger than one inch in diameter were patched with spare liner material and adhesive liner tape, and a monthly inspection of the cover has since been incorporated into site activities. Details regarding these monthly inspection activities should be incorporated into the O&M plan for the site, including the inspection of the leachate collection system. The bio-pile cover is noted as a temporary solution, rather than a long term remedial action.

- During the site inspection in February 2003, it was noted that the extraction wells and ground water monitoring wells could be accessed by walking around the gate and fence at Cavalcade Street or crossing the railroad tracks located on the east boundary of the site. The well covers were not locked.

Five-Year Review Summary Form

Recommendations and Follow-up Actions:

- The further evaluation of the current extent of DNAPL and dissolved ground water contamination is necessary to ensure that there is continued protection of human health and the environment for the long term. The 1988 Record of Decision (ROD) recommended remedial action for the shallow sand aquifer. However, since the first five-year review (July 1998), additional site characterization has confirmed that the DNAPL extends to a deeper interbedded sand aquifer at 25 to 40 feet below surface. Further field characterization is planned for January 2004 to define the leading edge of this additional source area and its associated dissolved phase in ground water.
- In addition, a quarterly ground water monitoring program will be implemented in October 2003 to document the effectiveness of the current extraction and treatment system. This information, combined with the information obtained from the January 2004 delineation for the interbedded sand, will be used to re-evaluate the existing ground water remedy and objectives currently in place. At that time, EPA and the Texas Commission on Environmental Quality (TCEQ) will revisit the recommendations from the first five-year review, including evaluation of additional natural attenuation or containment options for the contaminated ground water (OU1). If pump and treat continues as part, or all, of the long-term remedy, it is recommended that the current design be evaluated and optimized for long-term efficiency and capacity. Institutional controls to prevent onsite use of ground water and limit future use of the site to non-residential should also be re-evaluated at this time.
- Similarly, it will be necessary to re-evaluate remedial options for final actions for soils (OU2). The 1988 ROD selected onsite biological treatment as the preferred remedial action for soils. Treatment was discontinued in 1998 for failure to reach the modified 30 parts per million (ppm) cleanup level for carcinogenic polyaromatic hydrocarbons (cPAHs). The soil has been consolidated on the northern portion of the site in a temporary containment cell with limited access, pending final action by EPA and TCEQ. Evaluation of other remedial options for these contaminated soils (OU2) are recommended after the ground water (OU1) investigations are completed.
- The Operation and Maintenance (O&M) Plan for the site should be updated to include recent modifications to the treatment system, which improved overall efficiency. The system has been modified to more effectively separate out DNAPL and to treat larger volumes of ground water by converting from a batch mode to continuous mode of operation. The O&M plan should also include maintenance procedures to address potential degradation of the protective cover for the stockpile of contaminated soils. Tears in the cover were noted in the five-year review site inspection, but have since been repaired.
- The southern portion of the site includes the ground water treatment system and an array of ground water extraction and monitoring wells. Although access to the treatment system is controlled by perimeter fencing, access to the area containing the ground water wells is open on two sides. Access to the extraction wells and ground water monitoring wells should be restricted, and the well covers locked.

Five-Year Review Summary Form

Protectiveness Statement(s): This five-year review documents that the actions performed to date at the North Cavalcade site are protective of human health and the environment in the short-term because the contaminated surface soil has been contained and is protected from access, and the ground water treatment system continues to address DNAPLs and affected ground water. Although the affected ground water and DNAPL have not yet been completely defined, there are currently no ground water receptors. A determination regarding protectiveness of the remedy in the long-term is deferred until the completion of additional ground water and DNAPL investigations and subsequent re-evaluation of both ground water and soil remedies and objectives.

Other Comments: None.

Second Five-Year Review Report North Cavalcade Street Superfund Site

The United States Environmental Protection Agency (EPA) Region 6 has conducted the second five-year review of the remedial actions implemented at the North Cavalcade Street Superfund Site for the period July 1998 through June 2003. The site is located northeast of the intersection of Cavalcade and Maury Streets, and approximately one mile southwest of the intersection of Loop 610 North and U.S. Highway 59, in Houston, Harris County, Texas. The purpose of a five-year review is to determine whether the remedy at a site remains protective of human health and the environment, and to document the methods, findings, and conclusions in a five-year review report. Five-year review reports identify issues found during the review, if any, and recommendations to address them. This Second Five-Year Review Report documents the results of the review for the North Cavalcade Street Superfund site conducted in accordance with EPA guidance on five-year reviews. EPA RAC6 contractor CH2M HILL provided support for conducting this review and the preparation of this report.

EPA guidance on conducting five-year reviews is provided by the Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (EPA, June 2001) (replaces and supercedes all previous guidance on conducting five-year reviews). Guidance provided in this OSWER directive has been incorporated into the five-year review performed for the North Cavalcade Street site.

1.0 Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) call for five-year reviews of certain remedial actions. The EPA policy also calls for a five-year review of remedial actions in some other cases. The statutory requirement to conduct a five-year review was added to CERCLA as part of the Superfund Amendments and Reauthorization Act of 1986 (SARA). The EPA classifies each five-year review as either “statutory” or “policy” depending on whether it is being required by statute or is being conducted as a matter of policy. The five-year review for the North Cavalcade Street site is required by statute.

As specified by CERCLA and the NCP, statutory reviews are required for sites where, after remedial actions are complete, hazardous substances, pollutants, or contaminants will remain onsite at levels that will not allow for unrestricted use or unrestricted exposure. Statutory reviews are required for such sites if the Record of Decision (ROD) was signed on or after the effective date of the Superfund Amendments and Reauthorization Act of 1986 (SARA). CERCLA §121(c), as amended by SARA, states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

The NCP states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action [Title 40 of the Code of Federal Regulations (CFR) Part 300.430(f)(4)(ii)].

The five-year review for the North Cavalcade Street site is required by statute because the ROD at the site was signed in June 1988, after the effective date of SARA, and because materials remain onsite above levels that allow for unlimited use and unrestricted exposure. This is the second five-year review for the North Cavalcade Street site. The first five-year review was completed in July 1998 (EPA, 1998).

2.0 Site Chronology

A chronology of significant site events and dates is included in [Table 1](#), provided at the end of the report text. Sources of this information are listed in [Attachment 1, List of Documents Reviewed](#).

3.0 Background

This section describes the physical setting of the site, including a description of the land use, resource use, and environmental setting. Finally, this section briefly describes the history of contamination associated with the site, the initial response actions taken at the site, and the basis for each action.

3.1 Physical Characteristics

The North Cavalcade Street Superfund Site is located northeast of the intersection of Cavalcade and Maury streets, and about one mile southwest of the intersection of Loop 610 and U.S. Highway 59, Houston, Harris County, Texas. The site boundaries are Interstate Loop 610 to the north, Cavalcade Street to the south, and the Missouri and Pacific Railroad tracks to the east and west. The site is an elongated triangular shape with a base of approximately 600 feet and an apex of approximately 3,000 feet, with an area of approximately 21 acres. These features are shown on [Figure 1](#). The original wood preserving operation covered approximately nine acres. The surrounding areas are a mixture of residential, commercial, and industrial properties (**EPA, 1988**).

Regionally, the topography slopes gently south toward the Gulf of Mexico. The site, itself, is generally flat with several small mounds and depressions. Site drainage occurs through three storm water drainage ditches. Two of these flank the site on the east and west sides and drain to the third ditch which bisects the site into northern and southern sections. The third ditch drains into a flood control ditch which discharges into Hunting Bayou. Hunting Bayou is currently classified in the Texas Water Quality Standards as a limited aquatic habitat. Hunting Bayou is identified as a segment of the San Jacinto River Basin (**TCEQ, 2002**).

The North Cavalcade Street Superfund Site is located in the Southeast Texas Coastal Plain. This region is underlain with Holocene and Pleistocene deposits to a depth of approximately 2400 feet. Ground water used to supply water for domestic, industrial and agricultural purposes is pumped from the Lower Chicot and Evangeline aquifers. Both of these are confined aquifers and are isolated from surface recharge (**EPA, 1988**). Public water supply wells are screened in the Evangeline aquifer at depths greater than 600 feet. Industrial water users in the general area have wells screened in both aquifers at depths ranging from 50 to 576 feet.

The shallow and interbedded sand aquifers discussed in this report refer to water-bearing sand and silty sand units, interbedded with thin clay units, from the surface to approximately 40 feet. This report refers to the shallow sand aquifer, which is the sand unit at approximately 15 feet below ground surface; the interbedded sand aquifer is the interbedded silty sand/clay unit from about 25 to 40 feet below ground surface. Both units are hydraulically connected. The current pump and treat system is screened across the shallow sand aquifer only.

These water-bearing units are underlain by a thick regional confining clay, approximately 100 feet thick, which serves as a barrier to continued downward migration of contaminants. The Pecore Fault, a local surficial fault which runs along the southern boundary of the site, may also further contain or control the migration of DNAPL or contaminated ground water laterally.

These shallow aquifers are not being used for sources of drinking water onsite or within a one-mile radius of the site. Although a deep onsite aquifer is potentially useable as a public water supply source, onsite and neighboring residents are served by the City of Houston water supply which originates from a deeper aquifer 10 miles from the site, or a surface water reservoir located over 20 miles from the site. In addition, the Houston-Galveston Coastal Subsidence District requires notification and permits for the drilling of new ground water wells, discouraging the use of private wells in those areas adequately served by the City of Houston municipal water supply system (EPA, 2002).

Based on potentiometric information developed during the Remedial Investigation (RI) and more recent investigations conducted in 1998, shallow ground water flow is toward the west. There is strong surface recharge from rain events and through ditches crossing the site (EPA, 1988, EPA, 1998)

3.2 Land and Resource Use

Land use in the area is divided principally among residential, commercial, and industrial properties. The population in the area is approximately 50,000+. The nearest residential area, an older lower income neighborhood, is directly to the west. The closest residence is approximately 200 feet west of the site. Commercial properties are located along the major thoroughfares as well as onsite. The site is now partially used by two commercial enterprises which erected two buildings in the 1980's on the southern

part of the site, along the western boundary (see [Figure 2](#)). The remainder of the southern portion of the site is occupied by the ground water treatment system, including extraction wells, monitoring wells, and observation wells. Access to the ground water treatment system is limited by a perimeter security fence and locked gate. The northern portion of the site is occupied by the soil treatment cell. Access to the northern portion of the site is limited by a perimeter security fence with locked gates. The remainder of the site is not currently used. There has been no industrial activity on the site since 1964.

Access to the site is from two major highways, Interstate Highway (IH) 610 and U.S. Highway 59 via Cavalcade Street. The site is bordered on the east and west by active railroad lines.

The Harris County Toll Road Authority has proposed that an extension to the Hardy Toll Road be built along the rail right-of-way at the western boundary of the site. This is the only known potential future change in site use. If this extension is constructed, it will provide an additional barrier between the site and the residential properties to the west, but may impact subsurface contamination that has not yet been completely defined.

3.3 History of Contamination

The North Cavalcade Street site was not developed until 1946 when Mr. Leon Aron acquired the site and established a small creosote wood preserving business, Houston Creosoting Company, Inc.(HCCI), on the property. In 1955, HCCI added pentachlorophenol (PCP) wood preservation services and other support facilities (**EPA, 1988**). Some of the support facilities were creosote ponds, PCP/creosote storage structures, various tanks, lumber shed, treatment facility, and other buildings.

Wood preserving operations continued until 1961 when the East End Bank of Houston foreclosed on the property. In 1964, the bank sold the property to the Monroe Ferrell Concrete Pipe Company. There has been no industrial activity on the site since that time. Subsequent property owners divided the site into smaller tracts and sold them to a succession of owners. Two separate businesses have each constructed a building along the western boundary of the site nearest Cavalcade Street. The southern half of the site encompasses the operations and waste pit areas of the old wood preserving facility. Data developed during the site investigation indicated that creosote stored in areas corresponding to the historical

operation area and creosote lagoon contributed to the contamination. These areas cover approximately one acre. (EPA, 1988).

3.4 Initial Response

Between September 1985 and November 1987, EPA performed the RI for the site. During this investigation, EPA sampled air, surface water, sediments, soils, and ground water. Samples were analyzed for toxic substances associated with wood preserving sites. The data confirmed the presence of contamination in the soil, ditch sediments, and the upper ground water (shallow sand) unit at the site. The data for air and drainage ditch water showed no measurable contamination. Contaminants of concern for ground water and soils media included polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (benzene, ethylbenzene, toluene, and xylene), and limited metals with concentrations above background, associated with creosote-based operations. Pentachlorophenol, another wood-treatment chemical constituent used at the site, was not detected. (EPA, 1988).

Sediment samples indicated that polychlorinated biphenyls (PCBs) were present in an isolated area near the railroad track on the eastern boundary of the site. PCBs are not used in wood preserving operations. The cause of this contamination appeared to be a spill resulting from railroad activity (EPA, 1988).

3.5 Basis for Taking Action

The purpose of the response actions conducted at the North Cavalcade Street Superfund Site was to protect public health and welfare and the environment from release or threatened releases of hazardous substances from the site. Exposure to site contaminants was of concern because many of the chemicals are carcinogens (i.e. benzene and benzo(a)pyrene) or are otherwise toxic to humans (i.e. xylene and toluene). The following potential exposure pathways were evaluated:

- Inadvertent ingestion and *direct contact* with surficial soils and inhalation of dust and volatile chemicals by utility workers in trenches or construction workers in excavations;
- Inadvertent ingestion and *direct contact* with surficial soils by children if the site is ever developed for residential purposes;

- *Direct contact* with drainage ditch sediments by utility workers;
- Ingestion of shallow ground water *if* water supply wells are ever installed onsite.

EPA concluded from the risk assessment that adverse public health or environmental hazards could result if no action was taken to prevent exposure to contaminants found at the site. The principal exposure pathways leading to unacceptable risks were those involving surficial soils and ground water; contaminated sediments posed an additional cancer risk of only 1×10^{-9} (EPA, 1988).

Cleanup levels were derived accordingly for carcinogenic PAHs (cPAHs) and benzene in soils at 1 part per million (ppm) and 0.04 ppm, respectively; and for benzene in ground water at 5 parts per billion (ppb) or micrograms per liter (ug/l). Additional stipulations included the removal of non-aqueous phase liquids (NAPLs) in ground water. The soil remedial levels considered that the site would have continued use as a commercial site when selecting cleanup levels at the 1 in 100,000 (1×10^{-5}) risk range for carcinogens. Ground water cleanup goals were selected to comply with the Federal drinking water standard for benzene and to ensure that creosote-based compounds would not continue to leach into ground water (EPA, 1988).

4.0 Remedial Actions

The second five-year review specifically addresses remedial actions performed at the North Cavalcade Street site since completion of the first Five-Year Review Report, completed in July 1998 (EPA, 1998). This section provides a summary of the original remedy objectives, selection, and implementation. It also describes the ongoing operations and maintenance (O&M) activities, and the overall progress made at the North Cavalcade Street site since the first five-year review. As previously described, the site remediation has been divided into two Operable Units (OUs): OU1 for Ground Water; and OU2 for Soil. The Texas Commission on Environmental Quality (TCEQ), as lead agency, is managing contracts to remediate and provide O&M for both soils and ground water.

4.1 Remedy Objectives

The 1988 ROD specified that the selected remedy would treat the health- and environment-threatening contamination resulting from historical wood preserving operations at the site (EPA, 1988). More information on remedy selection and implementation is described in the following paragraphs.

4.2 Remedy Selection

The EPA proposed that the North Cavalcade Street Site be added to the National Priorities List (NPL) on October 5, 1984 (49 Federal Register [FR] 40320), and added the site to the final list on June 10, 1986 (51 FR 21054). The Record of Decision (ROD) for the North Cavalcade Street Superfund site was issued on June 28, 1988. The 1988 ROD remedy consisted of :

Ground water (OU1)

The selected remedy for OU1 (ground water) specified that contaminated ground water would be extracted and treated onsite using oil/water separation and carbon absorption until all non-aqueous phase liquids (NAPLs) were completely removed and benzene concentrations in ground water do not exceed 5 micrograms per liter ($\mu\text{g/L}$). Recovered NAPLs were to be incinerated offsite.

The ROD also included a decision to evaluate at a later date the optimal remedy for polychlorinated biphenyl (PCB) contaminants located in the drainage ditch on the eastern boundary of the site. Those contaminants are not used in wood preserving operations, but were most likely associated with other non-related railroad activities (a heavily used rail line is located directly east of the site).

Contaminated soils (OU2)

The selected remedy for soils was onsite biological treatment to a level of 1 part per million (ppm, or milligram per kilogram [mg/kg]) of carcinogenic polyaromatic hydrocarbons (cPAH). The actual method was to be selected based on the results of pilot testing during remedial design.

4.3 Remedy Implementation

The following paragraphs describe the implementation of the ground water and soil remedies.

Ground Water (OU1)

As described in the First Five-Year Review for this site (**EPA, 1998**), the ground water extraction and treatment was primarily designed for ground water and assumed that very little NAPL remained onsite. Construction was completed in December 1993, followed by plant start-up on December 27, 1993. The ground water pump and treat system operated for approximately two years until operations were suspended in 1995, due in part to problems in handling the large volumes of dense NAPL (DNAPL) encountered. During those two years of operation, more than 11,500,000 gallons of ground water were treated and 8,000 gallons of creosote (DNAPL) were recovered. The 1998 Five-Year Review recommended additional characterization to locate the remaining DNAPL and to determine if the contaminated ground water plume would naturally attenuate or if additional treatment would be necessary. Also, EPA noted in the first five-year review that further evaluation of the 1988 ROD remedial goals would be necessary to consider the larger volumes of DNAPL apparently remaining at the site (**EPA, 1998**).

A Phase I supplemental ground water field investigation and report were completed in November 1998 (**FWEC, 1998b**) and a Phase II interim report was completed in March 2000 (**FWEC, 2000a**). This investigation was conducted to better understand the geologic framework at the site, to determine the extent of DNAPL contamination and remaining volumes, and to better support improvement of the treatment system or further evaluation of the remedy. The study better defined the DNAPL in the shallow sand aquifer but also confirmed additional DNAPL in the interbedded sand aquifer below (at depth of approximately 25 - 40 feet bgs. Additional characterization is planned for January 2004, to verify the down-gradient extent of the interbedded sand DNAPL and associated ground water contamination, and to further evaluate whether the original remedial objectives in the 1988 Record of Decision are still applicable and the remedy protective. A preliminary scope of work for this mobilization was discussed at a meeting between EPA and the Texas Commission on Environmental Quality (TCEQ) and their contractors in April and May 2003 (**TCEQ, 2003**). The field operation will be a joint action by the TCEQ and EPA.

In addition, the ground water treatment design was modified to more effectively separate larger volumes of DNAPL. Construction to address those system modifications began in June 2000. Since start-up of the modified system in August 2001, Shaw Environmental & Infrastructure, Inc. (Shaw) has further optimized the system, changing from a batch to continuous mode of operation, subsequently increasing the volume capacity of the system. The current system pulls ground water from nineteen extraction wells across the site, screened across the shallow sand aquifer. Since the August 2001 start-up, the treatment system has recovered an additional 425 gallons of DNAPL and is processing 7,000 to 10,000 gallons of ground water per day (**Shaw, 2003b**).

The interbedded sand aquifer is not included in the present pump and treat system, but capacity and optimization of the current system will be evaluated after the January 2004 field work has been completed.

Soil (OU2)

The results of a pilot study conducted in 1992 indicated that the conditions necessary for bioremediation could be created and that the microorganisms could consume the cPAH chemicals onsite. Although, the study also indicated that under the best conditions, bioremediation could likely reduce the cPAH concentration to approximately 30 ppm and not 1 ppm as specified by the June 28, 1988, ROD (**EPA, 1994**). Since new knowledge was available at that time regarding the carcinogenicity of various creosote compounds, EPA performed a reassessment of the human lifetime cancer risk associated with the cPAHs in soils. Based on the results of the reassessment, EPA determined that concentrations up to 70 ppm for total cPAH compounds would still be protective of human health and the environment and would still remain at an acceptable 1 in 100,000 (1×10^{-5}) additional lifetime cancer risk. However, since the 1992 pilot study demonstrated that 30 ppm could be achieved, EPA set the new cleanup goal for all site soils at 30 ppm (**EPA, 1994**). In July 1994, the EPA issued an Explanation of Significant Differences (ESD) raising the soil cleanup goal from 1 ppm to 30 ppm for total cPAHs. The soil cleanup level for benzene was not changed (**EPA, 1994**).

Construction on the biotreatment facility began in May 1995 and was completed on April 18, 1996. The soil treatment was discontinued in August 1998, however, for failure to meet the new cleanup level

established in the 1994 ESD. The soils were consolidated into a temporary treatment cell at the north end of the site (the “bio-pile”). This containment cell measures approximately 550 feet long by 130 feet wide by 4.5 feet high, and is constructed of a 60-mil high-density polyethylene (HDPE) liner and cover, and includes a leachate collection system (EPA 2002). The leachate system has not been regularly sampled, but is used primarily to confirm the absence or presence of leachate. The TCEQ has initiated a program of regular inspections of the cover and leachate collection system.

In May 2001, the soils in the cell were sampled to characterize the contaminant concentration to support evaluation of remedial options. Analytical results demonstrated that cPAH concentrations remain above the 30 ppm soil cleanup goal (maximum concentration was 251 ppm). However, benzene was not detected above the soil cleanup goal of 0.04 ppm. Further evaluation of remedial options and development of a Feasibility Study was in progress in early 2003, but has been postponed pending the field work planned for January 2004.

4.4 Operations and Maintenance

An Operations and Maintenance Manual was prepared in May 2001 by Foster Wheeler Environmental Corporation (FWEC) and submitted to the Texas Natural Resource Commission (TNRCC), now the TCEQ, for the current ground water treatment system at the North Cavalcade Superfund Site. This document is kept at the site. The plan includes a description of the ground water treatment system, standard operating conditions, the operating logic, routine operations and maintenance procedures for the treatment system, contacts, response to alarm conditions, and emergency procedures. As described by the TCEQ contractor, Shaw Environmental (see interview record forms in [Attachment 2](#)), retrofits have been made to the system since the current O&M plan was submitted in 2001. The O&M plan should be modified to document these retrofits.

The treatment system has been retrofitted to discharge effluent from the treatment system to the ditch paralleling the eastern boundary. [Table 2](#) provides a list of the effluent and surface water discharge criteria for indicator constituents identified for the site. The effluent is sampled weekly and the results are included in the monthly O&M report. The influent is also sampled periodically to gauge the efficiency of the treatment system.

Shaw Environmental provides onsite personnel to monitor the site and treatment system on a daily basis. Daily and weekly inspections of the ground water treatment plant access controls, flow sensors, extraction wells, sump pump, air compressor, after-cooler and dryer are performed (**FWEC, 2001**). The treatment plant and extraction well system has automatic shut-off capability for over-excursions or overfills. Inspection reports are submitted to EPA and TCEQ on a monthly basis; weekly activity reports are e-mailed to both agencies and are included in the monthly summaries.

In addition, Shaw also monitors the gates, fences, and access roads. The southern portion of the site has controlled access from Cavalcade Street only. The sides are open along the eastern and western boundaries. The treatment area is separately fenced and equipped with a security and silent alarm system. If the security system is tripped, site personnel are contacted.

The soil bio-pile is contained on the northern portion of the North Cavalcade Street site, and access is restricted appropriately by fencing on all four sides. The HPDE cover is maintained as necessary and, as a result of observations made during the second five-year review site inspection, has been added to a monthly inspection program, to ensure that any new tears are quickly repaired. As previously mentioned, the leachate collection system for the soil containment system will be also checked during the monthly inspection.

Overall, O&M continues to ensure that the ground water treatment system is operating as expected under the remedy and that system efficiencies are added as needed. Recommendations to update the onsite O&M plan and further secure access to the monitoring and extraction well system address issues that do not impact the short term protectiveness of the remedy.

4.5 Progress Since Last Five-Year Review

The first five-year review, signed in July 1998, made further recommendations for additional characterization to locate the remaining DNAPL and to evaluate if the contaminated ground water would attenuate or if additional treatment would be necessary. To address those recommendations, a supplemental ground water field investigation and report were completed November 1998 and March 2000, respectively (**FWEC, 1998b; FWEC, 2000a**), which better defined the DNAPL in the shallow and

aquifer, and also confirmed additional DNAPL in the interbedded sand aquifer below (at depth of approximately 25 feet below ground surface (bgs) to the top of a regional clay at approximately 40 feet). Additional characterization is planned for January 2004, to verify the down-gradient extent of the deeper DNAPL and associated ground water contamination and support further evaluation of remedial options. Any change in remedy will consider the extent of contamination in both the shallow and intermediate sand aquifers (**FWEC, 2000a**, and **FWEC, 2000b**).

The treatment system was suspended in 1995 due in part to its inability to handle large volumes of DNAPL. The design was re-evaluated and modified to more effectively separate out DNAPL prior to treatment of the dissolved phase ground water. The modified ground water treatment system has since recovered 425 additional gallons of DNAPL since the system start-up in August 2001 through May 2003. A total of 3,469,325 gallons of contaminated ground water have been processed through the treatment system since modification (**Shaw, 2003b**).

Shaw also continues to update the treatment system to increase efficiencies. Since the 2001 start-up, the system has been converted from a batch mode operation to a continuous mode, significantly increasing the treatment capacity for extracted ground water. In addition, in January 2003, Shaw diverted the effluent from the infiltration gallery to a surface water outfall. The shallow ground water is extremely sensitive to surface infiltration from rainfall. Diverting the increased volume of treatment water to a surface ditch minimizes the effect to shallow ground water and promotes hydraulic containment of the dissolved phase ground water. Currently, the treatment system only accommodates the DNAPL and ground water extracted from the shallow sand only. The pump and treat system will be modified to treat DNAPL and contaminated ground water associated with the interbedded sand when that information is available and remedial options are fully evaluated.

Although there has been no ground water monitoring since the completion of the March 2000 study, TCEQ is initiating quarterly monitoring in October 2003 to provide a baseline to support the January 2004 characterization and remedy re-evaluation.

Similarly, additional evaluation is needed for the contaminated soil bio-pile. The biotreatment project was suspended in August 1998, just shortly after the first five-year review was completed, for failure to meet the new cleanup level established in the 1994 ESD. The soils were consolidated into a temporary treatment cell at the north end of the site (the “bio-pile”). In May 2001, the soils in the cell were sampled to characterize the contaminant concentration to support evaluation of remedial options. Analytical results demonstrated that cPAH concentrations remain above the 30 ppm soil cleanup goal (maximum concentration was 251 ppm). However, benzene was not detected above the soil cleanup goal of 0.04 ppm. Further evaluation of remedial options and development of a Feasibility Study has been temporarily postponed pending further ground water characterization and remedy review.

5.0 Five-Year Review Process

This second five-year review has been conducted in accordance with the EPA’s Comprehensive Five-Year Review guidance, dated June 2001 (EPA, 2001). Interviews were conducted with relevant parties; a site inspection was conducted on February 6, 2003; and, applicable data and documentation covering the period of the review was evaluated. The findings of the review are described in the following sections.

5.1 Administrative Components

The five-year review for this site was initiated by the EPA when contractor CH2M HILL, Inc., was tasked by the EPA to perform the technical components of the review. The review team was led by the EPA Remedial Project Manager (RPM) for this site, Ms. Camille Hueni, EPA Region 6. TCEQ agency representatives, Mr. Alvie Nichols (OU1) and Mr. Dan Switek (OU2), assisted the review team, providing information related to the North Cavalcade Street site and assistance during the February 2003 site inspection. As noted in the first five-year review, the TCEQ continues as lead agency for the North Cavalcade Street Superfund Site and is managing the contracts to further investigate, remediate, and manage O&M for the site. The components of the review included community involvement, document review, data review, a site inspection, interviews, and development of this Second Five-Year Review Report, as described in the following paragraphs.

5.2 Community Involvement

A public notice announcing initiation of the second five-year review was published in the *Houston Post* and *La Informacion* (two local newspapers of general circulation in the area of the site) on February 20, 2003. Upon approval of this second five-year review, the report will be placed in the information repositories for the site including: (1) the administrative record for the North Cavalcade Street site at the EPA Region 6 office in Dallas, Texas; (2) the TCEQ office in Austin, Texas; and (3) the Houston Central Library, Government Documents Area, 500 McKinney, Houston, TX. At that time an additional notice will be published announcing the report's completion, and its availability at the information repositories.

5.3 Document Review

This five-year review included a review of relevant site documents, including decision documents (the first Five-Year Review completed in 1998, the 1988 Record of Decision, and the 1994 Explanation of Significant Difference), construction and implementation reports, quarterly and annual operations reports, and related monitoring data. Documents that were reviewed are listed in [Attachment 1](#).

5.4 Data Review

Cumulative data associated with operation of the current ground water treatment system presented in the May 2003 Operation and Maintenance (O&M) Report were reviewed ([Shaw, 2003b](#)). Similar O&M reports have been submitted to TCEQ and EPA on a monthly basis, and include weekly e-mail status reports, effluent sample analysis, and production statistics.

Additional information from the 1998 field investigation by FWEC was reviewed, as well as preliminary plans by TCEQ and EPA for the field work planned for January 2004. Although the 1998 report provided a qualitative interpretation of the possible extent of DNAPL down-gradient to the southwest, the edge of the DNAPL and extent of the dissolved phase migration will be determined by borings and sample analysis to the top of the regional clay at 40 feet depth. The sample analysis from May 2003, and the first quarterly sampling in October 2003, will be used to focus the January field operation and to support the re-evaluation of remedial goals and objectives for the site's contaminated ground water.

5.5 Interviews

An interview was conducted with the site O&M manager during the site visit conducted on February 6, 2003. In addition, the EPA RPM and representatives from TCEQ and its contractor for each OU completed interviews for the site. The interview record forms which document the interviews with these individuals are presented in [Attachment 2](#).

Overall, the interviews verified that the ground water remedy incorporated at the site is functioning as designed, work conducted at the site is professionally managed with proper attention both to systems operation and maintenance and to health and safety issues, and that ongoing operations at the site appear to have minimal impact on the surrounding community. The modified ground water system is operating with adequate efficiencies to address DNAPL and contaminated ground water extracted from the shallow sand aquifer. However, it was recommended that the system design, capacity, and current configuration of extraction wells be re-evaluated, after the nature and extent of contamination in the interbedded sand aquifer is verified in the 2004 characterization.

There were no ongoing community concerns regarding the site identified during this five-year review.

5.6 Site Inspection

A site inspection was conducted on February 6, 2003. The completed site inspection checklist is provided in [Attachment 3](#). The site is in the shape of an elongated triangle with the base of the triangle formed by Cavalcade Street. Active Missouri Pacific Railroad tracks form the east and west boundaries of the site, and converge to form the apex of the elongated triangle at the north end of the site ([Figure 1](#)). Photographs taken during the North Cavalcade site inspection are provided in [Attachment 4](#).

The ground water treatment system for OU1 is located on the southern portion of the site at Cavalcade Street. The layout of the ground water extraction and treatment system is illustrated in [Figure 2](#). Site conditions for OU1 are depicted in [Photograph Nos. 20-54](#). As described previously, efforts to bioremediate the contaminated soils (OU2) were discontinued in August 1998. The soils were consolidated into a temporary treatment cell on the north end of the site and covered with an impermeable liner. Site conditions for OU2 are depicted in [Photograph Nos. 1-19](#).

OU2 is surrounded by an approximately 8-foot high security fence consisting of chain-link fence topped by three strands of barbed wire (**Photograph Nos. 2, 8, 17, and 19**). The fence has several locked gates to allow restricted access to this area. Identification signs appear to be posted at proper intervals on the perimeter fences (**Photograph Nos. 2, 8, 17, 19**). Portions of the perimeter fence are currently overgrown with vegetation (**Photograph No. 14**). This portion of the site is currently covered by heavy dead/dormant vegetation up to the edge of the covered bio-pile (**Photograph Nos. 1, 4, 7-14, 17**). **Photograph Nos 1-3, 5-7, 9-11, 13-16** depict the condition of the bio-pile HDPE impermeable cover. **Photograph Nos 5-7, 14** show polyvinyl chloride (PVC) risers or leachate detection points in the bio-pile cell. In general, the cover is in good condition with the following exceptions; **Photograph Nos. 2, 3, 16** show what appears to be small tears in the bio-pile cover. Also, it was noted that the northwest corner of the bio-pile cover appears to be loose and that soil from the bio-pile may have been released; this may have occurred either at the time of the installation or since that time (**Photograph No. 13**). The TCEQ has reported that in April 2003, however, all holes larger than one inch in diameter were patched with spare liner material and adhesive liner tape. At the time of the site visit, there was no visible evidence of trespassing or vandalism on this portion of the site.

The treatment system for OU1 occupies the southern portion of the North Cavalcade Street site. Vegetative cover consists primarily of bermuda grass and appears to be well maintained (**Photograph Nos. 20-24, 25-29, 31,33, 34**). Access to the site from Cavalcade Street is restricted by a locked security gate (**Photograph Nos. 31, 3, 16**). The ground water treatment system is enclosed by a security fence consisting of a locked gate, and chain link fence topped with three strands of barb wire (**Photograph Nos. 31-34, 50, 53**). Security fencing and gates were secured and in good condition. The only visible evidence of trespassing or vandalism was spray paint on the identification/ warning sign located on the gate to the site, from Cavalcade Street (**Photograph Nos. 50 - 52**). Existing extraction wells (**Photograph Nos. 22 - 30, 32**) and ground water monitoring wells were located during the North Cavalcade site inspection (**Photograph Nos. 29, 34**). The extraction wells and ground water monitoring wells are located outside the treatment system security fence. The surface completions appeared to be in good condition, but the covers for the extraction well and monitoring well vaults were not secured. Securing bolts were missing from the vault covers for the extraction wells, and securing bolts were loose or in some cases were missing from the surface completion covers for the monitoring wells.

6.0 Technical Assessment

The five-year review must determine whether the remedy at a site is protective of human health and the environment. The EPA guidance describes three questions used to provide a framework for organizing and evaluating data and information and to ensure all relevant issues are considered when determining the protectiveness of a remedy. These questions are assessed for the site in the following paragraphs.

6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The documents that detail the remedial decisions for the site are the June 1988 ROD and the July 1994 ESD which revised the OU2 soil remediation cleanup goal. The following paragraphs describe the functionality of the current remedy in terms of those decisions.

Remedial action performance. As stated in the first five-year review report completed in 1998, the original ground water extraction and treatment system design did not anticipate the presence of a large volume of creosote (DNAPL) in the subsurface. During the first two years, however, the system recovered almost 8,000 gallons of DNAPL. The system was suspended pending design modifications to more efficiently handle DNAPL, and further investigation was initiated. The first five-year review recommended that EPA and TCEQ continue to investigate the fate and transport of affected ground water to locate remaining DNAPL and to determine if the contaminated ground water plume would naturally attenuate or if further treatment or containment measures would be required. A supplemental investigation and report to evaluate the extent of DNAPL was completed in March 2000. The extraction system was redesigned and the new system began operation in 2001. The system has continued to operate since that time and has continued to recover DNAPL and a significant volume of contaminated ground water.

Routine ground water monitoring, however, has not been conducted since the 2000 study, so it is difficult to determine if the current pump and treat system has slowed the migration of the contaminant plume. Nonetheless, a considerable amount of source material (approximately 8400 gallons of DNAPL) has been removed since the initiation of pump and treat in 1993. The system operated from 1993 to 1995, was then suspended and later modified, and has since operated continuously from August 2001 to date, with

minimal shut-downs for pump tests and system improvements. The system currently extracts contaminated ground water from the shallow sand aquifer only. Recent modifications (since 2001) have significantly increased the treatment capacity and efficiencies of the system. The treated effluent is now discharged to surface drainage, rather than to an infiltration gallery (as originally designed), resulting in better hydraulic containment for the plume. This is an important improvement to the existing system, further controlling offsite migration of the shallow sand ground water contamination.

However, DNAPL volumes have been more significant than originally anticipated in the 1988 ROD and are confirmed within the interbedded sand aquifer and the top of the regional clay, again, at approximately 40 feet below ground surface. Although the investigation work described by the March 2000 report estimated the down-gradient edge of the shallow and interbedded sand DNAPL and affected ground water, the additional field work planned by EPA and TCEQ will confirm that extent with borings and sample analysis.

In summary, although the remedy for ground water is treating ground water and extracting DNAPL, as intended in the original 1988 Record of Decision, it is unlikely that the system can meet the final remedial objectives of the ROD. This is consistent with the findings of the first Five-Year Review Report in 1998, which recommended that other remedial options be evaluated, including natural attenuation to decrease dissolved phase concentrations. The remedial objectives will be revisited upon completion of the additional characterization activities planned for January 2004. Any modifications to remedial goals or options will have to meet the protectiveness standard.

The soil containment cell does not currently meet the treatment conditions specified in the 1988 ROD or the 1994 ESD. However, the current containment can be considered a temporary protective measure, until final remedial options are evaluated. Containment does meet the protectiveness standard intended in the ROD, effectively eliminating exposure to soils, but should be considered temporary, until more permanent solutions can be evaluated. Again, any modifications to remedial goals or options will have to meet the protectiveness standard.

System operations/operation and maintenance (O&M). Overall, O&M continues to ensure that the ground water treatment system is operating as expected under the remedy, that system efficiencies are added as needed, and that risk exposure pathways are controlled to ensure protectiveness. The treatment system has been retrofitted to discharge effluent from the treatment system to the ditch paralleling the eastern boundary instead of to the infiltration gallery. As a result, the pump and treat system not only treats extracted ground water, thereby reducing contaminant mass, but also hydraulically controls migration of contaminants from the shallow sand by controlling the quantity of treated water being returned back to the ground water system. Shaw also modified the treatment system to run on a continuous operation mode, rather than the initial batch mode treatment. Additional separation tanks were added to better separate the DNAPL from the dissolved phase. Larger volumes of ground water and DNAPL can now be extracted and processed through the treatment system.

Shaw Environmental provides onsite personnel to monitor the site and treatment system on a daily basis. Daily and weekly inspections of the ground water treatment plant access controls, flow sensors, extraction wells, sump pump, air compressor, after-cooler and dryer are performed (**FWEC, 2001**). The treatment plant and extraction well system has automatic shut-off capability for over-excursions or overfills. Inspection reports are submitted to EPA and TCEQ on a monthly basis; weekly activity reports are e-mailed to both agencies and included in the monthly summaries. The system has an automatic shut-off, if overflows or other problems within the system are detected.

Shaw also monitors the gates, fences, and access roads. The treatment area is separately fenced and equipped with a security and silent alarm system. If the security system is tripped, site personnel are contacted.

The soil bio-pile is contained on the northern portion of the North Cavalcade Street site, and access is restricted appropriately by fencing on all four sides. During the second five-year review inspection, there were minor tears noted in the HPDE cover. TCEQ's contractor has since repaired the tears and now conducts monthly inspections of the cover and leachate collection system. Although the bio-pile is contained and contact with soils is further prevented with the cover, this is considered a temporary remedy. Other options will be re-evaluated after the ground water work has been completed.

Previous recommendations to update the onsite O&M plan and to further secure access to the monitoring and extraction well system address issues that do not impact the short-term protectiveness of the remedy.

Costs of system operations/O&M. Since the ground water treatment system was returned to operation in August 2001, annual operation costs have ranged between \$265,000 and \$270,000 per year. Those costs have included system upgrades and maintenance, sampling events and lab analysis, and time/travel charges. The estimated cost of system operations and associated O&M understandably has changed since the 1988 ROD, which underestimated the amount of DNAPL at the site. However, the modified treatment system can now accommodate larger volumes of DNAPL and is operating on a continuous mode. Note, however, that the system only addresses contaminated ground water from the shallow sand aquifer and may have to be reconfigured to handle additional DNAPL and ground water from the interbedded sand aquifer, if pump and treat is continued as part of the re-evaluated remedy.

Implementation of institutional controls and other measures. The description of the selected remedy in the ROD, or the modification addressed in the ESD, did not address the need for institutional controls. Institutional controls should be considered to restrict the use of ground water onsite and to limit the use of the site to non-residential. For those areas adjacent to the site, the Houston-Galveston Coastal Subsidence District has notification and permitting requirements in place to further reduce ground water use and to discourage the use of private wells where a public water supply is readily available. (EPA, 2002).

Monitoring activities. Ground water has not been monitored on a regular basis since submittal of the FWEC March 2000 report. However, onsite monitoring wells were sampled in May 2003 and will be sampled again in October 2003 to provide a baseline to focus the January 2004 ground water investigation and support eventual re-evaluation of remedial options. The investigation will verify the nature and extent of the plume and DNAPL for both the shallow aquifer and the interbedded sand aquifer to the top of the regional clay. In addition, TCEQ is initiating quarterly monitoring for all monitoring and observation wells onsite, beginning with the October 2003 sampling event. Again, the network of monitoring wells will be revisited after nature and extent has been established for the dissolved phase

contamination in the interbedded sand aquifer. A monitoring approach for ground water will have to consider both the shallow and interbedded sands.

Opportunities for optimization. The ground water extraction and treatment system underwent major design modifications beginning in June 2000. The modified system was placed in service in August 2001. Shaw has since made further improvements to the system, changing from a batch to continuous mode of operation, subsequently increasing the volume capacity of the treatment plant. The current system pulls ground water from nineteen extraction wells across the site, which are screened across the shallow sand aquifer. The treatment system has recovered an additional 425 gallons of DNAPL and is processing 7,000 to 10,000 gallons of ground water per day, since 2001. Effluent from the treatment system has been redirected to a drainage ditch, instead of the subsurface infiltration gallery. Since the volume of treated ground water is not returned directly to the subsurface, the extraction system can also hydraulically contain the existing dissolved phase plume and thereby reduce further migration of contaminants.

There will be other opportunities for system optimization once ground water contamination in the interbedded sand is better defined. If pump and treat continues as all, or part, of the remedy, the system will have to be reconfigured for additional extraction wells in the interbedded sand.

Early indicators of potential remedy problems. The current remedy will be re-evaluated once additional information is reviewed after completion of the January 2004 field operation. Field investigations and preliminary conclusions, from the FWEC Phase I and Phase II reports, estimated the volume of DNAPL present in both the shallow sand aquifer and the interbedded sand aquifer. That information will be further refined by the additional field work planned for January, and will support re-evaluation of the remedial options and objectives for ground water, as was the recommendation of the first, and now this second, five-year review. Any modifications to remedial goals or options must also meet the protectiveness standard.

In addition, the soil containment cell does not meet the treatment conditions specified in the 1988 ROD. This containment is considered a temporary measure until such time as final remedial options can be

evaluated. Containment does currently meet the protectiveness standard intended in the ROD, effectively eliminating exposure to soils, pending re-evaluation of more permanent remedial options. Again, any modifications to remedial goals or options for soils will have to also meet the protectiveness standard.

6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of the Remedy Selection Still Valid?

The purpose of this question is to evaluate the effects of any significant changes in standards or assumptions used at the time of remedy selection. Changes in promulgated standards or "to be considered" (TBCs) and assumptions used in the original definition of the remedial action may indicate an adjustment in the remedy is necessary to ensure the protectiveness of the remedy.

Changes in Standards and To Be Considereds. The laws applicable or relevant to CERCLA activities are called Applicable or Relevant and Appropriate Requirements (ARARs). ARARs, or standards, for this site were identified in the June 1988 ROD. The five-year review for this site included the identification and evaluation of changes in the ROD-specified ARARs to determine whether such changes would affect the protectiveness of the selected remedy. The ARARs identified by the ROD for the selected remedy include the Safe Drinking Water Act (SDWA) and Clean Water Act (CWA) (National Primary Drinking Water Standards, the National Secondary Drinking Water Standards, and Ambient Water Quality Criteria), Underground Injection Control Regulations, the National Pollutant Discharge Elimination System, the Occupational Safety and Health Act, the Hazardous Materials Transportation Act, the Resource Conservation and Recovery Act (RCRA) standard applicable to generators and transporters of hazardous waste, the Solid Waste Disposal Act, the Texas Department of Health rules regarding allowable limits of metals in drinking water, and the location of wells used for drinking water supply, and the Texas Water Commission (now the Texas Commission on Environmental Quality) rules on water quality standards for surface waters, the prohibition of air contaminants which adversely affect human health (when soil is disturbed), the storage of volatile organic compounds, control of volatile emissions from oil/water separators, and the requirement for incineration of emissions from vacuum-producing systems.

The TCEQ and the Federal RCRA regulations have not been revised to the extent that the protectiveness of the remedy at the site would be called into question. The Texas Administrative Code Title 31 is now codified under Title 30; however, no other significant changes have been made that would affect the selected remedy.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics. There have been no changes in exposure pathways for the North Cavalcade Street site that would affect the short-term protectiveness of the remedies. No new contaminants or routes of exposure were identified as part of this five-year review. Also, there have been no significant changes in toxicity factors or other contaminant characteristics. Therefore, the remedies remain protective (that protectiveness will be re-evaluated if the plume has migrated further offsite to a point of exposure). Also, risk assessment methodologies have not changed significantly, since the time of the 1994 ESD for soils, and therefore the protectiveness of the remedies remain.

Although additional DNAPL source areas were verified by the 1998 ground water investigations, additional work is ongoing to further delineate and define these areas, particularly in the down-gradient direction. There is some uncertainty as to whether the dissolved phase plume has migrated offsite, and as a result, there remains some uncertainty that the remedy will be protective of human health and the environment in the future. However, the shallow ground water is not being used onsite or within a one-mile radius of the site, so original assumptions remain unchanged. The 1988 ROD considered exposure from ingestion of shallow ground water *if* water supply wells were ever installed onsite. Drinking water is provided by the City of Houston water supply. Exposure pathways will be re-evaluated after ground water characterization is completed for the site. There have been no additional source areas identified for soils. There are no complete soil exposure pathways, as the soils are temporarily contained in a containment cell pending final remedial action.

The majority of the site is undeveloped, but any future land use would most likely be commercial/industrial (two commercial facilities are currently located on the western boundary of the site). The planned construction of the Hardy Toll Road extension will extend down the western boundary of the site, and therefore may overlay the down-gradient extent of dissolved phase ground water contamination

moving from the North Cavalcade Street site. It is important to better characterize ground water conditions along the western boundary, so that EPA, TCEQ, and the Harris County Toll Road Authority can anticipate any potential impacts from a potentially migrating ground water contaminant plume. The January 2004 field operation is being scoped to provide that information for evaluation and discussion.

6.3 Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy

Since the original ROD was signed in 1988, operations at the treatment system and further investigations confirmed DNAPL in significant amounts in both the shallow sand aquifer and the interbedded sand aquifer. Although the current ground water treatment system is hydraulically containing and treating the shallow aquifer contaminant plume and removing source material (DNAPL), there is deeper source material at 25-40 feet that needs to be considered. Although the remedy is protective in the short-term because drinking water is being supplied through the City of Houston public water supply system, there are uncertainties regarding future protectiveness. Further ground water investigations are planned to define the extent of the deeper DNAPL and dissolved phase contamination, and the potential for its lateral and vertical migration. In addition, remedial objectives and goals will be re-evaluated to consider this post-ROD information.

No additional information has come to light that would call into question the protectiveness of the soil and ground water remedies, other than those uncertainties regarding the down-gradient edge of DNAPL and the dissolved phase plume. Those uncertainties must be addressed so that the site remedies will remain protective into the long-term.

In addition, EPA, TCEQ, and the Harris County Toll Road Authority are discussing the Authority's plans to extend the Hardy Toll Road along the western boundary of the North Cavalcade Street Superfund Site. Workers may have a short term exposure to DNAPL and the ground water contaminants at certain points along that boundary during construction. Precautions should also be taken during construction to ensure that any borings through the shallow impacted zone (to 40 feet) will not create pathways for the deeper migration of contaminants.

7.0 Issues

Several issues are identified for this site, as described in the following paragraphs.

1. While the remedy is protective in the short-term, there is some uncertainty as to how far the dissolved phase plume and DNAPL have migrated, particularly that associated with the deeper interbedded sand. As a result, there remains some uncertainty that the remedy will continue to be protective of human health and the environment in the future. Currently, the shallow ground water is not being used onsite or within a one-mile radius of the site; drinking water is provided by the City of Houston water supply. However, exposure pathways will need to be re-evaluated after the planned ground water characterization is completed for the site. Institutional controls should also be evaluated at that time to control future exposure. In particular, the pending Hardy Toll Road expansion, adjacent to the site, may impact affected ground water and/or soil. This concern will be discussed with the City of Houston and the Harris County Toll Road Authority after the ground water and DNAPL characterization has been completed.
2. Efforts to bioremediate the contaminated soils were discontinued in August 1998, due to the inability of the implemented remedial method to reach the 30 ppm cleanup goal for cPAHs. The soils were consolidated into a temporary treatment cell at the north end of the site (the "bio-pile") and covered with an impermeable HDPE liner awaiting a final disposition decision by EPA and TCEQ. Some degradation of the cover (tears and encroaching vegetation) was observed during the site inspection. TCEQ reported to EPA that in April 2003, all holes larger than one inch in diameter were patched with spare liner material and adhesive liner tape, and a monthly inspection has been incorporated into site activities. Details regarding these monthly inspection activities should be incorporated into the O&M plan for the site.
3. During the site inspection, it was noted that the extraction wells and ground water monitoring wells could be easily accessed by walking around the gate and fence at Cavalcade Street or crossing the railroad tracks located on the east boundary of the site. Also, the well covers are not locked.

8.0 Recommendations and Follow-up Actions

The evaluation of the current extent of DNAPL and dissolved ground water contamination is necessary to ensure that there is continued protection of human health and the environment for the long-term. The 1988 Record of Decision (ROD) recommended remedial action for the shallow sand aquifer. However, since the first five-year review (July 1998), additional site characterization has confirmed that the DNAPL extends to a deeper interbedded sand aquifer at 25 to 40 feet below surface. Further field characterization is planned for January 2004 to define the leading edge of this additional source area and its associated dissolved phase in ground water.

In addition, a quarterly ground water monitoring program will be implemented in October 2003 to document the effectiveness of the current extraction and treatment system, which again targets the shallow sand aquifer. This information, combined with the information obtained from the January 2004 delineation for the interbedded sand, will be used to re-evaluate the existing ground water remedy and objectives currently in place. At that time, EPA and TCEQ will revisit those recommendations from the first five-year review, including evaluation of natural attenuation or containment options for the contaminated ground water (OU1). If pump and treat continues as part, or all, of the long-term remedy, it is recommended that the current design be evaluated and optimized for long-term efficiency and capacity. Institutional controls, to prevent onsite use of ground water and to limit future use of the site to non-residential, should also be re-evaluated at this time.

Similarly, it will be necessary to re-evaluate remedial options for final actions for soils (OU2). The 1988 ROD selected onsite biological treatment as the preferred remedial action for soils. Treatment was discontinued in 1998 for failure to reach the modified 30 parts per million (ppm) cleanup level for carcinogenic polyaromatic hydrocarbons (cPAHs). The soil has been consolidated on the northern portion of the site in a temporary containment cell with limited access, pending final action by EPA and TCEQ. Evaluation of other remedial options for these contaminated soils (OU2) is recommended after the ground water (OU1) investigations are completed.

The O&M plan for the site should be updated to include recent modifications to the treatment system, which improved overall efficiency. The system has been modified to more effectively separate out

DNAPL and to treat larger volumes of ground water by converting from a batch mode to continuous mode of operation. The O&M plan should also include maintenance procedures to address potential degradation of the protective cover for the stockpile of contaminated soils. Tears in the cover were noted in the five-year review site inspection, but have since been repaired.

The southern portion of the site includes the ground water treatment system and an array of ground water extraction and monitoring wells. Although access to the treatment system is controlled by perimeter fencing, access to the area containing the ground water wells is open on two sides. Access to the extraction wells and ground water monitoring wells should be restricted, and the well covers locked.

Discussions are ongoing with the Harris County Toll Road Authority and the TCEQ to ensure that protective measures are in place during construction to provide for worker safety and to further prevent the inadvertent vertical migration of DNAPL to deeper zones. Results from the January 2004 ground water characterization should be coordinated with the Toll Road Authority as that information becomes available.

9.0 Protectiveness Statement

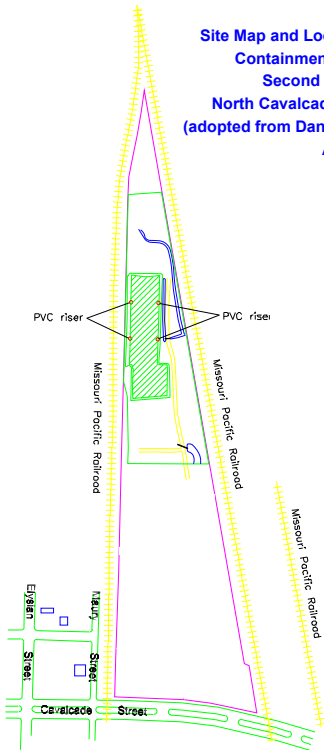
This five-year review documents that the actions performed to date at the North Cavalcade site are protective of human health and the environment in the short-term, because the contaminated surface soil has been contained and is inaccessible, and the ground water treatment system continues to address DNAPLs and affected ground water. Although the affected ground water and DNAPL have not yet been completely defined, there are currently no ground water receptors. A determination regarding protectiveness of the remedy in the long-term is deferred until the completion of additional ground water and DNAPL investigations (January 2004) and subsequent re-evaluation of both ground water and soil remedies and objectives.

10.0 Next Review

The next five-year review should be conducted for this site before or during September 2008. The primary focus for the 2008 five-year review should be the status of the ground water extraction system and progress of remediation for the ground water and the bio-pile.


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Figure 1
Site Map and Location of Existing
Containment Cell ("Bio-Pile")
Second Five-Year Review
North Cavalcade Superfund Site
(adopted from Daniel B. Stephens &
Associates, 2002)



0 400 ft

Explanation

 Estimated location of existing cell

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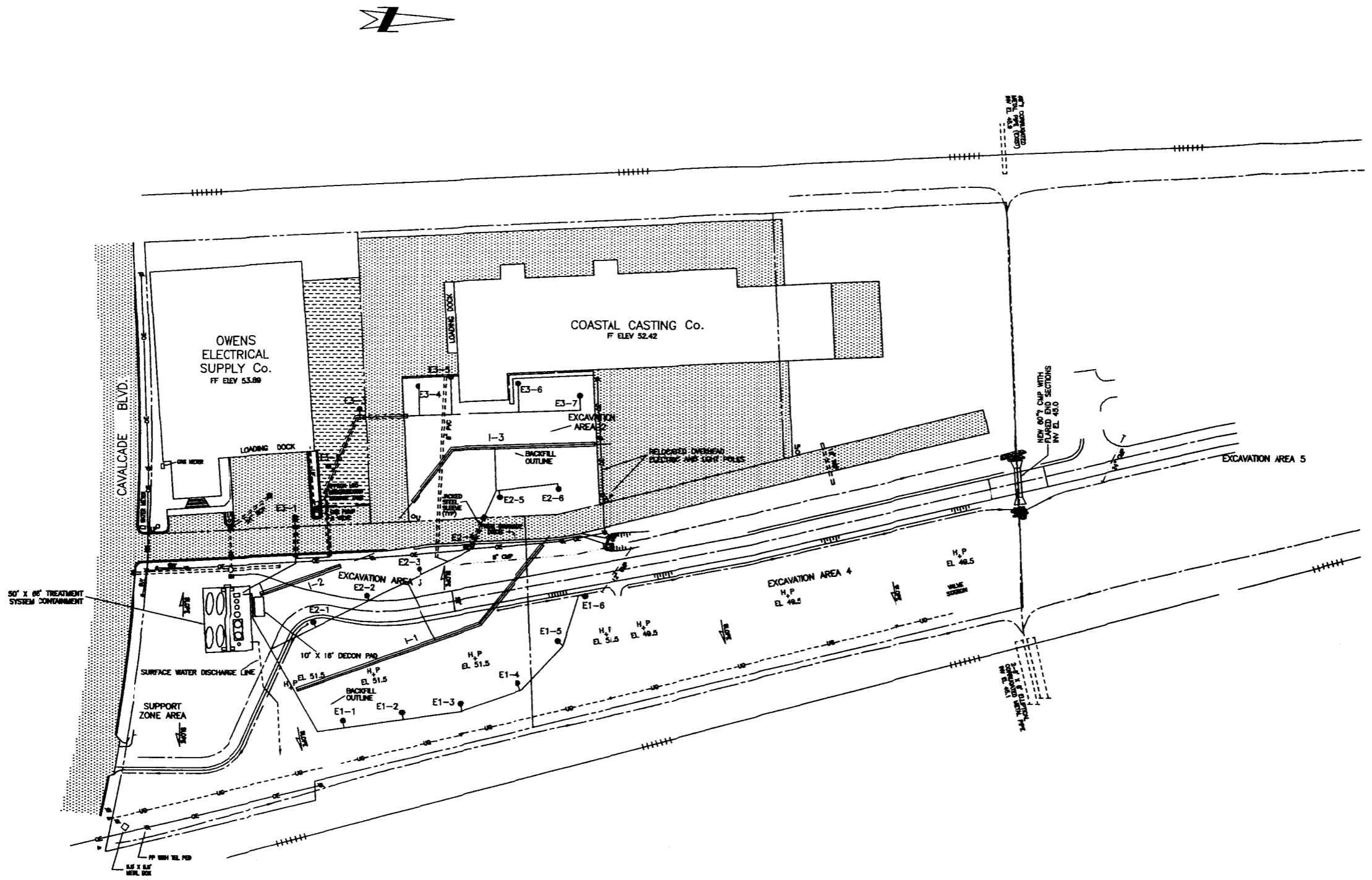


Figure 2
Layout of the Ground Water Extraction and Treatment System
North Cavalcade Street Superfund Site

					SCALE As Noted	Approved By	DATE MAY 14, 2001
					DR. ENV		Drawing No.
					DR. _____		3343-001
					CH. _____		REV = 1
NO.	DATE	REVISION	BY	CHK.	APPROVED		
						AutoCad Filename = atsklayout.DWG	

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Table 1
Chronology of Site Events
North Cavalcade Street Superfund Site
Houston, Texas

Date	Event
1946	The site was developed for wood treating by Houston Creosoting Co., Inc.
1955	Pentachlorophenol was added to wood preservation services.
1961	Bank foreclosure caused site operations to cease.
1964	The bank sold the property in 1964; various tracts are currently owned by several different owners.
1980	Two warehouses were built on the site.
September 1985 to November 1987	EPA sampled environmental media at the site, and confirmed contamination in soil, ditch sediments, and shallow groundwater.
June 28, 1988	ROD signed
1992	Field pilot study failed to demonstrate that bioremediation could reduce cPAH to below 1 µg/kg.
August 8, 1994	EPA approved an ESD to raise soil cleanup criteria for carcinogenic polyaromatic hydrocarbons (cPAH) from 1 µg/kg to 30 µg/kg.
December 1995	Operation of the groundwater pump and treat system was suspended.
July 8, 1998	First five year review was completed.
August 1998	Efforts to bioremediate contaminated soils were discontinued due to inability of remedial method to attain the cleanup goal.
December 1999	Soils were placed in a temporary treatment cell, covered with an impermeable liner awaiting final disposition by EPA and TCEQ.
June 2000	Foster Wheeler Environmental Corporation began modifications to the existing groundwater pump and treat system.
August 2001	Modified groundwater treatment system installation completed and the system was placed in service.
April 2001	IT (now the Shaw Group) assumed operation and maintenance of the groundwater treatment system.

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Table 2 Effluent and Surface Water Discharge Criteria North Cavalcade Street Superfund Site Houston, Texas		
Effluent Discharge Criteria¹		
Constituent	Limit (ug/L)	
benzene	5.0	
oil and grease	10 mg/L	
total carcinogenic PAHs	not detected (using detection limit of 10.0 ug/L ¹)	
Surface Water Discharge Criteria²		
Constituent	Daily Avg (mg/L)	Daily Max (mg/L)
oil and grease	report	15
total organic carbon	report	75
biological oxygen demand (5 day)	10	25
pentachlorophenol	0.008*	0.016*
phenanthrene	0.025*	0.053*
pH	6.0<pH<9.0	6.0<pH<9.0
flow	report	report
visual observations	report**	report**

Notes:

- 1 For discharge to the infiltration galleries. Reproduced from Attachment A of the O&M Manual (**FWEC, 2001**).
 - 2 Additional limits and conditions for discharge to surface waters. Reproduced from Table 4 of Attachment A of the O&M Manual (**FWEC, 2001**).
- * Calculated water quality limits using the acute criteria for the protection of aquatic life.
- ** The discharge shall not contain floating solids, visible oil or visible foam in other than trace amounts.

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Attachment 1
Documents Reviewed

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Attachment 1 Documents Reviewed

Camp Dresser & McKee Inc. (CDM), 1987. *Remedial Investigation Report for North Cavalcade Street Site, Houston, Texas*. October 28, 1987.

Daniel B. Stephens & Associates, 2002. *North Cavalcade Site Current Property Ownership and Location of Existing Cell, Harris County, Houston, Texas*. December 6, 2002.

Dannenbaum Engineering Corporation, 2002. *Project Layout Hardy Extension Drawing, Harris County, Houston, Texas*. July 2002.

Ebasco Environmental, 1993. *North Cavalcade Street Superfund Site Soils Operable Unit Bioremediation Pilot Test*. April 20, 1993.

Foster Wheeler Environmental Corporation (FWEC), 1998a. *Scope of Work for Design and Operation of the Ground Water Extraction and Treatment System at the North Cavalcade Street Superfund Site, Harris County, Houston, Texas*. November 1998.

Foster Wheeler Environmental Corporation (FWEC), 1998b. *Report of Field Activities for the North Cavalcade Street Superfund Site, Houston, Texas*. November 1998.

Foster Wheeler Environmental Corporation (FWEC), 2000a. *Interim Report on the Field Activities and Analytical Results for the North Cavalcade Street Superfund Site, Harris County, Houston, Texas*. March 2000.

Foster Wheeler Environmental Corporation (FWEC), 2000b. *Interim Report on the DNAPL Plume and Volume Estimate North Cavalcade Street Superfund Site, Harris County, Houston, Texas*. August 2000.

Foster Wheeler Environmental Corporation (FWEC), 2001. *Operations and Maintenance Manual for North Cavalcade Street Superfund Site, Vol I & II, Harris County, Houston, Texas*. May 2001.

Texas Commission on Environmental Quality (TCEQ), 2002. *Draft 2002 Texas Water Quality Inventory*.

Texas Commission on Environmental Quality (TCEQ), 2003. *Draft Conference Records for meetings held April 30, 2003 and May 1, 2003*. Prepared by Marilyn Long/TCEQ. June 2003.

Texas Water Commission, 1993. *Revision of the Action Level at the North Cavalcade Street Superfund Site*. June 14, 1993

- The Shaw Group Inc. (Shaw), 2002. *Second Revised Groundwater Gauging Report, North Cavalcade Superfund Site, Houston, Texas.* October 21, 2002.
- The Shaw Group Inc. (Shaw), 2003a. *March 2003 Operation and Maintenance Report, North Cavalcade Superfund Site, Houston, Texas.* April 16, 2003.
- The Shaw Group Inc. (Shaw), 2003b. *May 2003 Operation and Maintenance Report, North Cavalcade Superfund Site, Houston, Texas.* June 19, 2003.
- U. S. Environmental Protection Agency (EPA), 1988. *Record of Decision for North Cavalcade Street Superfund Site, Houston, Texas.* June 28, 1988.
- U. S. Environmental Protection Agency (EPA), 1994. *North Cavalcade Street Superfund Site Explanation of Significant Difference, Houston, Texas.* July 1994.
- U. S. Environmental Protection Agency (EPA), 1998. *North Cavalcade Street Superfund Site Five Year Review, Houston, Texas.* First five-year review for the site. Completed June 29, 1998, and signed on July 8, 1998.
- U. S. Environmental Protection Agency (EPA), 2001. *Comprehensive Five-Year Review Guidance.* OSWER No. 9355.7-03B-P. June 2001.
- U. S. Environmental Protection Agency (EPA), 2002. *Five-Year Review, South Cavalcade Street Superfund Site, Houston, Harris County Texas.* [The South Cavalcade Street Superfund Site is located directly south of the North Cavalcade Superfund Site (on the other side of Cavalcade Street)]. Completed September 2002, and signed on September 25, 2002.

Attachment 2
Interview Record Forms

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Five-Year Review Interview Record North Cavalcade Superfund Site Houston, Texas	Interviewee: Camille Hueni/US EPA Region 6 Phone: 214-665-2231 email: hueni.camille@epa.gov
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Site Name	EPA ID No.	Date of Interview	Interview Method
North Cavalcade Superfund Site	TXD980873343	April 15, 2003	email

Interview Contacts	Organization	Phone	Email	Address
Camille Hueni	EPA Region 6	214-665-2231	hueni.camille@epa.gov	1445 Ross Ave, Suite 1200 Dallas, Texas 75202-2733
Margaret O'Hare	CH2M HILL, as rep of EPA	972-980-2170	mohare@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251
Bill Thomas	CH2M HILL, as rep of EPA	972-980-2170	wthomas2@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251

Interview Questions

1. What is your overall impression of the work conducted at the site since the completion of the first five-year review in July 1998?

Response: Just after the first five-year review, the soil remedy was discontinued for failure to meet the remedial objectives of the ROD. The soils, consolidated on the northern section of the site, were covered until such time that the remedy could be revisited and final action taken. A Feasibility Study for final soil remedy has been postponed pending further characterization of the ground water and DNAPL.

Modification to the ground water treatment plant was started in 2000 (initial design did not allow significant DNAPL volume); the modified system was placed in operation in August, 2001. Since that time the operating contractor, Shaw Engineering, has converted the system from a batch mode to continuous operation, and increased the settling times to separate DNAPL from extracted ground water. Both improvements have increased the rate of DNAPL (source) extracted.

More work is needed to define the nature and extent of DNAPL and dissolved phase at the interbedded sand, particularly in the down-gradient direction. In addition, the overall efficiency of the extraction system should be re-evaluated, and optimized to achieve maximum DNAPL (source) recovery.

2. From your perspective, what effect have site operations had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?

Response: In the past, Coastal Casting has experienced some flooding at their facility during high rain events. Drainage pathways have been cleared along the edge of their property drive; the flooding has since abated. There are no known community concerns; community interest has been minimal.

3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.

Response: EPA Region 6 and TCEQ have jointly scheduled site visits over the last few years, to discuss progress on the ground water treatment system modification, to witness start-up of the system, to discuss remedial options for both ground water and soils. The most recent inspection, February 6, 2003, was conducted to support the ongoing Second Five-Year Review.

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities?

Response: There have been a few attempted break-ins at the ground water treatment plant, and one break-in at a supply shed. The buildings are coded for immediate response; Houston police have responded promptly in each case. The ground water treatment plant is fenced and locked. There have been no other reports of vandalism for other areas of the site, including the north portion where the covered soil is located (that area is separately fenced and locked).

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office?

Response: No. TCEQ is lead for the site. Any complaints/violations would be investigated by their office first. However, I am not aware of any significant complaints or violations that were referred to the State. Minor system incidents have been taken care of by the contractor, as they have come about, with input from TCEQ.

6. Please describe changes and impacts of any problems or difficulties encountered, during the period since the first five-year review in 1998, which impacted construction progress and implementability, or required a change in O&M procedures?

Response: The ground water treatment underwent a major modification, with construction starting in June 2000. System start-up was in August 2001. O&M procedures were provided after modification of the upgraded system (May 2001). I am not aware of any significant problems encountered since the first five-year review in 1998; the system has since been modified and continues to be improved to effectively extract and separate DNAPL, by the current contractor.

7. Are you aware of any changes in state or federal environmental standards since the completion of the first five-year review in 1998 which may call into question the protectiveness or effectiveness of the current remedial action?

Response: No.

8. Please describe any opportunities to optimize the operation, maintenance, or sampling efforts at the site since the start of the current remedial action, and whether such changes have been adopted.

Response: The initial ground water treatment plant was modified in 2000/2001 with operation and maintenance of the system adjusted accordingly. The most significant changes since completion of the modification have been conversion of the system from batch to continuous feed, and the addition of extra tanks to provide more residence time to separate the DNAPL from dissolved phase.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: TCEQ and EPA have been discussing additional characterization for the down-gradient edge of the DNAPL and dissolved phase, and will be starting that work once the workplan is completed. The additional characterization will support final remedy for the ground water. Optimization of the current system is recommended if the amended remedy includes a ground water treatment component. This will be addressed at a later date.

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Five-Year Review Interview Record North Cavalcade Superfund Site Houston, Texas		Interviewee: Alvie Nichols/TCEQ Phone: (512) 239-2439 email: anichols@tceq.state.tx.us			
Site Name		EPA ID No.		Date of Interview	Interview Method
North Cavalcade Superfund Site		TXD980873343		March 6, 2003	written
Interview Contacts	Organization	Phone	Email	Address	
Camille Hueni	EPA Region 6	214-665-2231	hueni.camille@epa.gov	1445 Ross Ave, Suite 1200 Dallas, Texas 75202-2733	
Margaret O'Hare	CH2M HILL, as rep of EPA	972-980-2170	mohare@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Bill Thomas	CH2M HILL, as rep of EPA	972-980-2170	wthomas2@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Interview Questions					
<p>1. What is your overall impression of the work conducted at the site since the completion of the first five-year review in July 1998?</p> <p>Response: There have been several modifications of the Groundwater Treatment System since the first five-year review. The system has improved but has had a small impact on the overall goal of capturing and removal the NAPL.</p>					
<p>2. From your perspective, what effect have site operations had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: The two adjacent businesses have expressed some concerns with the contractor leaving the gate unlocked and surface water drainage problems. These concerns have been addressed within the last year. There are no other problems that I am aware of.</p>					
<p>3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.</p> <p>Response: The contractor, Shaw Environmental & Infrastructure conducts 4 site visits (estimated 20 hrs) per week to conduct routine maintenance. There have been periodic site visits by TCEQ staff, usually in response to a concern with the operation or to get familiar with the site. The most recent visit was in February 2003 to meet with the EPA and CH2MHill personnel conducting the 5 year remedy review.</p>					

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities?

Response: The site is monitored by a motion and sound detector security system that, when triggered, notifies the contractor and/or the local police as appropriate. There have been vandalism events (e.g. trying to break into the storage facility) that have required a police response.

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office?

Response: In the spring of 2001, the owner of Coastal Casting stated his parking lot was flooding due to activities at the site. In July 2001, TCEQ hired IT Corp to dig a trench along the west side of the site to help drain the parking lot. In the summer of 2002, the TCEQ received complaints that the site gates were being left open when no one was working at the site. This issue was expressed to the contractor, and this issue seems to have been resolved.

6. Please describe changes and impacts of any problems or difficulties encountered, during the period since the first five-year review in 1998, which impacted construction progress and implementability, or required a change in O&M procedures?

Response: The GWTS was down in December 1995, due, in part, to problems handling the DNAPL volumes. It came back up in August 2001 after RECON modified the Groundwater Treatment System (GWTS). The modifications were extensive and, among other things, consisted of routing the effluent to an onsite ditch and using it when the infiltration galleries achieve high-level conditions. They also modified the equalization tanks to be used as effluent storage tanks -allowed for sampling of treated groundwater prior to discharge (batch-mode).

Several tests were completed to evaluate options to increase DNAPL recovery in the Interbedded Zone: DNAPL Yield Pump Test in March 2002 - identified low pumping rates may be more favorable for DNAPL removal. Wastewater Treatability Test in June 2002 - showed that Dissolved Air Flotation was the most effective enhancement to separate the LNAPL and the soluble DNAPL.

In August 2002, Shaw modified the GWTS to operate on a continuous-mode basis with weekly sampling of the effluent. This has significantly increased the volume of groundwater treated and eliminated the shutdown of the GWTS on a periodic basis while awaiting sample results prior to discharge.

In January 2003, the contractor reconfigured the valves to bypass the smaller oil/water separator and allow Tank B (designed as a flow equalization tank) to act as larger oil/water separator. The impact has been to increase the amount of residence time for the DNAPL to "fall out." This has increased the volume of DNAPL recovery and reduced the tendency for the smaller oil/water separator and downstream multi-media filters to become clogged.

7. Are you aware of any changes in state or federal environmental standards since the completion of the first five-year review in 1998 which may call into question the protectiveness or effectiveness of the current remedial action?

Response: No.

8. Please describe any opportunities to optimize the operation, maintenance, or sampling efforts at the site since the start of the current remedial action, and whether such changes have been adopted.

Response: Operating the GWTS on a continuous-mode basis, with weekly sampling, has significantly increased the volume of groundwater treated. Installing a larger oil/water separator seems to have increased the volume of DNAPL recovery.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: I am concerned with the equipment and operational problems that have been occurring at the site in the last year: (e.g., algae growth and high-level alarms going off in the oil/water separator, inoperable transfer pumps, air compressor, etc). In fact, at one point 9 of 19 extraction pumps were not operating. I don't know if this is typical for a NAPL GWTS or if there are some major design or construction flaws. I suggest that the design and construction of this system be reviewed to determine if some improvements can be made to the operation of the GWTS.

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Five-Year Review Interview Record North Cavalcade Superfund Site Houston, Texas		Interviewee: Dan Switek/TCEQ Phone: (512) 239-4132 email: dswitek@tceq.state.tx.us			
Site Name		EPA ID No.		Date of Interview	Interview Method
North Cavalcade Superfund Site		TXD980873343		Response received February 14, 2003	email
Interview Contacts	Organization	Phone	Email	Address	
Camille Hueni	EPA Region 6	214-665-2231	hueni.camille@epa.gov	1445 Ross Ave, Suite 1200 Dallas, Texas 75202-2733	
Margaret O'Hare	CH2M HILL, as rep of EPA	972-980-2170	mohare@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Bill Thomas	CH2M HILL, as rep of EPA	972-980-2170	wthomas2@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Interview Questions					
<p>1. What is your overall impression of the work conducted at the site since the completion of the first five-year review in July 1998?</p> <p>Response: I am not sure there has been a remedy underway on the soil since the last five year review. Biotreatment on the soil lasted from June 4, 1996 - August 21, 1998, when treatment was stopped because it became apparent that treatment goals would not be met. Notice to proceed on the construction of the temporary containment cell was given March 1, 1999. Final submittals for the closure cell were approved December 27, 1999.</p>					
<p>2. From your perspective, what effect have site operations had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: I do not think the temporary cell is having any effect on the surrounding community, and I do not know of any ongoing community concerns.</p>					
<p>3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.</p> <p>Response: Monthly site visits were conducted by a contractor to inspect the cell from December 1999 through May 2001. From May 2001 through present, the cell has been inspected on an approximate quarterly schedule by TCEQ staff.</p>					

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities?

Response: No.

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office?

Response: In the spring of 2001, Mr. Eichenour said that his parking lot at Coastal Casting was flooding due to activities at the site. In July 2001, TCEQ hired IT Corp to dig a trench along the west side of the site to help drain the parking lot.

6. Please describe changes and impacts of any problems or difficulties encountered, during the period since the first five-year review in 1998, which impacted construction progress and implementability, or required a change in O&M procedures?

Response: Not applicable.

7. Are you aware of any changes in state or federal environmental standards since the completion of the first five-year review in 1998 which may call into question the protectiveness or effectiveness of the current remedial action?

Response: No.

8. Please describe any opportunities to optimize the operation, maintenance, or sampling efforts at the site since the start of the current remedial action, and whether such changes have been adopted.

Response: Not applicable.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: Per our conversation during the site visit, we will start mowing the site on a regular basis to prevent trees or other vegetation from damaging the liner. We will also repair some of the small tears in the liner.

Five-Year Review Interview Record North Cavalcade Superfund Site Houston, Texas		Interviewee: Jimmy Gibson/Shaw Group Phone: email: jimmy.gibson@shawgrp.com			
Site Name		EPA ID No.		Date of Interview	Interview Method
North Cavalcade Superfund Site		TXD980873343		response received February 14, 2003	email
Interview Contacts	Organization	Phone	Email	Address	
Camille Hueni	EPA Region 6	214-665-2231	hueni.camille@epa.gov	1445 Ross Ave, Suite 1200 Dallas, Texas 75202-2733	
Margaret O'Hare	CH2M HILL, as rep of EPA	972-980-2170	mohare@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Bill Thomas	CH2M HILL, as rep of EPA	972-980-2170	wthomas2@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Interview Questions					
<p>1. What is your overall impression of the work conducted at the site since the completion of the first five-year review in July 1998?</p> <p>Response: Shaw has been involved in the project since 4/01 therefore we do not really have a 5-yr history. However for the past two years the project O&M has been conducted in an efficient manner. Changes in operation have been done where warranted and the remediation operations have been optimized with the current system configuration</p>					
<p>2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: I would say no effect. I do not know of any issues with the local community</p>					
<p>3. Are there routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by associated parties regarding the site (state, federal, local)? Please describe.</p> <p>Response: These include a weekly and monthly activities report. In addition typical project communication with the TCEQ PM occurs as needed</p>					
<p>4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please briefly describe the situation and the outcome.</p> <p>Response: Russell Perry takes care of this portion so he has first hand information on this topic.</p>					

5. Have there been any problems or difficulties encountered since the completion of the first five year review which impacted implementability, or a required a change in O&M procedures?

Response: The system was up-graded by Foster Wheeler so I am assuming that the up-grade was an improvement. Since Shaw has been conducting the O&M activities, the system operation has been changed from a batch process to a continuous process allowing for more mass to be recovered.

6. Have there been opportunities to optimize the operation, maintenance, or sampling efforts at the site since the completion of the first five-year review? Have such changes been implemented?

Response: yes, see above

7. Please describe the current O&M staff activities, and the date of the current O&M plan. Are any updates to the O&M plan needed or anticipated?

Response: The current O&M is done on a 20hr/wk basis. This typically includes 4 to 5 site visits per week to check the system, record data and make adjustments and/or minor repairs.

8. Where are operations-related documents maintained (including Health and Safety Plans, Operations and Maintenance Plans, and other waste management/contingency plans)? What procedures are in place to ensure compliance with these plans?

Response: Yes. The Shaw internal work orders are written to comply with these plans.

9. Please describe activities conducted to update/accelerate the remediation of the groundwater contamination at the site.

Response: The main thing Shaw is working on is to insure the current system is operating as efficiently as possible. I don't think this system will achieve the "ultimate clean-up" of the site however Shaw is continuously optimizing the operation to get as much mass out of the ground as possible with the current resources.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: I have a question on the ultimate goal for this site. If the intent of the current groundwater remediation system is to achieve clean-up goals, then I think it is very unlikely that the current operations will ever achieve that goal. I am assuming that both EPA and TCEQ are looking at this project in a step method were several phases will be implemented to achieve the final closure criteria.

Five-Year Review Interview Record North Cavalcade Superfund Site Houston, Texas		Interviewee: Russell Perry/Shaw Group Phone: email: russell.perry@shawgrp.com			
Site Name		EPA ID No.		Date of Interview	Interview Method
North Cavalcade Superfund Site		TXD980873343		received July 3, 2003	handwritten, by fax
Interview Contacts	Organization	Phone	Email	Address	
Camille Hueni	EPA Region 6	214-665-2231	hueni.camille@epa.gov	1445 Ross Ave, Suite 1200 Dallas, Texas 75202-2733	
Margaret O'Hare	CH2M HILL, as rep of EPA	972-980-2170	mohare@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Bill Thomas	CH2M HILL, as rep of EPA	972-980-2170	wthomas2@ch2m.com	12377 Merit Drive, 10 th Floor Dallas, Texas 75251	
Interview Questions					
<p>1. What is your overall impression of the work conducted at the site since the completion of the first five-year review in July 1998?</p> <p>Response: Shaw Environmental, Inc. (Shaw), formerly IT Corporation (IT) restarted the treatment system during April 2001 after modifications to the system were performed by Foster Wheeler Env. Corp and Remedial Construction. Shaw's efforts to date have improved the efficiency of the system. However, the system cannot achieve cleanup goals as configured in a reasonable time (See #10).</p>					
<p>2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: Operations are generally low-profile. Owner of Coastal Casting has complained about open gates and grass growth in the past. Since implementation of gate control and grass cutting in July 2002, there have been no more complaints from Coastal Casting to our knowledge.</p>					
<p>3. Are there routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by associated parties regarding the site (state, federal, local)? Please describe.</p> <p>Response: Weekly site status updates are prepared by Shaw and delivered by e-mail to the TCEQ & EPA. Monthly O&M reports are also submitted by mail. Frequent telephone calls between Shaw with TCEQ.</p>					

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please briefly describe the situation and the outcome.

Response: Vandals entered the site in December 2002 and attempted to break into the storage shed. Damage to the door was noted, but no items were removed. Alarm system dispatched police, but vandals were not caught. Door was subsequently repaired.

5. Have there been any problems or difficulties encountered since the completion of the first five year review which impacted implementability, or a required a change in O&M procedures?

Response: Retrofits to the system were made by Foster Wheeler to improve DNAPL recovery. Further retrofits (field/without engineering design) were made by Shaw. Changes in procedures include operating in continuous mode and weekly effluent sampling instead of batch sampling.

6. Have there been opportunities to optimize the operation, maintenance, or sampling efforts at the site since the completion of the first five-year review? Have such changes been implemented?

Response: Yes; startup test dated 9/13/01 recommended increase size of discharge pump, reconfigure for continuous operation, and weekly effluent sampling. All recommendations have been implemented. In addition, the second oil/water separator has been bypassed, Tanks A & B have been converted to settling tanks to optimize DNAPL recovery. 1st oil/water separator was cleaned out.

7. Please describe the current O&M staff activities, and the date of the current O&M plan. Are any updates to the O&M plan needed or anticipated?

Response: Current O&M involves approximate 4 to 5 site visits per week to conduct routine O&M, collect treatment data, and implement repairs/retrofits. Current O&M Plan prepared by Foster Wheeler, dated May 2001. Updates to O&M plan needed to document recent retrofits.

8. Where are operations-related documents maintained (including Health and Safety Plans, Operations and Maintenance Plans, and other waste management/contingency plans)? What procedures are in place to ensure compliance with these plans?

Response: Documents maintained on site & in office for reference and use. Field authorization forms and calendar showing tasks/duties are monitored by technician.

9. Please describe activities conducted to update/accelerate the remediation of the groundwater contamination at the site.

Response: Treatment system retrofits including a switch to continuous groundwater treatment instead of batch mode.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: Current pump-and-treat technology should be considered an engineering control to prevent dissolved-phase creosote from migrating. The current technology will not allow removal of the source in a reasonable amount of time. Recommend review of alternate technologies such as thermally enhanced SVE; excavation and disposal; excavation and thermal treatment or encapsulation/slurry wall and cap.

See DNAPL field pumping test prepared by IT corporation dated March 27, 2002 (conclusions/recommendations section) w/ remediation technologies screening matrix. Current estimate for DNAPL recovery from intermediate sand unit is 69 years with 100% treatment system uptime. Other strata not included.

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Attachment 3
Site Inspection Checklist

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North Cavalcade Street , Houston, Texas Five-Year Review Site Inspection Checklist

Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program. N/A means "not applicable."

I. SITE INFORMATION	
Site Name: North Cavalcade Street Superfund Site	EPA ID: TXD980873343
City/State: Houston, Texas	Date of Inspection: February 6, 2003
Agency Completing 5 Year Review: EPA	Weather/temperature: rain, windy, . 45 deg F
Remedy Includes: (Check all that apply) <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Landfill cover/containment (temporary cover for soil bio-pile only) <input type="checkbox"/> Access controls <input type="checkbox"/> Institutional controls <input checked="" type="checkbox"/> Groundwater pump and treatment <input type="checkbox"/> Surface water collection and treatment <input type="checkbox"/> Other: 	
Attachments: <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached	
II. INTERVIEWS (Check all that apply)	
1. O&M site manager (note: the term O&M as used in this checklist refers to system operations; O&M does not technically start until construction completion has been attained). Name: Russell S. Perry Title: Site Manager Date: July 2003 Interviewed: <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone Number: 281-368-4571 <u>Problems, suggestions:</u> <input type="checkbox"/> Additional report attached (if additional space required). See Attachment 2, Interview Record Forms.	
2. O&M staff: Name: J. Paul Rangel Title: System Operator Date: February 2003 Interviewed: <input checked="" type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone Number: 281-507-9935 <u>Problems, suggestions:</u> <input type="checkbox"/> Additional report attached (if additional space required). Information provided by onsite interview was incorporated into the text of the five-year review report.	

- 3. Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency: US Environmental Protection Agency

Contact:

Name: Ms. Camille Hueni

Title: Remedial Project Manager

Date: June 2003

Phone Number: 214-665-2231

Problems, suggestions: Additional report attached (if additional space required).

Agency: Texas Commission for Environmental Quality

Contact:

Name: Mr. Alvie Nichols

Title: Project Manager (OU 1, Groundwater)

Date: March 6, 2003

Phone Number: 512-239-2439

Problems, suggestions: Additional report attached (if additional space required).

Agency: Texas Commission for Environmental Quality

Contact:

Name: Dan Switek

Title: Project Manager (OU 2, Soil)

Date: February 14, 2003

Phone Number: 512-239-4132

Problems, suggestions: Additional report attached (if additional space required).

Agency:

Contact:

Name:

Title:

Date:

Phone Number:

Problems, suggestions: Additional report attached (if additional space required).

- 4. Other interviews** (optional) N/A Additional report attached (if additional space required).

Interview Record Forms are provided in Attachment 2 to the Five-Year Review Report.

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

- | | | | |
|---|---|-------------------------------------|------------------------------|
| <input checked="" type="checkbox"/> O&M Manuals | <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input checked="" type="checkbox"/> As-Built Drawings | <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input checked="" type="checkbox"/> Maintenance Logs | <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |

Remarks:

Modifications to the O&M Manual are planned to reflect the change from batch to continuous mode operation; changes to the As-Built drawings will be considered pending a system optimization review.

2. Health and Safety Plan Documents

- | | | | |
|--|---|-------------------------------------|------------------------------|
| <input checked="" type="checkbox"/> Site-Specific Health and Safety Plan | <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input checked="" type="checkbox"/> Contingency plan/emergency response plan | <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |

Remarks:

These documents are kept onsite. Modifications to the documents are planned to reflect recent additions to the ground water treatment system, including the shift to continuous operations.

3. O&M and OSHA Training Records

- | | | |
|---|-------------------------------------|------------------------------|
| <input checked="" type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
|---|-------------------------------------|------------------------------|

Remarks:

OSHA documents are available at Shaw's office; Shaw has indicated that copies will be maintained also at the site office.

4. Permits and Service Agreements

- | | | | |
|--|--|-------------------------------------|------------------------------|
| <input type="checkbox"/> Air discharge permit | <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input checked="" type="checkbox"/> Effluent discharge | <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input checked="" type="checkbox"/> Waste disposal | <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
| <input type="checkbox"/> Other permits | <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |

Remarks:

Surface water discharge from the ground water treatment plant meets discharge standards issued from TCEQ. Effluent analysis is submitted to TCEQ and EPA on a monthly basis. Waste disposal manifests are maintained for collected NAPL, waste, carbon filter, and PPE, to transfer waste offsite.

5. Gas Generation Records

- | | | |
|--|-------------------------------------|---|
| <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input checked="" type="checkbox"/> N/A |
|--|-------------------------------------|---|

Remarks:

6. Settlement Monument Records

- | | | |
|--|-------------------------------------|---|
| <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input checked="" type="checkbox"/> N/A |
|--|-------------------------------------|---|

Remarks: The bio-pile soils are contained in a temporary, onsite cell, covered with an impermeable liner. Settlement monitors were not installed. See site visit photographs.

7. Groundwater Monitoring Records

- | | | |
|--|-------------------------------------|------------------------------|
| <input type="checkbox"/> Readily available | <input type="checkbox"/> Up to date | <input type="checkbox"/> N/A |
|--|-------------------------------------|------------------------------|

Remarks: There is not a groundwater monitoring plan in place. TCEQ will conduct quarterly monitoring in FY2004; a monitoring plan will be developed after additional ground water characterization efforts.

<p>8. Leachate Extraction Records <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A <u>Remarks:</u> The leachate detection wells located in the bio-pile cell are not checked to determine if leachate is present.</p>
<p>9. Discharge Compliance Records <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A <u>Remarks:</u> Effluent is monitored weekly; lab analysis of the discharge effluent and volumes are reported to TCEQ and EPA monthly.</p>
<p>10. Daily Access/Security Logs <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <u>Remarks:</u> There is an automated security system for the ground water treatment system; when the system is tripped, a call goes in to the police and to the Site Manager. In addition, the system operator is at the site 3 to 4 times per week.</p>
<p>IV. O&M Costs <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A</p>
<p>1. O&M Organization <input type="checkbox"/> State in-house <input checked="" type="checkbox"/> Contractor for State <input type="checkbox"/> PRP in-house <input type="checkbox"/> Contractor for PRP <input type="checkbox"/> Other:</p>
<p>2. O&M Cost Records <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> Funding mechanism/agreement in place <u>Original O&M cost estimate:</u> <input type="checkbox"/> Breakdown attached <u>Remarks:</u> Since the ground water treatment system was returned to operation in August 2001, annual operation costs have ranged between \$265,000 and \$270000 per year. These costs have included system upgrades and maintenance, sampling events, lab analysis, and time/travel charges.</p>
<p>3. Unanticipated or Unusually High O&M Costs During Review Period <input type="checkbox"/> N/A <u>Describe costs and reasons:</u> Costs described in item 2 above include the conversion of the treatment system from a batch mode to continuous mode of operation.</p>
<p>V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A</p>
<p>A. Fencing</p>
<p>1. Fencing damaged <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Gates secured <input type="checkbox"/> N/A <u>Remarks:</u> Property with the covered bio-pile cell has a perimeter fence with locked gate to restrict unauthorized entry. Access to the remainder of the site, containing the treatment system, is limited by fencing and a locked gate across the front of the site, parallel to Cavalcade Street. Access to the south end of the site can be gained by walking around the ends of this fencing.</p>

B. Other Access Restrictions		
1. Signs and other security measures	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A
Remarks: Signs are posted on the security fences and gates.		
C. Institutional Controls		
1. Implementation and enforcement		
Site conditions imply ICs not properly implemented:	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A*
Site conditions imply ICs not being fully enforced:	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A*
Type of monitoring (e.g, self-reporting, drive by): Site operator is onsite 3 to 4 times per week.		
Frequency: See above.		
Responsible party/agency: TCEQ and Shaw Environmental & Infrastructure, Inc. (contractor)		
Contact: TCEQ and Shaw Environmental & Infrastructure, Inc. (contractor)		
Name: Alvie Nichols/TCEQ and Russell Perry/J. Paul Rangel (Shaw)		
Title: Project Manager, Site Manager, and System Operator, respectively		
Date: July 2003		
Phone Number: 512-239-2439, 281-368-4571, 281-507-9935, respectively		
Reporting is up-to-date:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> N/A
Reports are verified by the lead agency:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> N/A
Specific requirements in deed or decision documents have been met:	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Violations have been reported:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> N/A
<u>Other problems or suggestions:</u>	<input type="checkbox"/> Additional report attached (if additional space required).	
<u>Remarks:</u> The need for formal Institutional Controls will be further evaluated, along with the existing remedies, after completion of additional site characterization. Site access to the contained soils, at the north end of the site, and the ground water treatment system, at the south end, are fenced and secured. Direct access to the remainder of the property is limited at the south entrance, but not restricted on the east and west sides of the property.		
2. Adequacy	<input checked="" type="checkbox"/> ICs are adequate, in the short term <input type="checkbox"/> ICs are inadequate	<input type="checkbox"/> N/A
<u>Remarks:</u> See note in item 1 above. The wells should be further secured.		
D. General		
1. Vandalism/trespassing	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No vandalism evident
<u>Remarks:</u> The equipment/material storage shed at the groundwater treatment system has been broken into on several occasions.		
2. Land use changes onsite		<input checked="" type="checkbox"/> N/A
<u>Remarks:</u>		
3. Land use changes offsite		<input type="checkbox"/> N/A
<u>Remarks:</u> Plans are being made to construct the Hardy Extension along the western boundary of the site (Maury Road).		

VI. GENERAL SITE CONDITIONS			
A. Roads	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A	
1. Roads damaged	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Roads adequate	<input type="checkbox"/> N/A
<u>Remarks:</u> Roads are generally in good condition.			
B. Other Site Conditions			
<u>Remarks:</u> Vegetative cover on the north end of the site, the section of the site containing the temporary covered bio-pile is heavy and should be cut regularly. See site visit photographs.			
VII. LANDFILL COVERS			
		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
A. Landfill Surface (for this site, refers to temporary cover over temporary containment cell [biopile])			
1. Settlement (Low spots)	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Settlement not evident	
Areal extent:	Depth:		
<u>Remarks:</u>			
2. Cracks	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Cracking not evident	
Lengths:	Widths:	Depths:	
<u>Remarks:</u>			
3. Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident	
Areal extent:	Depth:		
<u>Remarks:</u>			
4. Holes	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Holes not evident	
Areal extent:	Depth:		
<u>Remarks:</u> A temporary cell was constructed to contain the bio-pile soils. The soil is covered with an impermeable liner. The cover appears to have tears or damaged seams at several locations (see site visit photographs). In July 2003, TCEQ/Shaw reported to EPA that 10 to 15 tears, each about 3 to 4 inches long, were found in a more detailed site inspection conducted by TCEQ/Shaw in April 2003, and all tears larger than 1 inch diameter were repaired at that time.			
5. Vegetative Cover	<input type="checkbox"/> Cover properly established	<input type="checkbox"/> No signs of stress	<input type="checkbox"/> Grass
<input type="checkbox"/> Trees/Shrubs			
<u>Remarks:</u> N/A			

6.	Alternative Cover (armored rock, concrete, etc.) <u>Remarks:</u> A temporary cell was constructed to contain the bio-pile, pending a design regarding a final remedy. The bio-pile soil is covered with an impermeable liner. The bio-pile measures approximately 550 feet long by 130 feet wide by 4.5 feet high, and is constructed of a 60-mil high-density polyethylene (HDPE) liner and cover, and includes a leachate collection system.	<input type="checkbox"/> N/A
7.	Bulges Areal extent: <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map Height: <input checked="" type="checkbox"/> Bulges not evident
8.	Wet Areas/Water Damage <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Wet areas/water damage not evident
9.	Slope Instability Areal extent: <u>Remarks:</u> Some instability was observed on the northwest side of the biopile. Refer to Photograph 13 in Attachment 4.	<input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability
B.	Benches (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Flows Bypass Bench <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
2.	Bench Breached <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
3.	Bench Overtopped <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay
C.	Letdown Channels (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Settlement Areal extent: <u>Remarks:</u>	<input type="checkbox"/> Location shown on site map Depth: <input type="checkbox"/> No evidence of settlement

<p>2. Material Degradation Material type: Remarks:</p>	<p><input type="checkbox"/> Location shown on site map Areal extent:</p>	<p><input type="checkbox"/> No evidence of degradation</p>
<p>3. Erosion Areal extent: Remarks:</p>	<p><input type="checkbox"/> Location shown on site map Depth:</p>	<p><input type="checkbox"/> No evidence of erosion</p>
<p>4. Undercutting Areal extent: Remarks:</p>	<p><input type="checkbox"/> Location shown on site map Depth:</p>	<p><input type="checkbox"/> No evidence of undercutting</p>
<p>5. Obstructions Type: Areal extent: Remarks:</p>	<p><input type="checkbox"/> Location shown on site map Height:</p>	<p><input type="checkbox"/> N/A</p>
<p>6. Excessive Vegetative Growth <input type="checkbox"/> Evidence of excessive growth <input type="checkbox"/> Location shown on site map Remarks:</p>	<p><input type="checkbox"/> No evidence of excessive growth <input type="checkbox"/> Vegetation in channels but does not obstruct flow Areal extent:</p>	
<p>D. Cover Penetrations</p>		<p><input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A</p>
<p>1. Gas Vents <input type="checkbox"/> Active <input type="checkbox"/> Passive <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks:</p>	<p><input type="checkbox"/> Routinely sampled <input type="checkbox"/> Functioning <input type="checkbox"/> Needs O&M</p>	<p><input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition</p>
<p>2. Gas Monitoring Probes <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks:</p>	<p><input type="checkbox"/> Functioning <input type="checkbox"/> Needs O&M</p>	<p><input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition</p>
<p>3. Monitoring Wells (within surface area of landfill) <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks:</p>	<p><input type="checkbox"/> Functioning <input type="checkbox"/> Needs O&M</p>	<p><input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition</p>

4.	Leachate Extraction Wells	<input type="checkbox"/> N/A
	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs O&M <u>Remarks:</u> There are several leachate extraction/detection wells located across the bio-pile cover. The cover penetrations generally look to be in good condition. The wells have not been inspected or sampled to determine if leachate is present.	
5.	Settlement Monuments	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <u>Remarks:</u>	
E.	Gas Collection and Treatment	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Gas Treatment Facilities	<input type="checkbox"/> N/A
	<input type="checkbox"/> Flaring <input type="checkbox"/> Thermal destruction <input type="checkbox"/> Collection for reuse <input type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
2.	Gas Collection Wells, Manifolds and Piping	<input type="checkbox"/> N/A
	<input type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
3.	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)	<input type="checkbox"/> N/A
	<input type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
F.	Cover Drainage Layer	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Outlet Pipes Inspected	<input type="checkbox"/> N/A
	<input type="checkbox"/> Functioning <u>Remarks:</u>	
2.	Outlet Rock Inspected	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Functioning <u>Remarks:</u>	
G.	Detention/Sedimentation Ponds	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Siltation	<input type="checkbox"/> N/A
	<input type="checkbox"/> Siltation evident Areal extent: Depth: <u>Remarks:</u>	
2.	Erosion	<input type="checkbox"/> N/A
	<input type="checkbox"/> Erosion evident Areal extent: Depth: <u>Remarks:</u>	

3.	Outlet Works	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
<u>Remarks:</u>			
4.	Dam	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
<u>Remarks:</u>			
H. Retaining Walls		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Deformations	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Deformation not evident
Horizontal displacement: Vertical displacement:		Rotational displacement:	
<u>Remarks:</u>			
2.	Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
<u>Remarks:</u>			
I. Perimeter Ditches/Off-site discharge		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	Siltation	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Siltation not evident
Areal extent: Depth:			
<u>Remarks:</u>			
2.	Vegetative Growth	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Vegetation does not impede flow
Areal extent: Type:			
<u>Remarks:</u>			
3.	Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
Areal extent: Depth:			
<u>Remarks:</u>			
4.	Discharge Structure	<input checked="" type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A
<input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Good Condition			
<u>Remarks:</u> Treated effluent from the groundwater treatment system is discharged to a ditch; then to an unnamed tributary; then to Hunting Bayou; then to the Houston Ship Channel/Buffalo Bayou Tidal Segment No. 1007 of the San Jacinto River Basin.			
VIII. VERTICAL BARRIER WALLS		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Settlement	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Settlement not evident
Areal extent: Depth:			
<u>Remarks:</u>			

2.	Performance Monitoring	<input type="checkbox"/> N/A
	<input type="checkbox"/> Performance not monitored <input type="checkbox"/> Performance monitored Frequency: <input type="checkbox"/> Evidence of breaching Head differential: <u>Remarks:</u>	
IX. GROUNDWATER/SURFACE WATER REMEDIES <input type="checkbox"/> Applicable <input type="checkbox"/> N/A		
A.	Groundwater Extraction Wells, Pumps, and Pipelines	<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	Pumps, Wellhead Plumbing, and Electrical	<input type="checkbox"/> N/A
	<input checked="" type="checkbox"/> All required wells located <input type="checkbox"/> Good condition <input checked="" type="checkbox"/> Needs O& M <u>Remarks:</u> Extraction well vault covers are not secured, and can be slid to one side to expose the wellhead plumbing.	
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances	<input type="checkbox"/> N/A
	<input checked="" type="checkbox"/> System located <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
3.	Spare Parts and Equipment	<input type="checkbox"/> N/A
	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Requires Upgrade <input type="checkbox"/> Needs to be provided <u>Remarks:</u>	
B.	Surface Water Collection Structures, Pumps, and Pipelines	<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1.	Collection Structures, Pumps, and Electrical	<input type="checkbox"/> N/A
	<input type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
2.	Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances	<input type="checkbox"/> N/A
	<input type="checkbox"/> Good condition <input type="checkbox"/> Needs O& M <u>Remarks:</u>	
3.	Spare Parts and Equipment	<input type="checkbox"/> N/A
	<input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires Upgrade <input type="checkbox"/> Needs to be provided <u>Remarks:</u>	
C.	Treatment System	<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	Treatment Train (Check components that apply)	
	<input type="checkbox"/> Metals removal <input checked="" type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input type="checkbox"/> Air stripping <input checked="" type="checkbox"/> Carbon adsorbents <input checked="" type="checkbox"/> Filters (list type): multi media filters <input type="checkbox"/> Additive (list type, e.g., chelation agent, flocculent)	

2.	Electrical Enclosures and Panels (properly rated and functional) <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M <u>Remarks:</u>		<input type="checkbox"/> N/A
3.	Tanks, Vaults, Storage Vessels <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs O&M <u>Remarks:</u>		<input type="checkbox"/> N/A
4.	Discharge Structure and Appurtenances <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M <u>Remarks:</u>		<input type="checkbox"/> N/A
5.	Treatment Building(s) <input checked="" type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs Repair <input type="checkbox"/> Chemicals and equipment properly stored <u>Remarks:</u>		<input type="checkbox"/> N/A
6.	Monitoring Wells (pump and treatment remedy) <input checked="" type="checkbox"/> All required wells located <input type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input checked="" type="checkbox"/> Needs O&M <u>Remarks:</u> Monitoring well covers were missing some bolts and existing bolts were not secure.		<input type="checkbox"/> N/A
D.	Monitored Natural Attenuation	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Monitoring Wells (natural attenuation remedy) <input type="checkbox"/> All required wells located <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M <u>Remarks:</u>		<input type="checkbox"/> N/A
X. OTHER REMEDIES		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
<p>Efforts to bioremediate the contaminated soils were discontinued in August 1998 due to the inability of the selected remedial method to reach the 30 mg/kg cleanup goal for cPAHs. The soils were excavated and consolidated into a temporary treatment cell and covered with an impermeable liner pending final disposition by EPA and TCEQ. A feasibility study to determine final remedial options for soils has been temporarily suspended pending additional site characterization for ground water.</p>			

Attachment 4
Site Inspection Photographs

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Photograph 1 of 53

Looking north-northwest from the southeast corner of the covered biopile.



Photograph 2 of 53

Looking west from the southeast corner of the covered biopile. The fence along the west site boundary, with information signs, can be seen in the left background.



Photograph 3 of 53

Looking northwest from the southeast corner of the covered biopile. Note the apparent tear in the biopile cover.



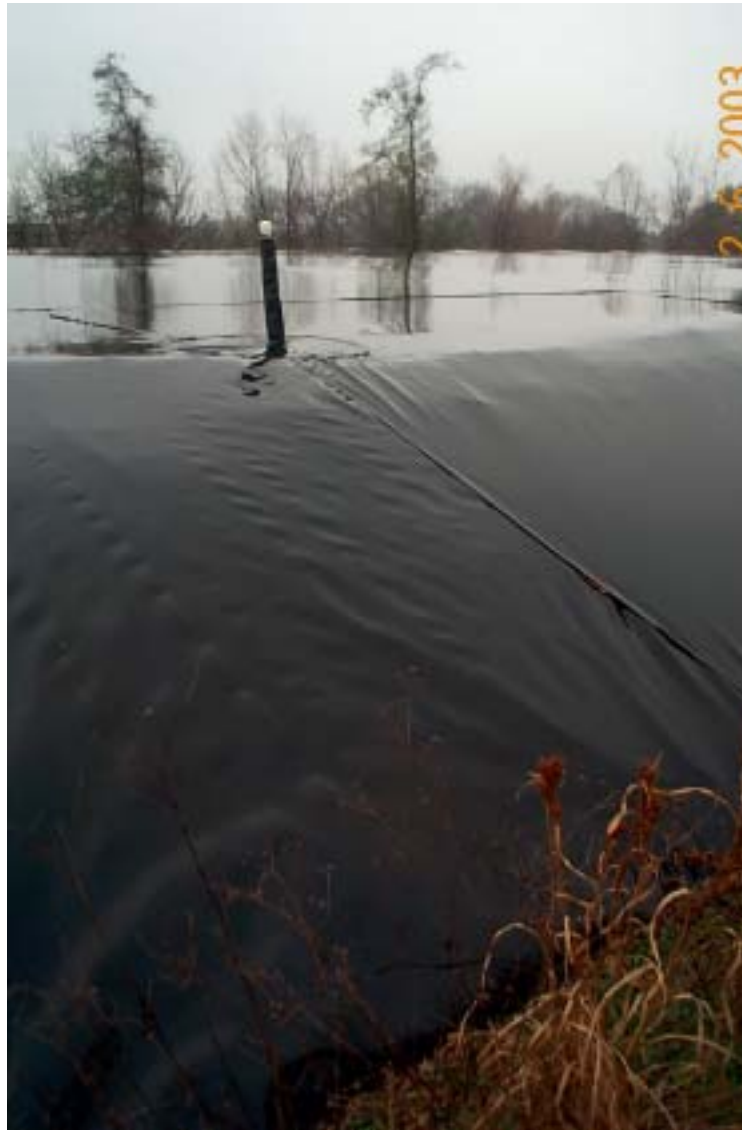
Photograph 4 of 53

Looking south from the southeast corner of the covered biopile.



Photograph 5 of 53

Looking west across the biopile cover. A leachate detection well is located in the center of the photograph.



Photograph 6 of 53

Looking west across the biopile. The leachate detection well is located on the eastern edge of the biopile.



Photograph 7 of 53

Looking west across the biopile. This leachate detection well is located near the northeastern corner of the biopile.



Photograph 8 of 53

Looking east toward the perimeter security fence. The fence encircles the property containing the biopile. A warning sign, in the center of the photograph, facing outward, is attached to the fence.



Photograph 9 of 53

Looking west across the north end of the covered biopile.



Photograph 10 of 53

Looking south along the east side of the covered biopile.



Photograph 11 of 53

Looking west across the north end of the covered biopile.



Photograph 12 of 53

Looking north from the north end of the covered biopile.



Photograph 13 of 53

Looking south from the north west corner of the covered biopile, along the west side of the covered biopile. The biopile cover appears to be loose and soil may have been released from the cell (either at the time of installation or since that time).



Looking south, along the west side of the covered biopile, from the north west corner of the covered biopile. Leachate detection wells can be seen along the west edge of the biopile. The west boundary fence, on the right, is obscured by vegetation.



Looking west, across the biopile cover, at a seam in the cover.



Photograph 16 of 53

Looking west, across the biopile cover. The seam in the center of the photograph appears to be torn.



Photograph 17 of 53

Looking south from the biopile cell area, at the gate to the covered biopile area (normally closed).



Photograph 18 of 53

Looking west from the gate to the biopile area, at a surface water drainage feature. The fence is in the upper right corner of the photograph.



Photograph 19 of 53

Looking north towards the gate to the covered biopile area. Warning signs are located on the fence to the left of the gate.



Photograph 20 of 53

Looking east towards railroad tracks along the east side of the site. The structure in the left center the photograph is a local utility gas line.



Photograph 21 of 53

Looking south across the site. An unidentified well is located in the center of the photograph.



Photograph 22 of 53

Looking southeast across the site. Extraction well E1-6 is located in the foreground of the photograph.



Photograph 23 of 53

Looking at extraction well E1-6.



Photograph 24 of 53

Looking southwest, from the site, onto Coastal Casting Inc. property at extraction wells.



Photograph 25 of 53

Looking west, from the site, onto Coastal Casting Inc. property at extraction wells.



Photograph 26 of 53

Extraction well E1-3. The vault cover is not secured to the concrete pad.



Photograph 27 of 53

Looking south across the site. Extraction wells are in the center of the photograph.



Photograph 28 of 53

Looking south across the site. Extraction wells are in the center of the photograph.



Photograph 29 of 53

Looking south across the site. Monitoring wells are in the center of the photograph. Extraction wells are located in the background. The groundwater treatment plant is in the upper right corner of the photograph.



Photograph 30 of 53

An Extraction well. DNAPL in vault is from a recent leak. The leak has been repaired.



Photograph 31 of 53

Looking south at the site entrance from Cavalcade Street. The security fence around the treatment system can be seen in the right center of the photograph.



Looking west towards Owens Electrical Supply Inc. An extraction well is in the foreground/one of the protective posts is bent. The groundwater treatment system is to the left of the photograph inside the security fence.



Photograph 33 of 53

Looking southwest towards the treatment plant. The discharge structure at the center of the photograph is for treated water. Security fence surrounding the treatment system can be seen across the site road.



Photograph 34 of 53

Looking west towards the treatment plant. A monitoring well is in the left center of the photograph.



Photograph 35 of 53

Groundwater treatment system control room building.



Photograph 36 of 53

Groundwater treatment system compressor is at the center of the photograph. The equipment storage shed is to the left of the compressor.



Photograph 37 of 53

Groundwater treatment system equalization and holding tanks.



Photograph 38 of 53

Groundwater treatment system equalization and holding tanks in secondary containment structure. The control room building is on the left.



Photograph 39 of 53

Groundwater treatment system equalization tanks in secondary containment structure.



Photograph 40 of 53

Groundwater treatment system oil water separator in the left center of the photograph. The blue tank is for DNAPL storage (currently not used). The vessel on the right is an unused DNAPL separator.



Photograph 41 of 53

Groundwater treatment system. The blue tank is for DNAPL storage (currently not used). Note the spent filter on the floor of the secondary containment structure in the center foreground.



Photograph 42 of 53

Groundwater treatment system lines from the extraction wells to the groundwater treatment system and lines from the groundwater treatment system to the infiltration gallery.



Photograph 43 of 53

Groundwater treatment system secondary containment structure. Drums in foreground contain DNAPL for disposal.



Photograph 44 of 53

Groundwater treatment system oil water separator in the upper center of the photograph. The blue vessel to the left is the DNAPL storage tank (currently not in use).



Photograph 45 of 53

Groundwater treatment system.



Photograph 46 of 53

Groundwater treatment system equalization and holding tanks.



Photograph 47 of 53

Groundwater treatment system equalization and holding tanks.



Photograph 48 of 53

Groundwater treatment system equalization and holding tanks.



Photograph 49 of 53

Groundwater treatment system. The blue tanks are the activated carbon adsorbers. The brown structures in the left center of the photograph, behind the adsorbers, are multi media filters.



Photograph 50 of 53

Gate into the site with site information sign. Cavalcade Street is on the left. The gate to the groundwater system is on the left.



Photograph 51 of 53

Sign on the entry gate to the site. Cavalcade Street is on the left.



Photograph 52 of 53

Close-up of the sign on the entry gate to the site. Cavalcade Street is on the left.



Photograph 53 of 53

Looking northeast at the groundwater treatment system for the North Cavalcade Site. Cavalcade Street is in the foreground.

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Attachment 5
Notices to the Public Regarding the Five-Year Review

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BERNARD HODES GROUP

220 East 42nd Street

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NORTH CAVALCADE STREET SUPERFUND SITE U.S. EPA Region 6 Begins Second Five-Year Review of Site Remedy



The U.S. Environmental Protection Agency Region 6 (EPA) has begun the Second Five-Year Review of the remedy for the North Cavalcade Street Superfund site in Houston, Texas. The review will evaluate the ability of the remedy to correct contamination problems and protect public health and the environment. The remedy, which EPA selected in June 1988 and revised in 1994, calls for biological degradation of contaminated soil and extraction and carbon adsorption treatment of contaminated groundwater.

The site is located at the intersection of Cavalcade and Maury Streets near Loop 610 North and U.S. Highway 59. A wood-treating facility, which operated from 1946 until 1961, was located on the 23-acre site. Facility operations resulted in contamination of soil and groundwater by creosote. The first Five-Year Review, which was completed in 1998, found the remedy to be protective of public health and the environment.

Results of the Second Five-Year Review will be made available to the public at the following information repository:

**Houston Central Library
Government Documents Area
500 McKinney Street
Houston, Texas 77002**

Questions concerning the North Cavalcade Street Superfund site should be directed to Camille Hueni at (214) 665-2231 or 1-800-533-3508 (toll-free). Information about the North Cavalcade site is available on the Internet at www.epa.gov/earth1r6/6sf/pdffiles/ncavalc.pdf.

SITIO SUPERFONDO DE NORTH CAVALCADE STREET

Región 6 de la U.S. EPA Inicia la Segunda Revisión de Cinco Años de la Remediación del Sitio

La Agencia para la Protección Ambiental de los Estados Unidos (EPA, por sus siglas en inglés) ha comenzado la Segunda Revisión de Cinco Años de la remediación del Sitio Superfondo de North Cavalcade Street en Houston, Texas. La revisión evaluará la capacidad de la remediación para corregir problemas de contaminación y proteger la salud pública y el medioambiente. La remediación, la cual fue seleccionada por la EPA en junio del 1988 y revisada en 1994, consiste en la degradación biológica del suelo contaminado y extracción, y el tratamiento de adsorción con carbón del agua subterránea contaminada.

El sitio está ubicado en la intersección entre Cavalcade y Maury Streets cerca al Loop 610 North y U.S. Highway 59. Una instalación para el tratamiento de madera, la cual operó desde 1946 hasta 1961, estaba ubicada en el sitio, con una extensión de 23 acres. Las operaciones de la instalación resultaron en la contaminación del suelo y el agua subterránea por creosota. La Primera Revisión de Cinco Años, la cual fue terminada en 1998, concluyó que la remediación protegió la salud pública y el medioambiente. Los resultados de la Segunda Revisión de Cinco Años estarán disponibles para el público en el siguiente depósito de información:

**Biblioteca de Houston - Sede Central
Área de Documentos del Gobierno
500 McKinney Street
Houston, Texas 77002**

Si Usted tiene una pregunta sobre el Sitio Superfondo de North Cavalcade Street por favor contactar a Camille Hueni a (214) 665-2231 o a 1-800-533-3508 (llamada gratis). Información sobre el Sitio North Cavalcade se encuentra en la Internet a www.epa.gov/earth1r6/6sf/pdffiles/ncavalc.pdf.

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NORTH CAVALCADE STREET SUPERFUND SITE U.S. EPA Region 6 Completes Second Five-Year Review of Site Remedy



SITIO SUPERFUND DE NORTH CAVALCADE STREET La Región 6 de la U.S. EPA termina la Segunda Evaluación de Cinco Años del Remedio del Sitio

The U.S. Environmental Protection Agency Region 6 (EPA) has completed the Second Five-Year Review of the remedy for the North Cavalcade Street Superfund site in Houston, Texas. The site is located at the intersection of Cavalcade and Maury Streets near Loop 610 North and U.S. Highway 59. A wood-treating facility, which operated from 1946 until 1961, was located on the 23-acre site. Facility operations resulted in contamination of soil and groundwater by creosote.

Results of the Five-Year Review

The five-year review documents that actions performed to date at the North Cavalcade site continue to be protective of human health and the environment in the short-term, but that further evaluation of the existing soil and ground water remedies will be necessary. Although the ground water treatment system continues to remove the creosote and affected ground water from the shallow sand aquifer, it is now known that the creosote extends to a deeper interbedded sand aquifer at 25 to 40 feet below surface. Work was recently completed at the site to further define the deeper source areas and extent of affected ground water. That information will be used to re-evaluate the existing ground water remedy and remedial objectives currently in place. Similarly, it will be necessary to re-evaluate final remedial action for contaminated soils. Biological treatment of soils was abandoned in 1998 for failure to reach prescribed cleanup levels for carcinogenic polyaromatic hydrocarbons (cPAHs). The soils have been consolidated in a temporary containment cell with a cover and limited access to prevent human exposure. There is no expected exposure to the contaminated ground water onsite as the City of Houston continues to provide drinking water onsite and to neighboring residences, through the City's public drinking water system. Re-evaluation of remedies for both ground water and soils will be completed by the end of 2004.

The *Second Five-Year Review Report* is available for public review at the following information repository:

**Houston Central Library
Government Documents Area
500 McKinney Street
Houston, Texas 77002**

The Report is also available on the Internet at www.epa.gov/earth1r6/6sf/pdffiles/nc_5yr_0903.pdf. Questions concerning the North Cavalcade Street Superfund site, or the Second Five-Year Review, should be directed to Camille Hueni at (214) 665-2231 or 1-800-533-3508 (toll-free).

La Agencia para la Protección del Medio Ambiente de los Estados Unidos (EPA, por sus siglas en inglés) ha terminado la Segunda Evaluación de Cada Cinco Años del remedio para el Sitio Superfund de North Cavalcade Street en Houston, Texas. El sitio está ubicado en la intersección de las calles Cavalcade y Maury, cerca del Loop 610 North y la carretera U.S. Highway 59. Una instalación para el tratamiento de madera, que operó desde 1946 a 1961, estuvo ubicado en las 23 acres del sitio. Las operaciones de la instalación resultaron en la contaminación del suelo y agua subterránea con creosota.

Resultados de la Evaluación de Cinco Años

La evaluación de cinco años afirma que las acciones desarrolladas hasta la fecha en el sitio de North Cavalcade continúan a proteger la salud humana y el medio ambiente dentro del corto plazo, pero que es necesario llevar a cabo más evaluaciones de remedios para el suelo y agua subterránea. Aunque el sistema de tratamiento de agua subterránea sigue removiendo el creosota y el agua subterránea afectada del acuífero arenoso, ahora se sabe que el creosota se extiende a niveles más profundos del acuífero arenoso entre 25 a 40 pies debajo de la superficie. Recientemente se llevaron a cabo investigaciones para mejor definir las áreas profundas de la fuente y el alcance del agua subterránea afectada. Se utilizará esa información para re-evaluar el remedio actual del agua subterránea y metas remediales actuales. Asimismo, será necesario re-evaluar la acción remedial final para suelos contaminados. El tratamiento biológico de suelos fue abandonado en 1998 dado su incumplimiento en alcanzar niveles de limpieza necesarias para hidrocarburo poliaromáticos cancerígenos (cPAHs, por sus siglas en inglés). Para evitar que humanos sean expuestos, los suelos se agruparon y están ubicados en una cámara cubierta y con acceso limitado. No se espera que sea expuesto al agua subterránea en el sitio dado que la Ciudad de Houston continúa a proveer agua potable en el sitio y a los vecinos alrededor del sitio por medio del sistema de agua potable de la Ciudad. La re-evaluación de los remedios para ambos suelos y aguas subterráneas será terminada al fin del 2004.

La Segunda Evaluación de Cinco Años del Remedio del Sitio está disponible para la revisión del público en el siguiente depósito de información:

**Houston Central Library
Government Documents Area
500 McKinney Street
Houston, Texas 77002**

El informe también está disponible en el Internet al www.epa.gov/earth1r6/6sf/pdffiles/nc_5yr_0903.pdf. Preguntas sobre el Sitio Superfund de North Cavalcade Street, o la Segunda Evaluación de Cinco Años, deben ser dirigidas a Camille Hueni al (214) 665-2231 o 1-800-533-3508 (llamada gratis).

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