FIFTH FIVE-YEAR REVIEW REPORT FOR NORTH CAVALCADE STREET SUPERFUND SITE HARRIS COUNTY, TEXAS

June 2018

2008

2017

Prepared by

U.S. Environmental Protection Agency
Region 6
Dallas, Texas

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FIFTH FIVE-YEAR REVIEW REPORT
NORTH CAVALCADE STREET SUPERFUND SITE
EPA ID#: TXD980873343
HARRIS COUNTY, TEXAS

This memorandum documents the U.S. Environmental Protection Agency's performance, determinations and approval of the North Cavalcade Street Superfund site (Site) fifth five-year review under Section 121 (c) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S. Code Section 9621 (c), as provided in the attached Fifth Five-Year Review Report.

Summary of the Fifth Five-Year Review Report

This FYR summarizes the current status of the remedy at the North Cavalcade Street Superfund site. For OU1, groundwater sampling indicates the contamination in the shallow aquifer is contained within the Technical Impracticability (TI) Zone. For OU2, site soils, the containment cell appears to be functioning as intended. For OU3, groundwater in the interbedded aquifer, sampling indicates migration of dense non-aqueous phase liquid (DNAPL) within the TI Zone. Groundwater detections of site-related contamination below current standards have been observed in the interbedded aquifer outside of the TI Zone.

Environmental Indicators

Human Exposure Status: Under Control
Contaminated Groundwater Status: Under Control
Site-wide Ready for Reuse: No

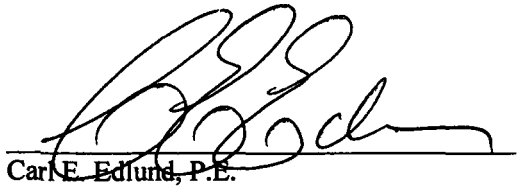
Actions Needed

The following actions must be taken for the remedy to be protective over the long term:

- MW-54S is near the railroad tracks and no buildings are located in this area; however, further evaluate the vapor intrusion pathway by using current data from appropriate wells and using multiple lines of evidence.
- Consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals. Evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed.
- Evaluate the need to update site contaminants of concern (COCs) in a decision document.
- Continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary).

Determination

I have determined that the remedy for the North Cavalcade Street Superfund site is currently protective of human health and the environment. This Five-Year Review Report specifies the actions that need to be taken for the remedy to be protective over the long term.



06/26/18

Carl E. Edlund, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

Date

CONCURRENCES

FIFTH FIVE-YEAR REVIEW REPORT
NORTH CAVALCADE STREET SUPERFUND SITE
EPA ID#: TXD980873343
HARRIS COUNTY, TEXAS

4/25/18

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Remedial Project Manager — Date

4/30/18

Carlos A. Sanchez
Chief, AR/TX Section — Date

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John C. Meyer
Chief, Superfund Remedial Branch — Date

6/14/18

Leonard Schilling
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06/19/18

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Chief, Superfund Branch, Office of Regional Counsel — Date

FOR 06/26/18

Pamela Phillips
Deputy Director, Superfund Division — Date

ISSUES/RECOMMENDATIONS

FIFTH FIVE-YEAR REVIEW REPORT
NORTH CAVALCADE STREET SUPERFUND SITE
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OU(s): 1	Issue Category: Monitoring			
	Issue: A conservative screening level risk assessment identified vapor intrusion risks for naphthalene at well MW-54S greater than EPA's noncancer hazard quotient (HQ) of 1 for industrial exposure.			
	Recommendation: MW-54S is near the railroad tracks and no buildings are located in this area; however, further evaluate the vapor intrusion pathway by using current data from appropriate wells and using multiple lines of evidence.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

OU(s): 3	Issue Category: Changed Site Conditions			
	Issue: The dense non-aqueous phase liquid (DNAPL) and the dissolved plume appear to be migrating west and site-related contaminants have been detected outside of the Technical Impracticability (TI) Zone.			
	Recommendation: Consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals. Evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

OU(s): 1 and 3	Issue Category: Monitoring			
	Issue: Potentially site-related contaminants that have not been formally identified in a decision document as contaminants of concern (COCs) exceed groundwater standards.			
	Recommendation: Evaluate the need to update site COCs in a decision document.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA/State	EPA/TCEQ	6/1/2020

OU(s): 1, 2 and 3	**Issue Category: Institutional Controls**			
	Issue: Soil and groundwater institutional controls required by site decision documents have not yet been implemented.			
	Recommendation: Continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

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LIST OF ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Record of Decision Amendment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
cPAH	Carcinogenic Polycyclic Aromatic Hydrocarbon
CPT	Cone Penetration Test
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
HQ	Hazard Quotient
IC	Institutional Control
ISS	In-Situ Stabilization
LCS	Liquid Collection Sump
LDS	Liquid Detection Sump
MIP	Membrane Interface Probe
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
NA	Not Applicable
NCP	National Contingency Plan
NM	Not Measured
NPL	National Priorities List
OU	Operable Unit
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PCL	Protective Concentration Limit
PCP	Pentachlorophenol
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
SDWA	Safe Drinking Water Act
SVOC	Semi-Volatile Organic Compound
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resources Conservation Commission
TRRP	Texas Risk Reduction Program
TI	Technical Impracticability
UU/UE	Unlimited Use and Unrestricted Exposure
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the North Cavalcade Street Superfund site (the Site). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of three operable units (OUs). This FYR addresses all three OUs. OU1 addresses the groundwater remedy for the shallow sand unit (shallow zone). OU2 addresses the soil remedy. OU3 addresses the groundwater remedy for the deeper interbedded sand.

EPA remedial project manager (RPM) David Abshire led the FYR. Participants included Marilyn Czimer Long with the Texas Commission on Environmental Quality (TCEQ) and Sarah Alfano and Kirby Webster from Skeo (EPA contractor support). The review began on 8/14/2017. Appendix A includes documents reviewed as part of the FYR. Appendix B includes the Site's chronology.

Site Background

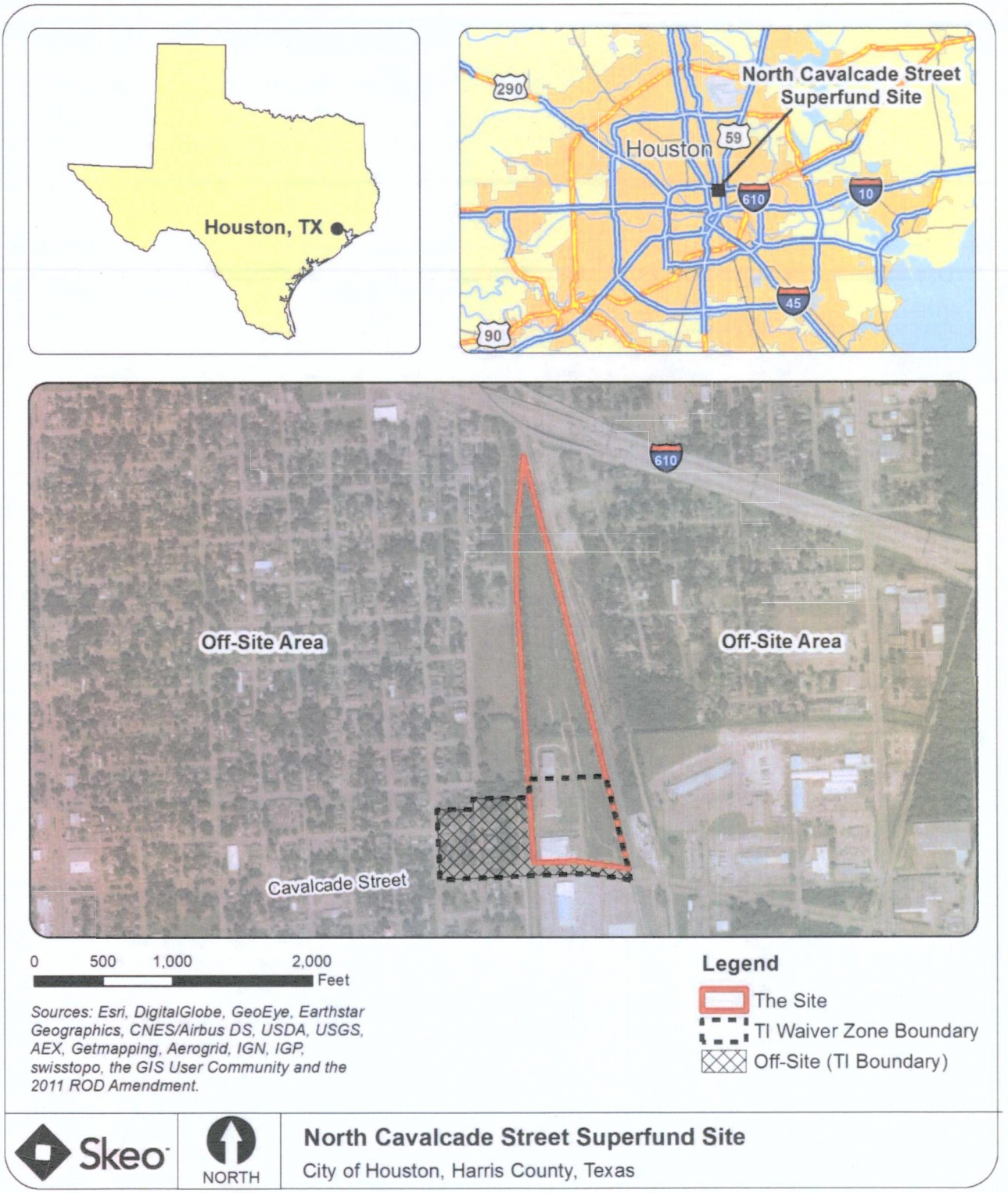
The 21-acre Site is located in a commercial/industrial corridor just north of downtown Houston, about 1 mile southwest of the intersection of Loop 610 and U.S. Highway 59, in Houston, Harris County, Texas (Figure 1). Beginning in 1946, Houston Creosoting Company, Inc. operated a creosote wood-treating plant on 10 acres on the southern portion of the Site. In about 1955, the company added pentachlorophenol (PCP) wood preservation services and other support facilities to their operations. In 1961, the property went into foreclosure. Facilities associated with wood-treating operations included creosote ponds, various tanks and storage units, a lumber shed, a treatment facility and other buildings. Site operations resulted in spills and releases that contaminated soil and groundwater with polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs).

Residential areas are located northeast and west of the Site. The South Cavalcade Street Superfund site, also a former wood-treating facility, is located directly south of the Site. Contamination at the North Cavalcade Street Superfund site is unrelated to contamination at the South Cavalcade Street Superfund site. There are currently two commercial businesses located on the southern portion of the Site – a warehouse for El Venado Foods and a Coastal Casting facility (a multi-faceted engine component distribution and re-manufacturing company).

Site topography is generally flat, with surface drainage occurring through three stormwater drainage ditches. Two of these ditches 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.

Groundwater occurs in three zones – the shallow, interbedded and deep zones. Contamination is limited to the shallow and interbedded zones, which are hydraulically connected but are confined from the deeper zone. These units are not being used for sources of drinking water on site or within a 1-mile radius of the Site. On-site workers and neighboring residents access water from the City of Houston's water supply, which obtains drinking water from the deep zone 10 miles from the Site, or a surface water reservoir located over 20 miles from the Site. Groundwater flow direction in the shallow and interbedded zones is to the west.

Figure 1: Site Vicinity



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Site.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: North Cavalcade Street		
EPA ID: TXD980873343		
Region: 6	**State:** Texas	**City/County:** Houston/Harris
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: David Abshire, with additional support provided by Skeo		
Author affiliation: EPA Region 6		
Review period: 8/14/2017 – 6/29/2018		
Date of site inspection: 12/12/2017		
Type of review: Statutory		
Review number: 5		
Triggering action date: 9/27/2013		
Due date *(five years after triggering action date)*: 9/27/2018		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Following site investigation, EPA placed the Site on the Superfund program's National Priorities List (NPL) in June 1986. In 1988, EPA and TCEQ concluded that remediation of contaminated soil and groundwater was needed based on future unacceptable human and environmental health risks due to direct exposure to contaminants in soil and future potable use of shallow zone groundwater contaminated with dense non-aqueous phase liquid (DNAPL). In 2009, EPA and TCEQ identified that DNAPL and contaminants detected in the interbedded zone would also pose unacceptable risk if this zone were used as a future drinking water supply. Table 1 summarizes the primary exposure media and contaminants of concern (COCs) for the Site.

Table 1: COCs, by Media

COC	Soil	Groundwater
Benzene	X	X
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)	X	X
Naphthalene		X

Response Actions

EPA selected the Site's initial remedy for OU1 soil, shallow zone groundwater and DNAPL in the Site's June 1988 Record of Decision (ROD). Following implementation of the 1988 remedy (see Table 2), EPA determined that additional remedy components were warranted to meet the remedial action objectives (RAOs) for the Site. EPA modified the Site's remedy in a 1994 Explanation of Significant Differences (ESD), 2009 Record of Decision Amendment (AROD) and 2011 AROD (see Table 2 for details). EPA also adjusted the Site's OUs from the original one to three, defined as:

- OU1: DNAPL associated with the shallow aquifer.
- OU2: Soil.
- OU3: Groundwater plume associated with the interbedded unit aquifer.

The final RAOs were established for soil and groundwater (to include DNAPL) in the 2009 AROD and the 2011 AROD, respectively. A summary of the remedy components to address the RAOs is presented in Table 2.

Table 2: Summary of RAOs and Soil and Groundwater Remedy Components

RAO	Remedy Components
Soil – OU2	
Prevent human exposure to contaminated soil in excess of current site preliminary remediation goals (PRGs) (30 parts per million for cPAHs). Minimize migration of soil contaminants currently residing in the temporary containment cell into the groundwater, surface water and other site soil. Return a majority of site surface area to reuse wherever practicable.	On-site biological treatment and containment (until 1998).[a]
	Construction of a permanent cap over the existing soil containment cell that has a double bottom liner.[b]
	Institutional controls to prevent disturbance of the containment cell.[b]
Groundwater – Shallow Zone (OU1) and Interbedded Zone (OU3)	
Contain two groundwater contaminant plumes, associated with the shallow zone (OU1) and the interbedded zone (OU3), through natural processes. Prevent human exposure to contaminated groundwater above acceptable risk levels by implementing institutional controls to restrict access to, or use of, contaminated water by restricting the installation of groundwater wells within the designated Technical Impracticability (TI) Zone. Remove site-related DNAPL accumulations in impacted monitoring wells until the amounts diminish and/or retrieval is no longer practicable.	OU1: Pump and treat groundwater using carbon absorption and DNAPL removal (until 2003).[c]
	OU1 and OU3: • In-situ stabilization (ISS) of DNAPL and monitored natural attenuation.[b] • TI Waiver for remaining dissolved-phase contamination and DNAPL in groundwater waives cleanup goals within the TI Zone.[d] • Periodic pumping of DNAPL in impacted monitoring wells until retrieval is no longer practicable.[d] • Implementation of institutional controls to:[b] - provide notice to property owners and prospective purchasers that contaminated water from the shallow and interbedded sand should not be used for drinking or potable water until remedial goals are met.

RAO	Remedy Components
	- prohibit digging into the stabilized area and to protect the monitoring wells. • Implement institutional controls to restrict access to, or use of, contaminated water by restricting the installation of groundwater wells within the designated TI Zone.[d] • Implementation of long-term monitoring.[d]

Notes.

a. A 1988 ROD component, discontinued because soil cleanup goal could not be achieved. Thus, contaminated soil was consolidated on the northern portion of the Site in a temporary containment cell pending evaluation of options for its final disposition.
b. Remedy component selected in the 2009 AROD.
c. The 1988 ROD pump-and-treat remedy addressed contaminated shallow groundwater and DNAPL (OU1). The system was shut down in 2003 due to inability to address contamination in the interbedded zone (OU3).
d. Remedy component selected in the 2011 AROD because EPA determined that it was technically impracticable to restore all parts of the dissolved-phase groundwater because of the intermittent occurrence of residual and free-phase DNAPL in the shallow and interbedded zones.

cPAH = carcinogenic polycyclic aromatic hydrocarbon

A summary of the cleanup goals for soil and groundwater and DNAPL is presented in Table 3.

Table 3: COC Cleanup Goals

COC	Soil (mg/kg)[a]	Groundwater[b] (µg/L)	DNAPL[c]
Benzene	0.04	5	Pumped for collection and disposal until the amounts diminish and/or retrieval is no longer practicable.
Benzo(a)pyrene (cPAHs for soil)	30	0.2	
Naphthalene	NA	1,500 on site[d] 490 off site[e]	

Notes

a. Established in the 1988 ROD, based on a 1 x 10^{-5} cancer risk for a commercial site. Goal for cPAHs changed in the 1994 ESD based on updated risk assessment methodologies. Also described in Section 2 of the 2009 AROD.
b. Established in the 2009 AROD based on the federal drinking water standards or a state standard in the absence of a federal drinking water standard; values only apply outside the TI Zone boundary according to the 2011 AROD (Section 7.4).
c. Established in 2011 AROD for residual DNAPL on site since most of the DNAPL had been addressed by the pump-and-treat system and ISS.
d. Based on commercial/industrial use.
e. Based on residential use.

NA = not applicable; a separate cleanup goal for naphthalene in soil was not established in the decision documents.
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
cPAH = carcinogenic polycyclic aromatic hydrocarbon
TI = Technical Impracticability

Status of Implementation

OU2 - Soil

Through an agreement between EPA and the state, the Texas Natural Resources Conservation Commission (TNRCC, now TCEQ) obtained contracts to implement the remedy in the Site's 1988 ROD. TNRCC constructed

the biotreatment facility in April 1996 and performed biotreatment for 808 days without achieving the cleanup level established in the 1994 ESD for carcinogenic polycyclic aromatic hydrocarbons (cPAHs). TNRCC discontinued treatment in August 1998. EPA modified the TNRCC contract to include a modified closure phase to place the contaminated soil in the treatment cell on the northern portion of the Site and cover it with a liner pending final determination of disposition by EPA and TNRCC.

Based on the 2009 AROD, EPA modified the temporary treatment cell for permanent containment by retrofitting the liner and installing a permanent cap. Prior to the remedial design, EPA confirmed the containment cell was constructed with a bottom liner consisting of the following from top to bottom: geotextile fabric, high-density polyethylene primary liner (leachate collection liner), sand leachate collection layer and a high-density polyethylene secondary liner (leachate detection liner). EPA completed the remedial design of the permanent containment cell in July 2010. Construction activities began in August 2010 and largely finished by February 2011. The old high-density polyethylene cover was removed. The surface of the contaminated soil was regraded and additional material placed such that the appropriate slope was achieved. The final cover consists of about 8 inches of soil, followed by a geocomposite drainage net, a low-density polyethylene geomembrane and a geosynthetic clay liner. The cell contains five PVC leachate riser pipes. Four of the riser pipes, one at each corner of the containment cell, are for the liquid detection sump (LDS). The riser on the south side is for the liquid collection sump (LCS). TCEQ began operation and maintenance (O&M) activities for the soil remedy in September 2012.

OU1 and OU3 - Groundwater

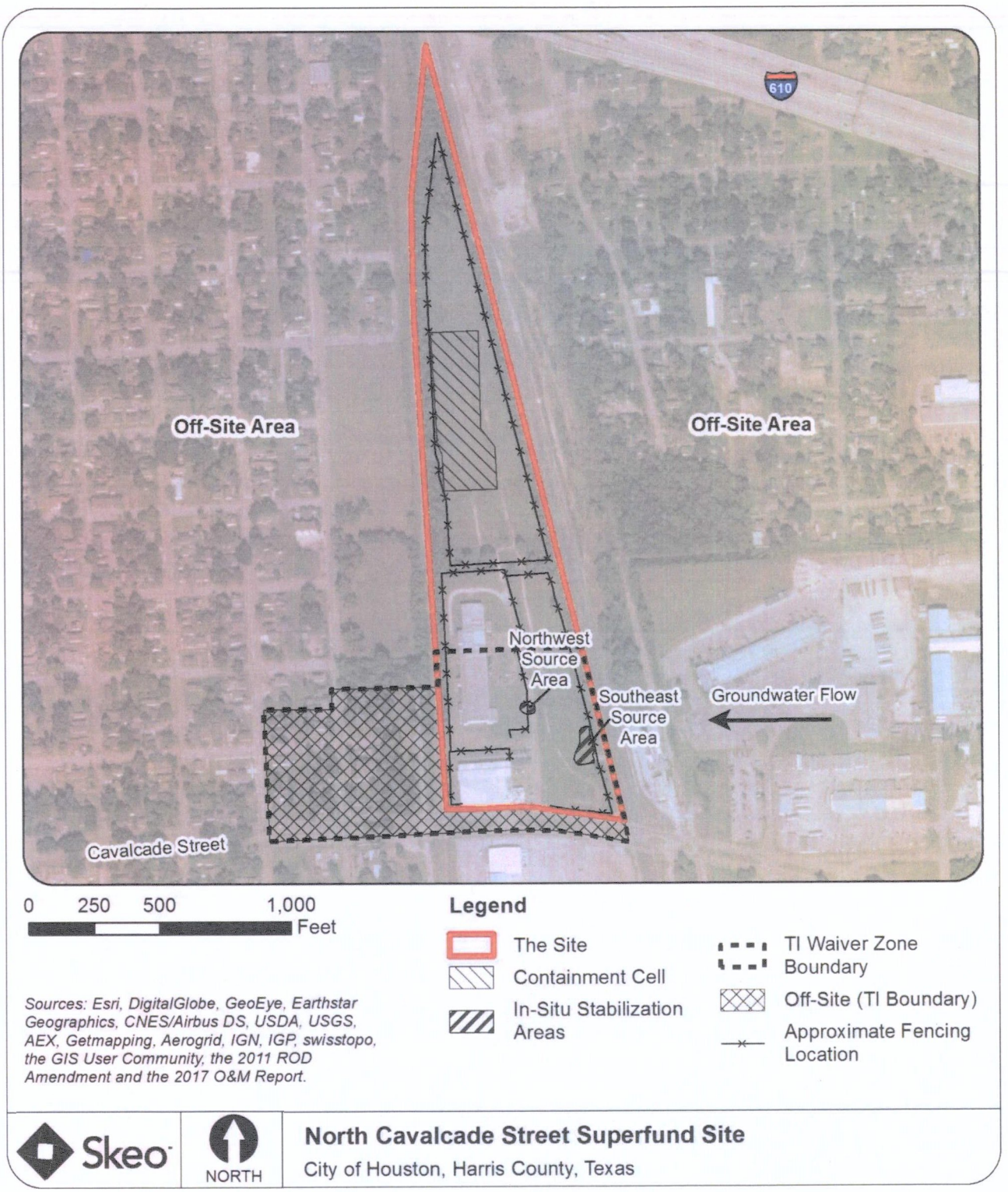
Between September 1988 and September 1991, EPA completed the remedial design for the pump-and-treat system to address shallow groundwater contamination. Additional sampling demonstrated that DNAPL extended below the shallow zone to the interbedded zone. After some modifications to the system, operation of the pump-and-treat system was suspended in October 2003 since it could not operate effectively in the much siltier interbedded zone. EPA completed a focused feasibility study in 2008 to evaluate additional remedies to address groundwater and DNAPL contamination in the interbedded zone that had extended off site to the west.

In 2009, EPA and TCEQ selected in-situ stabilization (ISS) to address the highest-volume DNAPL areas within the shallow and interbedded zones and reduce the rate of dissolution of the three target compounds (benzene, benzo(a)pyrene and naphthalene) in groundwater. EPA completed the remedial design for ISS between September 2009 and May 2010. EPA performed the ISS in two source areas: the northeast source area and the southwest source area (Figure 2). EPA completed the ISS remedial action in May 2010; installation of a permanent monitoring well network followed between November 2010 and March 2011. Monitored natural attenuation was to be considered as a remedial technology used in conjunction with ISS. It was later ruled out in 2011 due to the presence of DNAPL in some wells within the newly installed monitoring well network. In 2011, EPA revised the groundwater remedy to address remaining DNAPL present in monitoring wells. A 16-acre Technical Impracticability (TI) Zone was established as part of the 2011 AROD. Within the TI Zone, the groundwater cleanup levels (Table 3) are waived. The 2011 AROD also specified the periodic removal of DNAPL in several wells where residual DNAPL remained and institutional controls to restrict installation of groundwater wells. In June 2012, DNAPL removal was discontinued. The 2013 FYR indicated that the DNAPL accumulation in select wells do not represent a mobile plume but is a residual phase that is confined to the formation pore space of the water-bearing zones. The 2013 FYR recommended continued tracking of the occurrence of DNAPL in the monitoring wells but discontinued the DNAPL removal and sampling of these monitoring wells.

The 2011 remedy specifies that long-term groundwater monitoring will document the effectiveness of the source stabilization and the stability of the dissolved groundwater plumes in the shallow and interbedded zones. TCEQ began O&M activities for the final groundwater remedy in September 2013.

In addition to regular O&M activities, TCEQ also conducted a cone penetration test (CPT) and membrane interface probe (MIP) evaluation in July and August 2017 in an area northwest of the Site to assess the potential downgradient migration of site contaminants. The results of the CPT/MIP evaluation are included in the Data Review section of this FYR.

Figure 2: Site Detail



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Institutional Control (IC) Review

Table 4 shows a summary of institutional controls. Figure 3 shows an institutional control map. To date, none of the institutional controls have been implemented. The City of Houston does not have zoning regulations, instead development is governed by codes that address how property can be subdivided. The City follows Chapter 42, the City's 1986 land development ordinance.[1] If an owner wanted to change the land type, they would need to submit an application to the planning department. If any deed or land use restrictions exist, they would be flagged during the land use change process.

The United States of America owns the parcel where the soil containment cell is located. The on-site and off-site areas are provided drinking water through a public supply and the cell containment area is surrounded by a locked chain-link fence that prevents access to this portion of the Site. Fencing is not a remedy component but it is present and prevents disturbance of on-site remedy components. EPA and TCEQ are currently working on developing institutional controls as required in the decision documents.

Table 4: Summary of Institutional Controls (ICs)

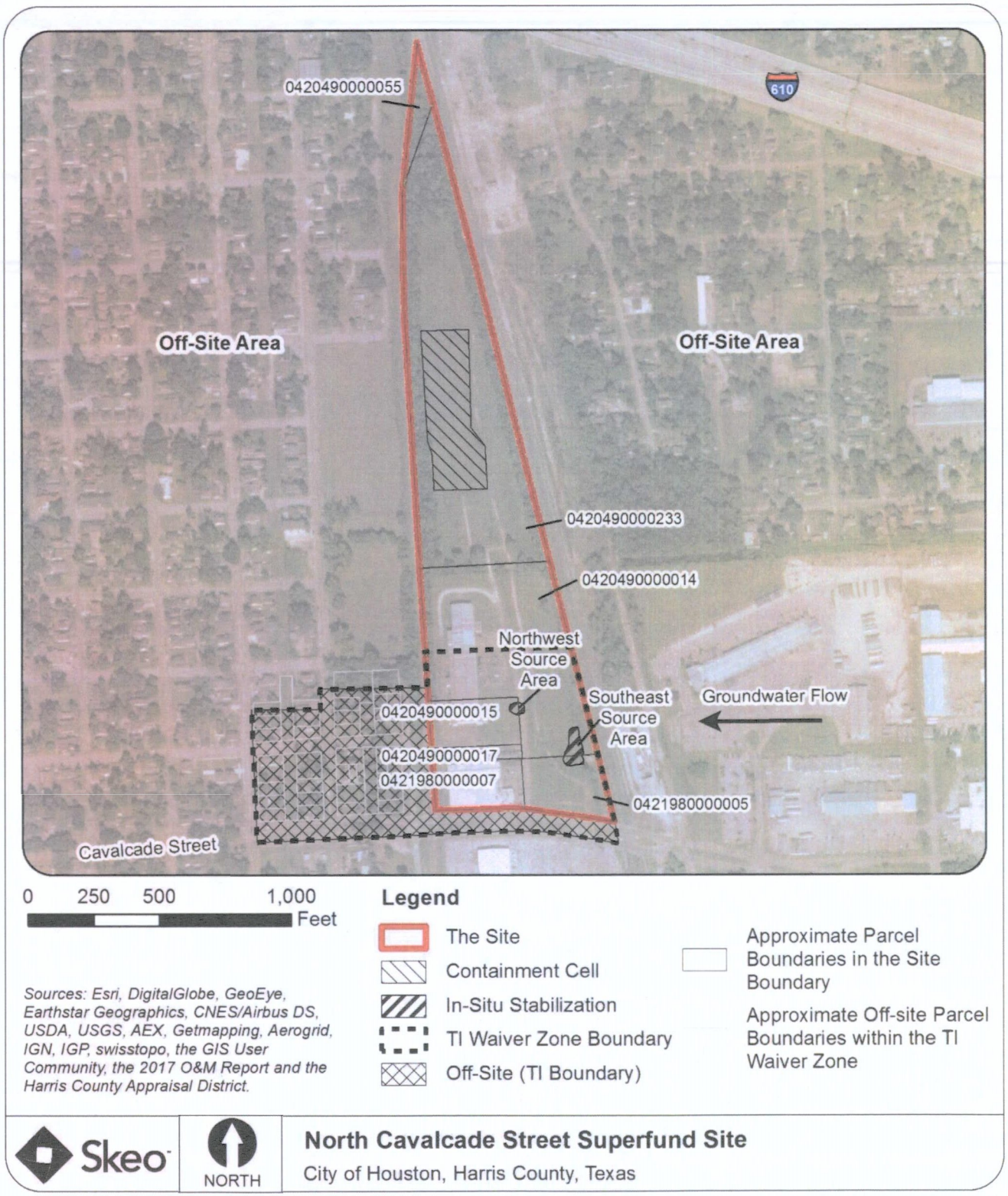
Media That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)[a]	IC Objective	Title of IC Instrument Implemented and Filing Date
OU1 – ISS Areas	Yes	Yes	0420490000014 0421980000005 0420490000015	Prevent human exposure to contaminated soil[b]	None
OU2 – Containment Cell	Yes	Yes	0420490000233	Prevent disturbance of the containment cell[c]	None
OU1/OU3 Groundwater TI Zone	Yes	Yes	To Be Determined	Provide notice to property owners and prospective purchasers that contaminated water from the shallow and interbedded sand should not be used for drinking or potable water until remedial goals are met[e]	None

Notes:

a. Parcel information from: https://arcweb.hcad.org/parcelviewer/.
b. The 2011 AROD required implementation of restrictions to protect components of the groundwater remedy (the two stabilized source areas and permanent monitoring wells).
c. The 2009 AROD called for institutional controls to be put in place for OU2 soils to prevent disturbance of the capped soil containment cell.
d. The 1988 ROD based soil cleanup goals on commercial use of the site properties. The 2009 AROD states that "The EPA will implement a program to place institutional controls on all properties affected by the groundwater and soil contamination following completion of the construction activities at the Site."
e. The 2011 AROD specified institutional controls to provide notice to on-site and off-site property owners and prospective purchasers that contaminated water from the shallow and interbedded groundwater should not be used for drinking or potable water where cleanup goals are not met or have been waived. The 2011 AROD also required placement of restrictions to prevent the installation of water supply wells in those areas.

[1] http://www.houstontx.gov/planning/DevelopRegs/dev_ord.html

Figure 3: Institutional Control Map



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Systems Operations/O&M

TCEQ is currently responsible for O&M activities at the Site. Required O&M activities for the soil and groundwater remedies are outlined in the 2014 O&M Plan prepared by Shaw Environmental. Activities specified in the 2014 O&M Manual for remedies implemented at the Site include:

- Monthly mowing/inspection of the capped areas and around site monitoring wells during the growing season.
- Periodic inspection of the Site during the non-growing season.
- Inspection of the Site following severe weather events (as needed).
- Inspection of site wells and leachate system riser pipes during the annual gauging/sampling event, and the gauging-only event. Gauging is to include the collection of water levels and DNAPL thickness measurements in all site monitoring wells.
- One gauging/sampling event performed per year, during which all leachate collection and detection sump risers will be gauged and sampled, all monitoring wells will be gauged, and select monitoring wells will be sampled. Within the interbedded unit, wells with measurable DNAPL will not be sampled. Within the shallow sand, only select wells near the perimeter of the monitoring zone will be sampled.
- One gauging-only event performed per year, inclusive of all site monitoring wells and leachate collection and detection sump risers.
- Annual evaluation and reporting of collected data (by August of each year).
- Routine and non-routine maintenance as needed.

Table 5 summarizes annual O&M costs since the 2013 FYR Report. According to the 2011 AROD, the annual O&M costs were presented as a range from $60,000 to $200,000, based on the frequency of sampling, wells sampled and other O&M tasks (e.g., monthly site inspections and mowing). The 2009 AROD estimated average annual O&M costs for the soil remedy of about $37,000 per year. TCEQ assumed responsibilities for O&M tasks in the 2013/2014 year. In addition to regular O&M activities, TCEQ performed the following tasks:

- 2013/2014: Prepared site-specific documents, a Health and Safety Plan and a Field Sampling O&M Plan.
- 2015/2016: Transitioned to a new contractor, modified site-specific documents, repaired three wells and plugged one well.
- 2016/2017: Conducted CPT/MIP evaluation and prepared Report, re-surveyed two wells, repaired a leak detection sump and restored flow to culvert southeast of soil containment cell.

Table 5: Annual O&M Costs

Fiscal Year	Total Cost (rounded to nearest $1,000)
9/1/2013 – 8/31/2014	$178,000
9/1/2014 – 8/31/2015	$69,000
9/1/2015 – 8/31/2016	$104,000
9/1/2016 – 8/31/2017	$150,000

III. PROGRESS SINCE THE PREVIOUS REVIEW

This section includes the sitewide protectiveness determination and statement from the last FYR as well as the recommendations from the last FYR and the status of those recommendations.

Table 6: Protectiveness Determination from the 2013 FYR Report

OU #	Protectiveness Determination	Protectiveness Statement
Sitewide	Short-term Protective	The remedial actions for ground water and soils are protective of human health and the environment in the short term because there is no completed exposure pathway to human health or environmental receptors for either media. Contaminated surface soil is contained within a protective cell. Ground water is not being used in the impacted area. The City of Houston provides drinking water to the area through their public water supply system. In order for the remedies to be protective in the long term, institutional controls will need to be implemented to restrict use of impacted properties (on site/off site), as appropriate, to protect the ISS and cell remedies, and to prevent the use of contaminated ground water. Changes in site conditions (i.e., uncertainties) will also need to be evaluated to determine if there are impacts to future protectiveness.

Table 7: Status of Recommendations from the 2013 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
OU1,2,3	Some wells were noted to be unlocked.	Install locks.	Completed	All wells were locked during the site inspection.	12/12/2017
OU1,2,3	Institutional controls have not been established to date.	Establish institutional controls.	Ongoing	EPA and TCEQ are coordinating to establish groundwater and soil institutional controls.	NA
OU1/3	Presence / accumulation of DNAPL in select monitor wells.	Continue gauging and sampling monitor wells, and monitor presence of DNAPL and dissolved-phase groundwater contaminant concentrations relative to the TI Zone boundary.	Completed	TCEQ continues to gauge the accumulation of DNAPL in monitoring wells and groundwater concentrations in wells not affected by DNAPL in annual reports.	10/27/2017

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
OU1/3	(a) PCP has been confirmed in shallow sand (very limited) and interbedded sands groundwater samples. (b) Industrial reuse of the on-site property was considered in setting the remedial goal to address naphthalene in the impacted on-site groundwater. (c) Detections of vinyl chloride and solvent-related contaminants have been noted in on-site wells MW-37I, MW-37S, and OW-2, and off-site wells MW-45S and MW-45I.	Continue monitoring the shallow groundwater plumes for both VOCs and semi-volatile organic compounds (SVOCs) in the O&M phase to further evaluate the presence of PCP and limited occurrence of chlorinated solvents. Evaluate the application of an industrial (use-specific) remedial goal for on-site concentrations of naphthalene.	Ongoing	Annual monitoring reports and the groundwater remedy evaluation summarized in the 2017 annual monitoring report summarize results from VOC and SVOC monitoring. The application of the industrial (use-specific) remedial goal for on-site concentrations of naphthalene has not formally been evaluated.	10/27/2017

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

A public notice was made available by a newspaper posting in the Houston Chronicle, on 11/15/2017 in English and on 11/19/2017 in Spanish (Appendix C). It stated that the FYR was underway and invited the public to submit any comments to EPA. The results of the review and the report will be made available at the Site's information repository, Houston Central Library, located at 550 McKinney Street, Houston, Texas.

During the FYR process, EPA and its contractor reached out to several parties to document any perceived problems or successes with the remedy implemented to date, including representatives of TCEQ, TCEQ contractor EnSafe, on-site businesses El Venado and Coastal Casting, the City of Houston, Harris County and the Harris County Toll Road Authority. EPA did not receive interview responses from El Venado and Coastal Casting. Completed interview forms are included in Appendix F.

Representatives from TCEQ and its contractor, EnSafe, responded that they feel the site is acceptable. Communication and coordination has been ongoing between EPA and TCEQ regarding site status and general maintenance issues. TCEQ representatives identified the following issues: the presence and apparent expansion of DNAPL within the TI Zone boundary, the lack of institutional controls implemented by the EPA, and the urban development in the site area (inside and outside of the TI Zone boundaries). Groundwater sampling and gauging events over the past five years indicate the plume is not stable and the effectiveness of DNAPL containment using natural processes may not be a viable remedy. EnSafe representatives commented that real estate in the neighborhood near the Site has become more attractive to new residential development. New residential homes and condominiums have been built within the past five years in areas west of the Site, downgradient of the TI Zone.

Representatives from the City of Houston and Harris County responded that the City and County have no first-hand knowledge of the status of the cleanup activities at the Site. They are very concerned that there may be ongoing issues at the Site that are not being addressed by the current soil and groundwater remedies.

Based on the review of publicly-available documents and knowledge of ongoing concerns at the nearby South Cavalcade Street Superfund site, the City and County are concerned that contaminated groundwater at the Site may be infiltrating nearby storm sewer lines. They recommend an investigation into whether the Site is actively discharging into the storm sewers and ultimately to the Waters in the State of Texas and Waters of the United States. The City and State requested EPA's site website include information about current activities at the Site as well as documentation regarding plume stability, ongoing assessment, ongoing remedial and monitoring activities, and remedy implementation and effectiveness.

During the December 2017 site inspection, site inspection participants also walked through surrounding neighborhoods and knocked on several doors for interviews. No residents were available.

Data Review

This data section summarizes the leachate and groundwater monitoring program for the OU2 containment cell and OU1/OU3 groundwater monitoring associated with the DNAPL and dissolved phase plumes. This data review section will focus on the most recent sampling event, which was conducted in February 2017 and summarized in the 2017 Annual O&M Report. Historic trends observed during this FYR period (2013 through 2017) will be discussed as appropriate.

Leachate and groundwater samples collected during this FYR period were analyzed for VOCs, semi-volatile organic compounds (SVOCs) and metals. The ROD and ARODs identify benzene, benzo(a)pyrene and naphthalene as site COCs. In the 2013 FYR Report, EPA recognized vinyl chloride and PCP as solvent-related constituents or related constituents. In April 2014, TCEQ assumed responsibility for O&M duties. TCEQ added arsenic to the list of chemicals to be monitored. The February 2017 Annual O&M Report compares results against preliminary remediation goals (PRGs) or Texas Risk Reduction Program (TRRP) protective concentration limits (PCLs) for all analyzed constituents including those specified as COCs and those not specified as COCs. This data review section will include a discussion of all analyzed constituents.

The overall conclusions of the data review include:

- OU1: sampling indicates the contamination in the shallow aquifer is contained within the TI Zone.
- OU2: the containment cell appears to be functioning as intended.
- OU3: sampling indicates migration of the DNAPL extent within the TI Zone (west-southwest area) and groundwater detections below cleanup goals, of site-related contamination in the interbedded aquifer outside of the TI Zone (northwest area).

OU2 Soil Containment Cell - Leachate Monitoring Program

The containment cell leachate monitoring program was performed concurrent with the annual groundwater monitoring/gauging event (February 2017) and the gauging-only event (June 2017). During the monitoring and gauging events, the depth to liquid in the five LCS and LDS sump risers were measured (LCS, LDS-NW, LDS-SW, LDS-SE and LDS-NE, shown in Figure G-1 in Appendix G). Generally, fluid thickness measurements during this FYR period were similar to past thickness measurements, however thickness measurements observed during the June 2017 event are the lowest on record, with the exception of the measurement at the LCS. Table G-1 in Appendix G shows measured leachate fluid thickness. It is measured by subtracting the depth to water from the total well depth. The 2017 total well depth measured at the LCS was about 6 to 9 feet greater than past historical total well depth measurements. The 2017 Annual O&M Report identifies the gauging discrepancy as a field data collection error. The LCS and LDS are operating as intended.

During the annual groundwater monitoring event, three leachate samples were collected from the five sump risers and groundwater samples were collected from the six shallow zone monitoring wells that surround the containment cell (Figure G-1 in Appendix G). Samples were analyzed for VOCs, SVOCs and metals. Analytical results of fluid samples collected from the sumps during the February 2017 sampling event identified no constituents exceeding the PRGs or TRRP PCLs, with the exception of arsenic levels in LCS and LDS-NW (Figure G-5). The comparison of fluids collected from the sump risers to PRGs and PCLs is only to provide a reference. PRGs and PCLs are action levels relative to evaluation of groundwater, not soil containment cell leachate.

No monitored constituents including the site COCs exceeded their respective PRGs or PCLs in groundwater samples collected from the six groundwater monitoring wells surrounding the containment cell in 2017 (MW-22S through MW-27S, Figure G-5 in Appendix G). Additionally, there have been no exceedances of site COCs during this FYR period in the containment cell monitoring wells. See Tables 3, 5 and 7 in the 2017 Annual O&M Report. These results indicate the containment cell is functioning as intended.

OU1 and OU3 - Outside the TI Zone Boundary

Shallow monitoring wells outside of the TI Zone boundary are located around the containment cell and discussed above.

Within the interbedded zone, no site COCs were detected within the past five years at concentrations above their respective PRG limits in groundwater monitoring wells (49I, 50I, 52I) outside of the TI Zone (Figure G-6 in Appendix G).

OU1 and OU3 - Within the TI Zone Boundary

The current groundwater monitoring activities include DNAPL gauging in wells located in the interbedded zone, water level gauging and groundwater sampling activities within the interbedded zone in wells without DNAPL and select monitoring wells within the shallow zone. Sampling is conducted annually and gauging is conducted on a semiannual basis.

DNAPL

The cumulative DNAPL thickness measurements recorded during this FYR period are provided in Table G-2 in Appendix G. The 2017 DNAPL extent is shown in Figure G-3 and the DNAPL extent over time is shown in Figure G-4. As shown in the Table G-2, DNAPL thickness appears to be increasing over time in both on-site and off-site (TI Boundary) wells. MW-47I did not have DNAPL present until April 2014, when 0.03 feet in thickness was observed; the thickness has increased to almost 5 feet in June 2017. Monitoring well MW-47I is the furthest downgradient occurrence of DNAPL to the west. DNAPL thickness in MW-37I also continues to increase, albeit more gradually, since 2016 (Table G-2). This well is located near the TI Zone boundary to the northwest. TCEQ conducted a CPT/MIP evaluation in July and August 2017 in an area northwest of the Site to determine potential downgradient migration of site contaminants beyond the TI Zone boundary. Results of the investigation are discussed below.

Shallow Zone

Within the shallow zone, no site COCs (benzene, naphthalene and benzo(a)pyrene) were detected in groundwater at concentrations above their respective PRG limits inside of the TI Zone in 2017. This is fairly consistent with data collected during the past five years for the wells that are currently sampled. However, all three COCs exceeded PRG limits in monitoring wells in 2013 and 2014; the majority of these wells have not been sampled since 2014.

The analytical data for the shallow zone is presented in Tables 3 through 8 in the 2017 Annual O&M Report.

Interbedded Zone

During the 2017 sampling event, site COCs benzene and naphthalene exceeded PRGs in several interbedded zone wells (Table G-3). These wells have consistently exceeded the PRGs for benzene and naphthalene since 2013. Table G-4 shows naphthalene concentrations for the last five years in wells that had exceedances during the 2017

sampling event. As shown, the concentrations have increased in MW-34I, which is located downgradient of the northwest and southeast source areas.

Other Monitored Constituents – Shallow and Interbedded Zones

The 2013 FYR recognized PCP as site-related and vinyl chloride as solvent-related contaminants. Both these contaminants were not originally identified as final COCs in the 1988 ROD because these contaminants at that time were below detection in soil and groundwater. The 2013 FYR also determined that while these other contaminants were routinely sampled over the years, the analytical methods did not have low enough sample detection limits to meet the levels of required performance under TRRP. In April 2014, TCEQ assumed responsibility for O&M duties, and groundwater was monitored for the solvent-related constituents and site-related constituents. TCEQ also included arsenic to the list of chemicals to be monitored. This section summarizes the results of the Site COCs and other contaminants that are now being detected due to the use of more sensitive analytical methods.

Table G-5 shows other chemicals exceeding PRG and/or TRRP Tier 1 PCLs during the most recent sampling event in both the shallow and interbedded zones. The 2017 data show that a majority of the exceedances occur in the interbedded zone, with the highest concentrations detected in MW-34I and MW-35I, which are located downgradient of the northwest and southeast source areas. Lower exceedances occur as far west as MW-46I, which is located west and off site (TI Boundary) of the facility. Arsenic was detected at MW-32I in 2017 (Figure G-5). All exceedances were within the TI Zone boundary with the exception of monitoring well MW-32I, located just outside the northern TI Zone boundary, east of the Coastal Casting facility.

In the shallow zone, carbazole was detected in MW-54S at 0.31 mg/L which is above the PCL of 0.100 mg/L. Monitoring well MW-54S is located within the TI Zone, near the eastern boundary (Figure G-4). The groundwater flow direction near monitoring well MW-54S is relatively flat. Carbozole has routinely been detected in MW-54S at concentrations exceeding its PCL during previous sampling events.

2017 CPT/MIP Evaluation (Remedy Protectiveness Assessment)

In addition to regular O&M activities, TCEQ contractor EnSafe conducted a CPT/MIP evaluation of the shallow and interbedded units in July and August 2017 in an area northwest of the Site to assess the potential downgradient migration of site contaminants beyond the TI Zone boundary. There was no evidence of DNAPL in the nine boring locations. Based on conditions observed in the subsurface during the CPT/MIP evaluation, groundwater samples were collected at targeted intervals (26 to 28 feet below ground surface). Results from groundwater analysis identified detections of benzo(a)pyrene, PCP, 1,1-dichloroethene, and vinyl chloride below current groundwater standards at MIP-B5 and MIP-C5 in the interbedded unit. These detections may be indicative of downgradient migration of site-specific chemicals beyond the TI Zone boundary. CPT/MIP locations are shown in Figure G-4.

Site Inspection

The site inspection took place on 12/12/2017. Participants included EPA RPM David Abshire, Marilyn Czimer Long with TCEQ, and Sarah Alfano and Claire Marcussen with EPA FYR support contractor Skeo. The purpose of the inspection was to assess the protectiveness of the remedy. A completed checklist and site inspection photos are included in Appendix D and E, respectively.

Participants met at El Venado Food's warehouse facility on the southwest corner of the Site and then proceeded to the Coastal Casting facility. Flush-mounted monitoring wells were observed at both the El Venado and Coastal Casting properties; all wells were locked and secured. A locked chain-link fence surrounds the two commercial businesses where two source areas were stabilized as part of the groundwater remedy for the shallow and interbedded zones. A locked fence also surrounds the containment cell for the soil remedy (OU2) located on the northern site parcel. Participants then viewed the Harris County Flood Control District easement that bisects the Site. The drainage feature is maintained by Harris County and appeared clear and unobstructed by debris. The soil

containment cell was observed to be vegetated with grass and no erosion or burrows were observed. Drainage ditches on the slopes of the containment cell were lined with grass or rock to prevent erosion by runoff.

All perimeter wells were located and were secured, labeled and in good condition. Participants also walked on top of the containment cell to observe the LCS and the four leachate detection system risers (LDS-SE, LDS-NE, LDS-NW and LDS-SW), which appeared to be secured and in good condition. Site participants then observed the two stabilized source areas on the southern portion of the Site and associated monitoring wells, which included flush-mounted and stick-up wells, all of which were secured and in good condition. The stabilized source areas were covered with thick grass and well maintained by routine mowing. Participants then observed over a dozen monitoring wells within and outside the TI Zone boundary. All were flush mounted, locked and in good condition. New townhomes were observed west of Maury Street and near MW-49I.

Skeo staff visited the designated site repository, Houston Central Library, in Houston, Texas. The repository had copies of the 1988 ROD, the 2009 AROD, the 2011 AROD, and the 2013 Community Involvement Plan. The repository did not contain any FYRs or the Preliminary Close-Out Report.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

OU2
The OU2 remedy included consolidation of wastes in a containment cell and institutional controls to prevent disturbance of the containment cell. Current monitoring requirements include a network of liquid collection and detection sumps. Current monitoring indicates the OU2 remedy continues to operate and function as intended by the decision documents. Institutional controls are not in place to prevent disturbance of the containment cell. However, the containment cell area is enclosed by a locked chain-link fence to prevent disturbance of the remedy. The containment cell is on the parcel owned by the United States of America, however institutional controls are not yet in place.

OU1 and OU3
The OU1 and OU3 remedy included ISS, monitored natural attenuation and a TI Waiver for groundwater. In addition, the remedy included institutional controls and long-term monitoring. Based on the data review, monitoring data to date indicate that the remedy is not functioning as intended by the decision documents. DNAPL appears to be migrating within the interbedded unit in the TI Waiver Zone. A remedy protectiveness assessment took place in 2017 which included a CPT/MIP investigation. Based on the results of the CPT/MIP investigation of the shallow and interbedded units in July and August 2017 in an area northwest of the Site to evaluate potential downgradient migration of site contaminants beyond the TI Zone boundary, additional evaluation is needed. Results of the assessment indicated downgradient migration of COC and non-COC chemicals beyond the TI Zone boundary, however concentrations of those COCs are still below cleanup goals. The contractor recommended the installation of a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals, and to assess the protectiveness of the TI Zone boundary. Institutional controls have not been put in place.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:

Yes. The RAOs used at the time of the remedy selection are still valid. The Site remains in commercial use. The chemical-specific applicable or relevant and appropriate requirements (ARARs) for groundwater presented in the 2009 AROD were reviewed and demonstrate that the ARARs remain valid (Appendix H).

Toxicity values have changed for some soil and groundwater COCs. The cleanup goals were evaluated (Appendix I) to determine if revisions are warranted and whether the revisions affect the proposed TI Zone boundary. Based on a screening-level risk evaluation of the soil and groundwater cleanup goals, soil cleanup goals remain valid for commercial or industrial land uses. Groundwater cleanup goals remain valid for benzene and benzo(a)pyrene. However, a screening level risk assessment of the on-site and off-site (TI Boundary) groundwater cleanup goals (Table I-3) indicates that the cleanup goals for naphthalene exceed a cancer risk of 1×10^{-4} and a noncancer hazard quotient (HQ) of 1. The cleanup goal for naphthalene was based on a state standard. There are currently no completed exposure pathways because groundwater is not being used in this area. Additionally, the 2011 AROD waived cleanup goals within the TI Zone.

Other monitored chemicals have exceeded PRGs and/or TRRP Tier 1 PCLs during the most recent sampling event in both the shallow and intermediate zones. All exceedances were within the TI Zone boundary with the exception of monitoring well MW-32I, located just outside the northern TI Zone boundary, east of the Coastal Casting facility. An evaluation should be done to determine whether these other chemicals are site related, should be included as COCs and/or require additional actions.

The vapor intrusion pathway was evaluated in the previous FYR Report, which concluded that this exposure pathway did not represent a current exposure pathway based on the data and risk assessment methods at that time. This FYR completed a screening-level vapor intrusion evaluation using the EPA's Vapor Intrusion Screening Level (VISL) calculator, which incorporates current toxicity. The current groundwater monitoring sampling plan includes only select wells near the perimeter of the monitoring zone in the shallow sand aquifer. Typically, wells located near buildings would be used in a screening level assessment. Because wells located near buildings are not part of the current monitoring program, the wells with the highest concentrations of volatile compounds in the shallow aquifer were used as inputs to the evaluation. As shown in Table I-5, the 2017 maximum concentration of naphthalene on site is equivalent to a screening-level residential risk greater than EPA's cancer risk management range, while the noncancer HQ for both industrial and residential land use exceeds 1.0. These results indicate the need for further evaluation of the on-site vapor intrusion pathway following EPA guidance requiring the use of multiple lines of evidence to determine if this is a completed exposure pathway. There are currently active industrial buildings in use on site. The off-site (TI Boundary) evaluation demonstrates that vapor intrusion is not a current exposure pathway; risks and HQs are below EPA risk management levels. Periodically sampling the existing shallow wells located near buildings would provide a better assessment of the vapor intrusion pathway.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

New residential homes and condominiums have been built within the past five years in areas west of the Site, within and downgradient of the TI Zone. A screening level vapor intrusion assessment (Table I-5) indicates the vapor intrusion pathway is not currently a concern off site (TI Boundary). This pathway should continue to be monitored as concentrations fluctuations have been observed at some monitoring wells.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the FYR:
None.

Issues and Recommendations Identified in the FYR:

OU(s): 1	**Issue Category: Monitoring**			
	Issue: A conservative screening level risk assessment identified vapor intrusion risks for naphthalene at well MW-54S greater than EPA's noncancer HQ of 1 for industrial exposure.			
	Recommendation: MW-54S is near the railroad tracks and no buildings are located in this area; however, further evaluate the vapor intrusion pathway by using current data from appropriate wells and using multiple lines of evidence.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

OU(s): 3	**Issue Category: Changed Site Conditions**			
	Issue: The DNAPL and the dissolved plume appear to be migrating west and site-related contaminants have been detected outside of the TI Zone.			
	Recommendation: Consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals. Evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

OU(s): 1 and 3	**Issue Category: Monitoring**			
	Issue: Potentially site-related contaminants that have not been formally identified in a decision document as COCs exceed groundwater standards.			
	Recommendation: Evaluate the need to update site COCs in a decision document.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA/State	EPA/TCEQ	6/1/2020

OU(s): 1, 2 and 3	Issue Category: Institutional Controls			
	Issue: Soil and groundwater institutional controls required by site decision documents have not yet been implemented.			
	Recommendation: Continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party/Support Agency**	**Milestone Date**
No	Yes	EPA	EPA/TCEQ	6/1/2020

OTHER FINDINGS

Several additional recommendations were identified during the FYR. These recommendations do not affect current and/or future protectiveness.

- Update site repository.
- Monitor the vapor intrusion pathway off site (TI Boundary) and in the off-site area, if needed, in response to new construction.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: 1	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU1 currently protects human health and the environment because there are no completed exposure pathways. However, in order for the remedy to be protective in the long term, the following actions need to be taken: MW-54S is near the railroad tracks and no buildings are located in this area; however, further evaluate the vapor intrusion pathway by using current data from appropriate wells and using multiple lines of evidence, consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals, evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed, evaluate the need to update site COCs in a decision document, and continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary) to ensure protectiveness.	

Protectiveness Statement(s)	
Operable Unit: 2	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU2 currently protects human health and the environment because there are no completed exposure pathways. However, in order for the remedy to be protective in the long term, the following actions need to be taken: continue to work toward implementing institutional controls required in decision documents on site to ensure protectiveness.	

Protectiveness Statement(s)	
Operable Unit: 3	*Protectiveness Determination* Short-term Protective
Protectiveness Statement: The remedy at OU3 currently protects human health and the environment because there are no completed exposure pathways. However, in order for the remedy to be protective in the long term, the following actions need to be taken: consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals, evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed, evaluate the need to update site COCs in a decision document, continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary) to ensure protectiveness.	

Sitewide Protectiveness Statement
Protectiveness Determination Short-term Protective
Protectiveness Statement. The remedy for the North Cavalcade Street Superfund site is currently protective of human health and the environment. However, in order for the remedy to be protective in the long term, the following actions need to be taken: MW-54S is near the railroad tracks and no buildings are located in this area; however, further evaluate the vapor intrusion pathway by using current data from appropriate wells and using multiple lines of evidence, consider installing a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals, evaluate the effectiveness and function of the remedy based on current monitoring data and additional data as needed, evaluate the need to update site COCs in a decision document, and continue to work toward implementing institutional controls required in decision documents both on site and off site (TI Boundary) to ensure protectiveness.

VIII. NEXT REVIEW

The next FYR Report for the North Cavalcade Street Superfund site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Addendum No. 1 to the April 2014 Field Sampling Plan for Operation and Maintenance Activities – North Cavalcade Street Federal Superfund Site. Houston, Harris County, Texas. Ensafe. February 18, 2016.

Annual Operation and Maintenance Report Fiscal Year 2017 (September 2016 – August 2017). North Cavalcade Street Federal Superfund Site. Houston, Harris County, Texas. Prepared for TCEQ by EnSafe. October 27, 2017.

Addendum No. 1 to the April 2014 Field Sampling Plan for Operation and Maintenance Activities. North Cavalcade Street Federal Superfund Site, Houston, Harris County, Texas. EnSafe Inc. February 2016.

Explanation of Significant Differences, North Cavalcade Street Superfund Site, Houston, Texas. EPA Region 6. August 1994.

Field Sampling Plan for Operations and Maintenance at the North Cavalcade Street Superfund Site, Houston, Harris County, Texas, Version 2.0. Prepared by Shaw Environmental, Inc. April 2014.

Record of Decision, North Cavalcade Street Superfund Site, Houston, Texas. EPA Region 6. June 1988.

Record of Decision Amendment, North Cavalcade Street Superfund Site, Houston, Texas. EPA Region 6. September 2009.

Record of Decision Amendment, North Cavalcade Street Superfund Site, Houston, Texas. EPA Region 6. August 2011.

Superfund Site Profile – North Cavalcade Street, Houston, Texas. EPA Region 6. Accessed at https://www.epa.gov/superfund/north-cavalcade.

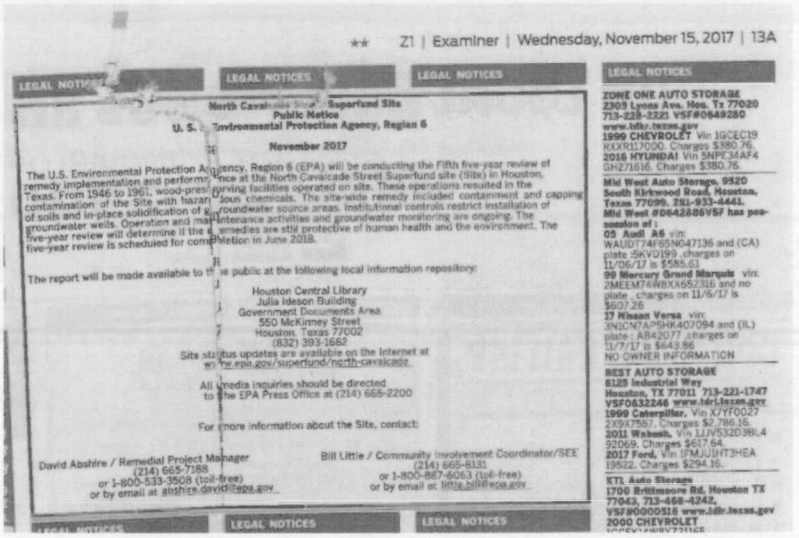
APPENDIX B – SITE CHRONOLOGY

Table B-1: Site Chronology

Event	Date
Houston Creosoting Company, Inc. developed the property for wood treating.	1946
Site operations ceased due to a bank foreclosure.	1961
The bank sold the Site property in 1964; the property was split into tracts, now under three different owners.	1964
The commercial owners built two warehouses on the southwestern portion of the Site.	1980
EPA proposed the Site for listing on the NPL.	October 1984
EPA sampling confirmed contamination in soil, ditch sediments and shallow groundwater.	September 1985 to November 1987
EPA finalized the Site's listing on the NPL.	June 10, 1986
EPA signed the Site's ROD. It outlined remedies for OU1 (shallow groundwater) and OU2 (soils).	June 28, 1988
First cleanup action initiated.	September 12, 1991
TNRCC implemented a field pilot study for OU2. It failed to demonstrate that bioremediation could reduce cPAH concentrations below 1 part per million.	1992
TNRCC began groundwater DNAPL pump-and-treat operations at the Site for shallow groundwater (OU1).	December 27, 1993
EPA signed an ESD to raise soil cleanup criteria for cPAHs to 30 parts per million.	August 8, 1994
Operation of the groundwater pump-and-treat system was suspended to reevaluate system capacity and inefficiencies in handling larger volumes of extracted DNAPL.	December 1995
Construction of the biotreatment facility for soils finished.	May 18, 1996
Operation of the biotreatment facility began.	June 4, 1996
EPA completed the Site's first FYR.	July 1998
Efforts to bioremediate contaminated soils were discontinued due to inability of the selected remedial approach to reach the ESD-revised cleanup goal.	August 1998
TNRCC (now TCEQ) completed the first groundwater investigation and determined the initial extent of the DNAPL and contaminant plume.	November 1998
Soils were placed in a temporary treatment (containment) cell, covered with an impermeable liner awaiting final disposition by EPA and TCEQ.	December 1999
TCEQ completed a phase II groundwater investigation that confirmed the presence of DNAPL and contaminated groundwater in the interbedded unit (OU3) below the shallow sand aquifer (OU1).	March 2000
Modifications to the groundwater pump-and-treat system began to expand capacity and accommodate the DNAPL volume being extracted from the Site.	June 2000
Modifications to the groundwater treatment system finished and the system was placed back online.	August 2001
EPA completed the Site's second FYR.	September 2003
The groundwater treatment system was suspended pending evaluation of the deeper DNAPL and groundwater contamination in the interbedded unit, and consideration of other remedial options for both groundwater zones (OU1 and OU3) and soils (OU2), per EPA and TCEQ agreement.	October 2003
EPA and TCEQ completed additional field work at the Site. The extent of groundwater contamination was delineated off site for the interbedded	January 2004

Event	Date
unit and confirmed for the shallow sand unit. The two DNAPL source areas (on site) were better defined to support reassessment of the existing remedy and other remedial options. EPA formally designated the contaminated interbedded unit as OU3.	
EPA completed the evaluation of remedial alternatives for soils (OU2) and groundwater (OU1 and OU3) detailed in the focused feasibility study (EPA, 2008).	June 2008
EPA completed the Site's third FYR.	September 2008
EPA issued the AROD Proposed Plan for soils (OU2) and groundwater (OU1 and OU3).	July 2009
The EPA AROD selected ISS for the two DNAPL source areas to minimize the continued impacts of free-phase DNAPL at these two locations on dissolved-phase groundwater (OU1 and OU3). The final remedy for soils was selected to cap contaminated soils in place, changing the initial treatment remedy to containment.	September 2009
The 2011 AROD revised RAOs to include containment of the groundwater plumes through natural processes (stratigraphic limitations); implementation of institutional controls to prevent human exposure to groundwater by restricting access to groundwater wells in the TI Zone; and removal of DNAPL in monitoring wells until retrieval is no longer practicable (source removal).	August 2011
EPA issued the Preliminary Close-Out Report.	August 2011
Remedial Action Report documenting completion of the remedy for soils at OU2 completed, including reconstruction of an existing containment cell cover and installation of permanent monitoring wells around the containment cell.	September 2011
EPA issued the Remedial Action Report for OU1 and OU3. It documented the completion of groundwater source area stabilization and installation of the long-term monitoring well network (installed to demonstrate the effectiveness of the stabilization remedy for source control and the containment remedy for the dissolved-phase groundwater plume).	September 2012
Site's fourth FYR Report signed by EPA.	September 2013
TCEQ assumed O&M responsibilities	October 2013
TCEQ conducted a CPT and MIP evaluation to assess potential downgradient migration of groundwater contaminants in an area northwest of the Site.	July – August 2017

APPENDIX C – PRESS NOTICE



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LEGAL NOTICES

North Cavalcade Street Superfund Site
Public Notice
U.S. Environmental Protection Agency, Region 6

November 2017

The U.S. Environmental Protection Agency, Region 6 (EPA) will be conducting the Fifth five-year review of remedy implementation and performance at the North Cavalcade Street Superfund site (Site) in Houston, Texas. From 1946 to 1961, wood-preserving facilities operated on site. These operations resulted in the contamination of the Site with hazardous chemicals. The site-wide remedy included containment and capping of soils and in-place solidification of groundwater source areas. Institutional controls restrict installation of groundwater wells. Operation and maintenance activities and groundwater monitoring are ongoing. The five-year review will determine if the remedies are still protective of human health and the environment. The five-year review is scheduled for completion in June 2018.

The report will be made available to the public at the following local information repository:

Houston Central Library
Julia Ideson Building
Government Documents Area
550 McKinney Street
Houston, Texas 77002
(832) 393-1662

Site status updates are available on the Internet at www.epa.gov/superfund/north-cavalcade

All media inquiries should be directed to the EPA Press Office at (214) 665-2200

For more information about the Site, contact:

David Abshire / Remedial Project Manager
(214) 665-7188
or 1-800-533-3508 (toll-free)
or by email at abshire.david@epa.gov

Bill Little / Community Involvement Coordinator/SEE
(214) 665-8131
or 1-800-887-6063 (toll-free)
or by email at little.bill@epa.gov

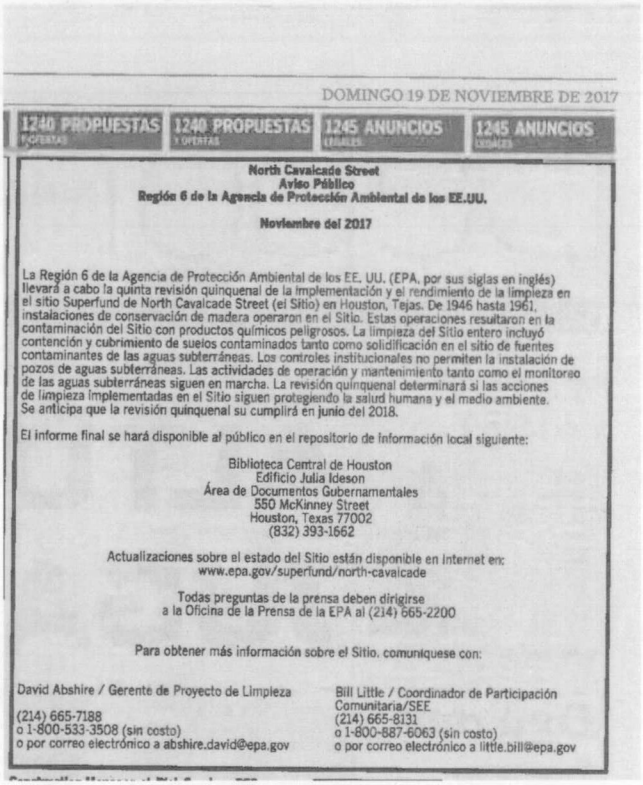
LEGAL NOTICES

ZONE ONE AUTO STORAGE
2309 Lyons Ave, Hou, Tx 77020
713-228-2221 VSF#0649280
www.tdlr.texas.gov
1999 CHEVROLET Vin 1GCEC19 RXXR117000. Charges $380.76.
2016 HYUNDAI Vin 5NPE34AF4 GH276816. Charges $380.76.

Mid West Auto Storage, 9520 South Kirkwood Road, Houston, Texas 77099. 281-933-4441. Mid West #0642886VSF has possession of :
05 Audi A6 vin: WAUDT74F65N047136 and (CA) plate 5KVD199 ,charges on 11/06/17 is $585.61
99 Mercury Grand Marquis vin: 2MEEM74W8XX552316 and no plate , charges on 11/6/17 is $607.25
17 Nissan Versa vin: 3N1CN7AP5HK407094 and (IL) plate : AB42077 ,charges on 11/7/17 is $643.86
NO OWNER INFORMATION

BEST AUTO STORAGE
6125 Industrial Way
Houston, TX 77011 713-221-1747
VSF0632244 www.tdlr.texas.gov
1999 Caterpillar, Vin X7YF0027 2X9X7557, Charges $2,786.16.
2011 Wabash, Vin 1JJV532D3BL4 92069, Charges $617.64.
2017 Ford, Vin 1FMJU1HT3HEA 19522, Charges $294.16.

KTL Auto Storage
1700 Brittmoore Rd, Houston TX 77043, 713-468-4242,
VSF#00005316 www.tdlr.texas.gov
2000 CHEVROLET



DOMINGO 19 DE NOVIEMBRE DE 2017

1240 PROPUESTAS Y OFERTAS | 1240 PROPUESTAS Y OFERTAS | 1245 ANUNCIOS LEGALES | 1245 ANUNCIOS LEGALES

North Cavalcade Street
Aviso Público
Región 6 de la Agencia de Protección Ambiental de los EE.UU.

Noviembre del 2017

La Región 6 de la Agencia de Protección Ambiental de los EE. UU. (EPA, por sus siglas en inglés) llevará a cabo la quinta revisión quinquenal de la implementación y el rendimiento de la limpieza en el sitio Superfund de North Cavalcade Street (el Sitio) en Houston, Tejas. De 1946 hasta 1961, instalaciones de conservación de madera operaron en el Sitio. Estas operaciones resultaron en la contaminación del Sitio con productos químicos peligrosos. La limpieza del Sitio entero incluyó contención y cubrimiento de sueios contaminados tanto como solidificación en el sitio de fuentes contaminantes de las aguas subterráneas. Los controles institucionales no permiten la instalación de pozos de aguas subterráneas. Las actividades de operación y mantenimiento tanto como el monitoreo de las aguas subterráneas siguen en marcha. La revisión quinquenal determinará si las acciones de limpieza implementadas en el Sitio siguen protegiendo la salud humana y el medio ambiente. Se anticipa que la revisión quinquenal su cumplirá en junio del 2018.

El informe final se hará disponible al público en el repositorio de información local siguiente:

Biblioteca Central de Houston
Edificio Julia Ideson
Área de Documentos Gubernamentales
550 McKinney Street
Houston, Texas 77002
(832) 393-1662

Actualizaciones sobre el estado del Sitio están disponible en Internet en:
www.epa.gov/superfund/north-cavalcade

Todas preguntas de la prensa deben dirigirse
a la Oficina de la Prensa de la EPA al (214) 665-2200

Para obtener más información sobre el Sitio, comuníquese con:

David Abshire / Gerente de Proyecto de Limpieza
(214) 665-7188
o 1-800-533-3508 (sin costo)
o por correo electrónico a abshire.david@epa.gov

Bill Little / Coordinador de Participación Comunitaria/SEE
(214) 665-8131
o 1-800-887-6063 (sin costo)
o por correo electrónico a little.bill@epa.gov

APPENDIX D – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: North Cavalcade Street	**Date of Inspection:** December 12, 2017
Location and Region: Houston, Texas 6	**EPA ID: TXD980873343**
Agency, Office or Company Leading the Five-Year Review: EPA REGION 6	**Weather/Temperature:** Sunny and windy/50°F

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: ISS
- ☐ Monitored natural attenuation
- ☒ Groundwater containment (TI Zone)
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Marilyn Czimer Long (Name) TCEQ Project Manager (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☒ Report attached: See Appendix F.

2. **O&M Staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

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). Fill in all that apply.

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____Name _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____

	Contact Name _____ Title _____ Date _____ Phone No. _____ Problems/suggestions ☐ Report attached: _____				
4.	**Other Interviews** (optional) ☐ Report attached: _____				
Skeo tried to interview several residents but none were home.					
Representatives from the City of Houston and Harris County					
III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)					
1.	**O&M Documents**				
	☒O&M manual	☐ Readily available	☐ Up to date	☐N/A	
	☐ As-built drawings	☐ Readily available	☐ Up to date	☒N/A	
	☐ Maintenance logs	☐ Readily available	☐ Up to date	☒N/A	
	Remarks: O&M documents are located at TCEQ's office.				
2.	**Site-Specific Health and Safety Plan**	☐ Readily available	☐ Up to date	☒N/A	
	☐ Contingency plan/emergency response plan	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
3.	**O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
4.	**Permits and Service Agreements**				
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A	
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A	
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A	
	☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
7.	**Groundwater Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A	
	Remarks: _____				
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: TCEQ reports that no pumping of leachate has been required.				
9.	**Discharge Compliance Records**				
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	
	Remarks: _____				
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A	

Remarks: The Site is surrounded by a locked security fence even though fencing was not a required remedy component. The fencing protects OU2 remedy components and on-site wells while EPA and TCEQ are working on institutional controls to prevent disturbance of the remedy.

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☒ Contractor for state

☐ PRP in-house ☐ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

2. **O&M Cost Records**

☒ Readily available ☒ Up to date

☒ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: 9/1/2013 (Date)	To: 8/31/2014 (Date)	$178,000 (Total cost)	☐ Breakdown attached
From: 9/1/2014 (Date)	To: 8/31/2015 (Date)	$69,000 (Total cost)	☐ Breakdown attached
From: 9/1/2015 (Date)	To: 8/31/2016 (Date)	$104,000 (Total cost)	☐ Breakdown attached
From: 9/1/2016 (Date)	To: 8/31/2017 (Date)	$150,000 (Total cost)	☐ Breakdown attached
From: _____ (Date)	To: _____ (Date)	_____ (Total cost)	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: Fencing is not a remedy component but it is present and prevents disturbance of on-site remedy components.

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☒ N/A

Remarks: _____

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A

Type of monitoring (e.g., self-reporting, drive by): N/A

Frequency: _____

Responsible party/agency: _____

Contact	David Abshire	EPA RPM	_____	_____
	Name	Title	Date	Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☒ No ☐ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

ICs were specified in the 2009 ARAD as well as the 2011 AROD as part of the remedy ICs are in process, but have not yet been implemented

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: Institutional controls are required to prevent future exposure to groundwater and soil and to prevent disturbance of remedy components. TCEQ and EPA continue to work on establishing institutional controls; none have been implemented at this time.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: ____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☐ N/A

Remarks: Three townhomes were constructed next to older residential homes on the west side of Hardy Street, near MW-49I, outside the western extent of the current TI Zone boundary. Two homes were constructed next to MW-47S and MW-47I along Elysian Street, which is located within the TI Zone.

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: Roads are in good condition on the paved areas of the southern portion of the Site; there are no paved roads in the northern area where the containment cell was located.

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident

Area extent: _____ Depth: _____

Remarks: The landfill surface was well maintained. No low lying areas were noted.

2.	**Cracks**	☐ Location shown on site map	☒ Cracking not evident
	Lengths: _____	Widths: _____	Depths: _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☒ Erosion not evident
	Area extent: _____		Depth: _____
	Remarks: _____		
4.	**Holes**	☐ Location shown on site map	☒ Holes not evident
	Area extent: _____		Depth: _____
	Remarks: _____		
5.	**Vegetative Cover**	☒ Grass	☒ Cover properly established
	☒ No signs of stress	☐ Trees/shrubs (indicate size and locations on a diagram)	
	Remarks: _____		
6.	**Alternative Cover** (e.g., armored rock, concrete)		☒ N/A
	Remarks: _____		
7.	**Bulges**	☐ Location shown on site map	☒ Bulges not evident
	Area extent: _____		Height: _____
	Remarks: _____		
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident	
	☐ Wet areas	☐ Location shown on site map	Area extent: _____
	☐ Ponding	☐ Location shown on site map	Area extent: _____
	☐ Seeps	☐ Location shown on site map	Area extent. _____
	☐ Soft subgrade	☐ Location shown on site map	Area extent: _____
	Remarks: _____		
9.	**Slope Instability**	☐ Slides	☐ Location shown on site map
	☒ No evidence of slope instability		
	Area extent: _____		
	Remarks: Slopes and the landfill were covered with thick, well-maintained grass.		
B. Benches		☐ Applicable ☒ N/A	
	(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.)		
1.	**Flows Bypass Bench**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
2.	**Bench Breached**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
3.	**Bench Overtopped**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		

C. Letdown Channels ☒ Applicable ☐ N/A

(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.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ No evidence of settlement
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☒ No evidence of degradation
   Material type:_____ Area extent: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ No evidence of erosion
   Area extent: _____ Depth: _____
   Remarks: All drainageways leaving the landfill were unobstructed and contained some riprap to prevent erosion. They eventually drained to the Harris County Flood Control District Easement maintained by Harris County.

4. **Undercutting** ☐ Location shown on site map ☒ No evidence of undercutting
   Area extent: _____ Depth: _____
   Remarks: _____

5. **Obstructions** Type: _____ ☒ No obstructions
   ☐ Location shown on site map Area extent: _____
   Size: _____
   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____
   ☒ No evidence of excessive growth
   ☒ Vegetation in channels does not obstruct flow
   ☐ Location shown on site map Area extent: _____
   Remarks: _____

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: A leachate extraction system is in place but pumping has not been required due to the low volume present.

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☒ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☒ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☐ Erosion not evident

Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement: _____ Vertical displacement: _____

Rotational displacement: _____

Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident

Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

☐ Vegetation does not impede flow

Area extent: _____ Type: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A

Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential. _____

Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: _____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☒Properly secured/locked ☒Functioning ☒ Routinely sampled ☒ Good condition

☒All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

The OU2 soil remedy initially was biotreatment followed by containment of treated soils that still exceeded cleanup goals in an on-site cell. In addition, the soils remedy included institutional controls to prevent disturbance of the containment cell and long-term monitoring of leachate and groundwater immediately outside the containment cell. For the shallow and interbedded groundwater zones, OU1 and OU3, respectively, the remedy began with pumping and treating of groundwater, DNAPL removal, and ISS of two DNAPL source areas. The final component of the long-term remedy was establishing a TI Zone, periodic pumping of DNAPL as necessary and long-term montioring to ensure the residual contaminant plumes remain stabilized within the TI Zone.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

TCEQ/TCEQ contractor conducted a focused CPT/MIP evaluation to the west of the TI Zone boundary. The contractor recommended the installation of a permanent monitoring well at boring location MIP-C5 to continue to monitor concentrations of site-related chemicals and assess the protectiveness of the TI Zone boundary.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

Data since the previous FYR indicate that DNAPL may be migrating beyond the current northwest TI Zone boundary near monitoring well MW-37I and MW-47I westward near the TI Zone boundary.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Determine if the TI Zone needs to be revised in areas west and northwest due to DNAPL in the interbedded unit. In addition, evaluate vapor intrusion in residential and commercial areas overlying the groundwater plumes to determine if additional remediation is warranted.

APPENDIX E – REMOVAL ACTION AND/OR REMEDIAL ACTION AND SITE INSPECTION PHOTOS

BEFORE – 2008 FYR Site Inspection

South side of southeast corner of soil cap

South gate of soil cap area from on top of cap

Sign on perimeter fence, 50 to 100 feet west of gate

AFTER – 2018 FYR

Looking south toward North Cavalcade Street and the El Venado Foods facility

Looking north toward the Coastal Casting facility

A view of the paved industrial portion of the Site

View along the west fence at the Site behind the Coastal Casting facility

The vegetated containment area

MW-26S around the edge of the containment cell

LDS – SE

LCS

Containment cell drainage

Solidification area, southeast source area

Southern entrance area

Recently constructed townhome complex, west of the Site, within TI Waiver zone

APPENDIX F – INTERVIEW FORMS

North Cavalcade Street Superfund Site Five-Year Review Interview Form

Site Name: North Cavalcade Street **EPA ID No.:** TXD980873343

Interviewer Name: **Affiliation:**

Subject Name: Phillip M. Goodwin **Affiliation:** The City of Houston
Sarah Jane Utley Harris County

Subject Contact Information: 900 Bagby St., 3rd Floor, Houston, Texas 77002
Phillip.Goodwin@houstontx.gov
1019 Congress Ave., 15th Floor, Houston, Texas 77002
Sarah.Utley@cao.hctx.net

Time: **Date:** 1/24/2018

Interview Location:

Interview Format (circle one): In Person Phone Mail Other:

Interview Category: Local Government

Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

The City of Houston (the City) and Harris County (the County) have no first-hand knowledge of the status of the cleanup activities at the North Cavalcade Street Superfund Site (the Site), but are generally aware of the environmental issues through the documents currently made available through the EPA website portal. However, based on the review of these documents and knowledge of on-going concerns at the nearby South Cavalcade Street Superfund Site, the City and Harris County are very concerned that there may be on-going issues at the Site that are not being addressed by the current soil and groundwater remedies.

Based on observations and concerns at the South Cavalcade Street Superfund Site, the City and Harris County are concerned that the Site contaminated groundwater may be infiltrating the nearby storm sewer lines. The City and Harris County previously raised the alarm regarding infiltration of Site contaminants into storm sewer lines running through the South Cavalcade Street Superfund Site. Based on City internal databases, storm sewer lines are located within the contaminated groundwater at this Site as well, raising the potential for contaminant infiltration into these storm sewer lines. The City and Harris County recommend an investigation into whether this Site is actively discharging into the storm sewers and ultimately to the Waters in the State of Texas and Waters of the United States.

The 2013 Five-Year Review identified several issues including: unlocked wells, the need to establish institutional controls, accumulation of DNAPL in monitoring wells in the TI zone, and changed site conditions – such as PCP in the Shallow Sand and detections of solvent-related contaminants in on-site and off-site monitoring wells. Based on our review of the documents available on-line, it is unclear whether these concerns have been investigated or addressed.

2. Do you feel well-informed regarding the Site's activities and remedial progress? If not, how might EPA convey site-related information in the future?

   The City and Harris County acknowledges that certain documents are available on-line through the EPA website portal. However, it can be difficult to ascertain the current status of remedial actions at the Site. Therefore, the City and Harris County request that the website include current activities at the Ssite as well as documentation regarding plume stability, on-going assessment, on-going remedial and monitoring activities, and remedy implementation and effectiveness.

3. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   As noted herein, the City and Harris County are concerned that there may be continuing discharges from the Site.

4. Are you aware of any changes to state laws or local regulations that might affect the protectiveness of the Site's remedy?

   No.

5. Are you aware of any changes in projected land use(s) at the Site?

   As noted in the 2013 Five-Year Review and more recently in the June 9, 2015 Site Update, HCTRA will be constructing an extension of the Hardy Toll Road along the rail right-of-way adjacent to the Site's western boundary.

6. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   The City and Harris County appreciate the EPA extending this opportunity to complete this questionnaire. Moving forward, please send future correspondence to the following:

   Bob Allen, Director
   Harris County Pollution Control Services Department
   101 S. Richey, Suite H
   Pasadena, Texas 77506

   Bureau Chief, Environmental Health Division
   Pollution Control & Prevention
   Houston Health Department
   7411 Park Place Blvd.
   Houston, Texas 77087-4441

7. Do you have any comments, suggestions or recommendations regarding the project?

   As previously mentioned, based on observations at a nearby similar superfund site, Harris County and the City are concerned that the current remedy may be inadequate and that contamination from the Site may not have been fully identified. As an initial step. Harris County and the City request that the EPA inspect and/or test the storm sewers in or near the contaminated groundwater to ensure that there is no infiltration into the storm sewer lines. Harris County and the City would appreciate any opportunity to review and comment on plans for assessment, sampling data or future plans for operation and maintenance of the remedies.

8. Do you give permission for the following to be included in the Five-Year Review Report and appendices, which becomes a public document? Please initial below.

   Responses for Sarah Jane Utley, Harris County:

   a. Your name? Yes ✓ No_____
   b. Your affiliation? Yes ✓ No_____
   c. Your responses? Yes ✓ No_____

   Responses for Phillip M. Goodwin, City of Houston.

   a. Your name? Yes ✓ No_____
   b. Your affiliation? Yes ✓ No_____
   c. Your responses? Yes ✓ No_____

North Cavalcade Street Superfund Site Five-Year Review Interview Form

Site Name:	**North Cavalcade Street**	**EPA ID No.:**	**TXD980873343**
Interviewer Name:		**Affiliation:**	
Subject Name:	**M. Czimer Long, P.G.**	**Affiliation:**	**TCEQ**
Subject Contact Information:			
Time:		**Date:**	**2/13/2018**
Interview Location:			

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:** ***Email***

Interview Category: **State Agency and O&M Contractor**

NOTE: *Comments/observations from Ms. Danielle Getsinger, EnSafe (TCEQ Contractor), have been included by the TCEQ in order to provide comprehensive responses. M.C. Long (TCEQ)*

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

TCEQ: The site is acceptable. Communication and coordination has been on-going between the U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) regarding site status and general maintenance issues. However, the TCEQ has identified several issues such as: the presence and apparent expansion of dense non-aqueous phase liquid (DNAPL) within the Technical Impracticability (TI) boundary, the lack of institutional controls implemented by the EPA, and the urban development in the site area (i.e., inside and outside of the TI boundaries).

EnSafe: The site is acceptable. EnSafe has conducted annual Operation and Maintenance (O&M) evaluations to verify remedy performance /protectiveness since 2016 and was responsible for the preparation of the 2016 and 2017 Annual O&M reports.

2. What is your assessment of the current performance of the remedy in place at the Site?

TCEQ: Although the remedy components are protective of human health and the environment in the short term, the TCEQ conducted a supplemental evaluation to verify remedy performance/protectiveness. Refer to Comments #4 and #8 (below).

EnSafe: The following comments pertain to remedy performance and are based on the past five years of O&M activities:

- The containment cell [Operable Unit (OU) 2] and the in-situ stabilization areas are in good condition. These engineering controls continue to be protective of preventing direct contact to contamination disposed of in place on site.
- The TI Zone currently contains a DNAPL plume. Based on groundwater sampling and gauging events over the past five years, the DNAPL plume does not appear to be stable;

therefore, the effectiveness of containment of DNAPL using "natural processes" may not be a viable remedy.

- DNAPL measurements in MW-47I increased from non-detect prior to April 2014 to 0.80 feet in June 2015 and June 2016, to 4.98 feet in June 2017. Although MW-47I is within the limits of the TI boundary, it represents the farthest downgradient occurrence of DNAPL to the west.
- DNAPL thickness in MW-37I to the northwest also continues to increase, measuring 2.93 feet in June 2015, 3.35 feet in June 2016, and 4.10 feet in June 2017. MW-37I is the westernmost monitoring well before approaching the TI boundary to the northwest, along the railroad right of way.
- Solvent-related chemicals were detected in groundwater collected from downgradient boring location MIP-B5 and MIP-C5 during the July and August 2017 Cone Penetrometer Test (CPT) and Membrane Interface Probe (MIP) evaluation, including benzo(a)pyrene, pentachlorophenol, 1,1-dichloroethene, and vinyl chloride.

- Institutional controls (ICs) have not been implemented.

Note – DNAPL data can be referenced on Table 2, Cumulative DNAPL Thickness Measurements in Monitor Wells (feet), *Annual O&M Report, Fiscal Year 2017* (Ensafe).

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

TCEQ: To my knowledge, the TCEQ has not received any complaints regarding site-related environmental issues. However, following Hurricane Harvey (August 2017), national and local media presented concerns regarding the impact of the storm to superfund sites in the area and the subsequent potential environmental impact to the communities from these sites. The EPA mobilized to assess the superfund sites located along the Gulf Coast. Based on communication with the EPA it is my understanding the North Cavalcade site was not adversely impacted by the hurricane nor were there indications of subsequent environmental impact to the area from the site.

EnSafe: No comment.

4. Has your office conducted any site-related activities or communications in the past five years apart from routine activities? If so, please describe the purpose and results of these activities.

TCEQ: Although the remedy components are protective of human health and the environment in the short term, the TCEQ has conducted a supplemental evaluation to verify remedy performance/protectiveness. In addition, the TCEQ and EPA coordinated on a supplemental task related to access to the North Tract.

In 2015, the EPA and TCEQ shared costs, specific to the relocation of the drainage ditch culvert crossing (i.e., Harris County Flood Control District [HCFCD] ditch). The property owner had informed the TCEQ & EPA of his intent to construct a building that would block the gates and

the original drainage ditch crossing. A new crossing was necessary to access the North Tract/ Soil Containment Cell and continue O&M tasks. The TCEQ-EPA coordination included:

- TCEQ/TCEQ Contractor met with HCFCD staff for a construction meeting, prepared the Culvert Design per HCFCD specifications, submitted the design and obtained approval from HCFCD to construct, and completed vegetation clearing of the ditch construction area.
- The EPA/EPA Contractor constructed the drainage ditch crossing and installed new gates.

In 2017, the TCEQ/TCEQ Contractor conducted a focused CPT/MIP evaluation to the west of the TI boundary (i.e., outside of the TI boundary/downgradient of monitor well MW- 37I). This preliminary CPT/MIP evaluation was conducted to determine if a potential excursion of DNAPL and/or "detections of vinyl chloride and solvent-related contaminants" were present beyond the TI boundary (refer to the Fourth Five-Year Review Report (2013), Protectiveness Statements/Issue 3 & Issue 4).

EnSafe: TCEQ contractors have performed O&M activities over the past five years, which have included monthly inspections, as well as gauging and monitoring 59 monitor wells and five leak detection/collection sumps. Maintenance activities have also included the repair of wells, culverts, and monthly mowing and the surveying of repaired wells. To supplement O&M activities, in July and August 2017, a focused CPT/MIP evaluation was conducted west of monitor well MW-37I and downgradient/outside of the TI Zone boundary on Harris County Toll Road Authority (HCTRA) property, as noted above in TCEQ's comment. Refer to Comments #2 and #8.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

TCEQ: To my knowledge, there have not been changes to state law(s) that might affect the protectiveness of the Site's remedies.

EnSafe: No comment.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

TCEQ: No. The EPA has not yet implemented the Institutional Controls (ICs) as required by ROD Amendment (2011) and the associated SSC. The ICs were intended to be placed on property/tracts within the TI boundaries during the transition from the O&F to O&M phase.

The following documents refer to ICs as a component of the selected remedy, the implementation of ICs (i.e., under Remedial Action), and the long-term protectiveness of the remedy:

- Record of Decision Amendment (2011): A component of the selected remedy included the implementation of institutional controls.

residential construction has increased downgradient of the site, both inside and outside of the TI boundary.

Real estate in the neighborhood near the site has become more attractive to new residential development. New residential homes and condominiums have been built within the past five years in areas west of the site, downgradient of the TI zone. In the 2016 and 2017 Annual O&M Reports, new residential construction was documented on Hardy St, Terry St, and Elysian St west and northwest of the site.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

TCEQ: Although the remedy components are protective of human health and the environment in the short term, the TCEQ has conducted a supplemental O&M evaluation (as needed) to verify remedy performance and remedy protectiveness.

TCEQ & Ensafe comments/recommendations include:

General comments:

- Containment Cell (includes cell, leachate monitoring system and groundwater monitor wells): The containment cell is in good condition.
- In-situ Stabilization Areas (2): Both areas are in good condition.
- Groundwater Monitor Well Network (inside and outside the TI boundary): Overall, monitor wells are in good condition.
- Site fencing and gates: Fencing, gates and locks are in good condition. The site is mowed and heavy vegetation along the fence line is maintained.

Issues/Recommendations:

Issue - DNAPL (inside TI boundary): DNAPL gauging data indicates the extent of DNAPL appears to be expanding and the DNAPL thicknesses are increasing in downgradient monitor wells (Issue 3, 2013 Five-Year Review Report).

Recommendation: The previous commercial/industrial vapor intrusion screening evaluation was prepared for the commercial/industrial area of the site circa 2008. The North Cavalcade Street Focused Feasibility Study, Version 2.1, Section 1-5-4.3 Vapor Intrusion Summarized (CH2M HILL, June 2008) may not be applicable for current residential human health considerations.

Issue – Pentachlorophenol (PCP): In the 2017 annual groundwater sampling event, PCP was not reported to exceed the Protective Concentration Level (PCL = 0.001 mg/L) in monitor wells completed in the Shallow Sand. PCP was reported to exceed the PCL in monitor wells MW-34I (0.0034 mg/L) and MW-46I (0.0016 mg/L), which are completed in the lower Interbedded Unit. Both wells are in close proximity to the mapped DNAPL plume areas inside the TI boundary; however, MW-46I is located in the residential area within the TI boundary. (Issue 4a, 2013 Five-Year Review Report).

Recommendation: As recommended in the 2013 Five-Year Review Report, continue monitoring.

Issue - Vinyl Chloride and Solvent-Related Contaminants: The 2013 Five-Year Review identified several on-site and off-site monitor wells that detected vinyl chloride and solvent-related contaminants (Issue 4c, 2013 Five-Year Review Report). In addition, the CPT/MIP evaluation conducted in 2017 indicated the presence of these contaminants in groundwater samples collected from the CPT borings located outside the TI boundary. Refer to Appendix A-Remedy Evaluation, *Annual O&M Report, Fiscal Year 2017 (Ensafe).*

Recommendation: Further delineation of the detected vinyl chloride and solvent-related contaminants will be logistically difficult due to the railroad right-of-way (ROW). Also, access to the railroad ROW may not be forthcoming. However, the installation of monitor wells on HCTRA property may be possible and is recommended. The source(s) of these constituents have not been determined.

Issue - Institutional Controls (ICs): ICs have not been implemented (Issue 2, 2013 Five-Year Review Report).

Recommendation: ICs need to be implemented in accordance with the Texas Risk Reduction Program, 30 TAC §350.111

9. Do you give permission for the following to be included in the Five-Year Review Report and appendices, which becomes a public document? Please initial below.

   a. Your name? Yes _____ No _____
   b. Your affiliation? Yes _____ No _____
   c. Your responses? Yes _____ No _____

APPENDIX G – DATA TABLES AND FIGURES

Table G-1: 2014-2017 Measured Leachate Fluid Thickness within Sumps (Table 1, 2017 Annual Report)

Sample Location	Date Measured	Fluid Thickness (feet)
LDS-NW	4/23/14	0.38
	6/16/14	0.15
	2/3/15	1.51
	6/9/15	1.16
	3/7/16	1.76
	6/15/16	1.69
	2/6/17	1.24
	6/22/17	1.06
LDS-NE	4/23/14	0.97
	6/16/14	0.09
	2/3/15	1.15
	6/9/15	0.77
	3/7/16	0.72
	6/15/16	1.65
	2/6/17	1.65
	6/22/17	0.09
LDS-SW	4/23/14	0.24
	6/16/14	1.75
	2/3/15	0.88
	6/9/15	0.59
	3/7/16	0.43
	6/15/16	1.45
	2/6/17	0.98
	6/22/17	0.31
LDS-SE	4/23/14	1.10
	6/16/14	0.81
	2/3/15	1.26
	6/9/15	0.52
	3/7/16	0.49
	6/15/16	1.55
	2/6/17	1.03
	6/22/17	0.23
LCS	4/23/14	2.34
	6/16/14	2.84
	2/3/15	3.05
	6/9/15	3.66
	3/7/16	1.56
	6/15/16	2.66
	2/6/17	2.12
	6/22/17	9.75*

Notes:
* Suspected to be a field error

Table G-2: Cumulative DNAPL Thickness Measurements in Monitoring Wells (feet)

Interbedded Unit Monitoring Wells	April 2014	June 2014	February 2015	June 2015	March 2016	June 2016	February 2017	June 2017
MW-29I	3.00	3.14	3.01	3.13	3.22	3.25	3.26	3.40
MW-30I	1.66	2.05	2.37	2.98	3 08	3.35	3.53	4.22
MW-33I	4.38	4.55	4.45	4.39	4.78	4.36	4.40	4.85

Interbedded Unit Monitoring Wells	April 2014	June 2014	February 2015	June 2015	March 2016	June 2016	February 2017	June 2017
MW-37I	3.01	2.93	3.17	2.93	3.50	3.35	3.81	4.10
MW-39I	0.80	0.47	0.81	0.78	0.88	0.75	0.81	1.06
MW-47I	0.03	0.16	0.26	0.80	NM	0.80	2.48	4.98
MW-54I	1.47	1.60	1.83	2.04	2.70	2.38	2.63	3.16
MW-56I	4.04	4.24	4.86	4.99	4.93	4.92	NM	5.29
MW-57I	5.51	5.10	5.33	5.35	5.42	4.87	4.92	5.42
MW-59I	4.10	4.17	4.12	3.95	4.33	4.01	4.04	4.24

Notes
NM = not measured
Source: Table 2 in the Annual Operation and Maintenance Report Fiscal Year 2017 (September 2016 – August 2017). North Cavalcade Street Federal Superfund Site. Houston, Harris County, Texas. Prepared for TCEQ by ENSAFE. October 27, 2017.

Table G-3: COCs Exceeding Current Standards during the 2017 Groundwater Monitoring Event Within the TI Zone Boundary[2]

Parameter	PRG (mg/L)	Shallow Sands Wells (mg/L)	Interbedded Wells within Facility (mg/L)	Interbedded Wells Downgradient of Facility (mg/L)
Benzene	0.005	--	MW-34I (0.13) MW35I (0.052)	MW-46I (0.0097)
Benzo(a)pyrene	0.0002	--	Detection limit exceeded PRG at MW-34I (0.00024) MW-35I (0.00023)	--
Naphthalene	0.49/1.5 off-site residential/on-site commercial/industrial	--	MW-34I (18) MW35I (4.8)	MW-46I (1.1)

Table G-4: Naphthalene (mg/L) Variability in the Past Five Years in Wells with Current Exceedances

	PRG	2013	2014	2015	2016	2017
MW-34I	1.5 on-site	**11.5**	**4.2**	**10**	**10**	**18**
MW-35I	1.5 on-site	Not Sampled	**19**	**2.6**	**6.7**	**4.8**
MW-46I	0.49 off-site	**1.59**	0.31	**1.6**	**0.64**	**1.1**
Notes. **Bold** indicates exceedance of PRG. Note that these wells are all in the TI Zone.						

Table G-5: Non-COC Chemicals Exceeding Current Standards during the 2017 Groundwater Monitoring Event[3]

Parameter	Current TRRP Tier 1 PCL[a] (mg/L)	Shallow Sands Wells (mg/L)	Interbedded Wells within Facility (mg/L)	Interbedded Wells Downgradient of Facility (mg/L)
Arsenic[b]	0.01	LDS-NW (0.0149) LCS (0.0173)	MW-34I (0.0175) MW-35I (0.0587) MW-31I (0.0377) MW-32I (0.0143)	MW-46I (0.0368)
Carbozole	0.046/0.1 off-site residential/on-site commercial/industrial	MW-54S (0.31)	MW-34I (0.65) MW35I (0.28)	MW-46I (0.11)
PCP[b]	0.001	--	MW-34I (0.0034)	MW-46I (0.0016)
2-methylnaphthalene	0.098/0.29 off-site residential/on-site commercial/industrial	--	MW-34I (0.47)	--
3&4-methylphenol	0.12/0.37 off-site residential/on-site commercial/industrial	--	MW-35I (0.44)	--
Hexachlorobutadiene	0.12/0.026	--	--	MW-46I (0.012)

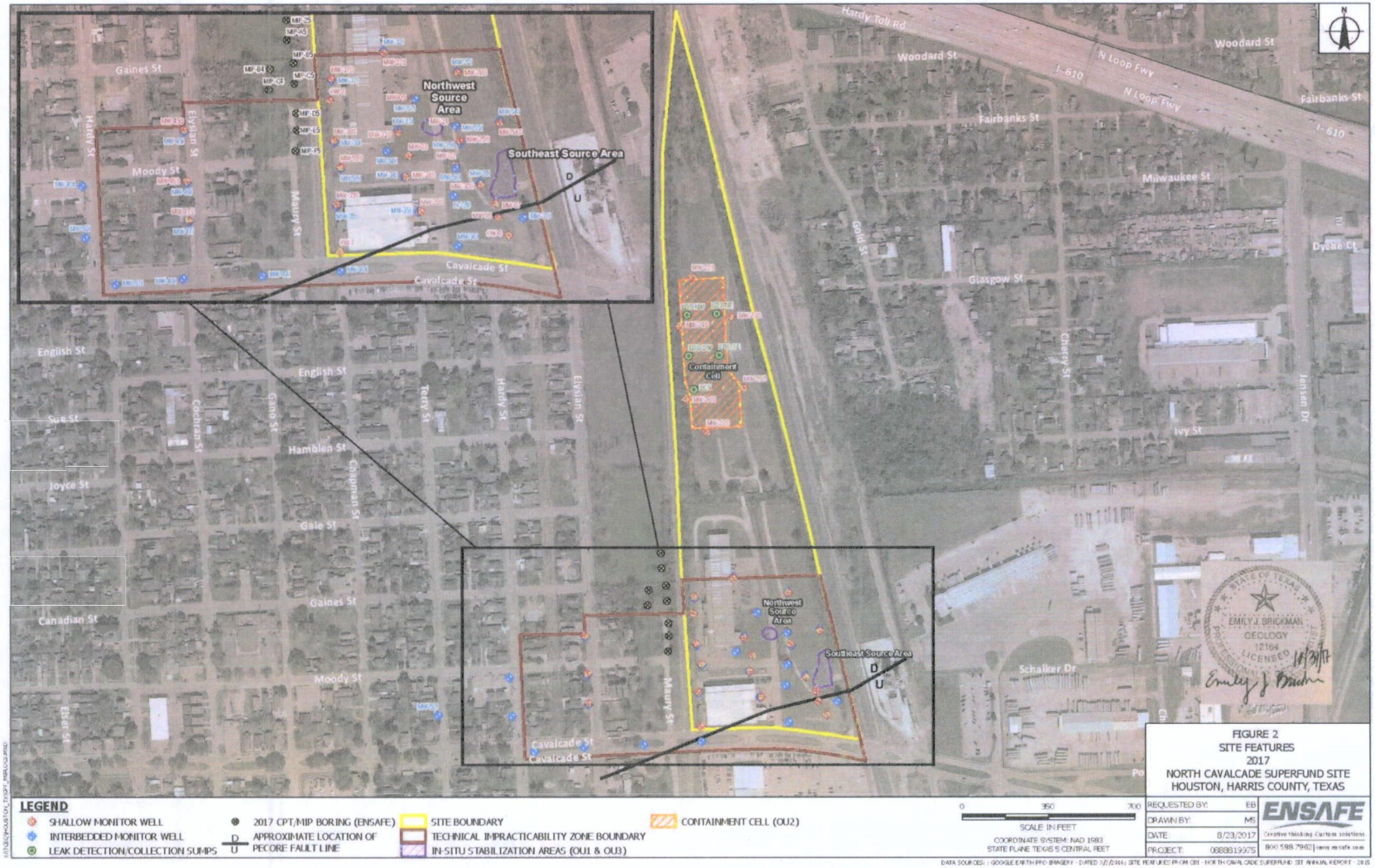
[2] Adapted from Table on pdf page 16 of the 2017 O&M Annual Report.

[3] Adapted from Table on pdf page 16 of the 2017 O&M Annual Report.

Parameter	Current TRRP Tier 1 PCL[a] (mg/L)	Shallow Sands Wells (mg/L)	Interbedded Wells within Facility (mg/L)	Interbedded Wells Downgradient of Facility (mg/L)
	off-site residential/on-site commercial/industrial			
1,1-dichloroethene[b]	0.007	--	--	MW-45I (0.11) MIP-C5 (0.061)
Vinyl chloride[b]	0.002	--	--	MW-45I (0.005) MIP-C5 (0.013)

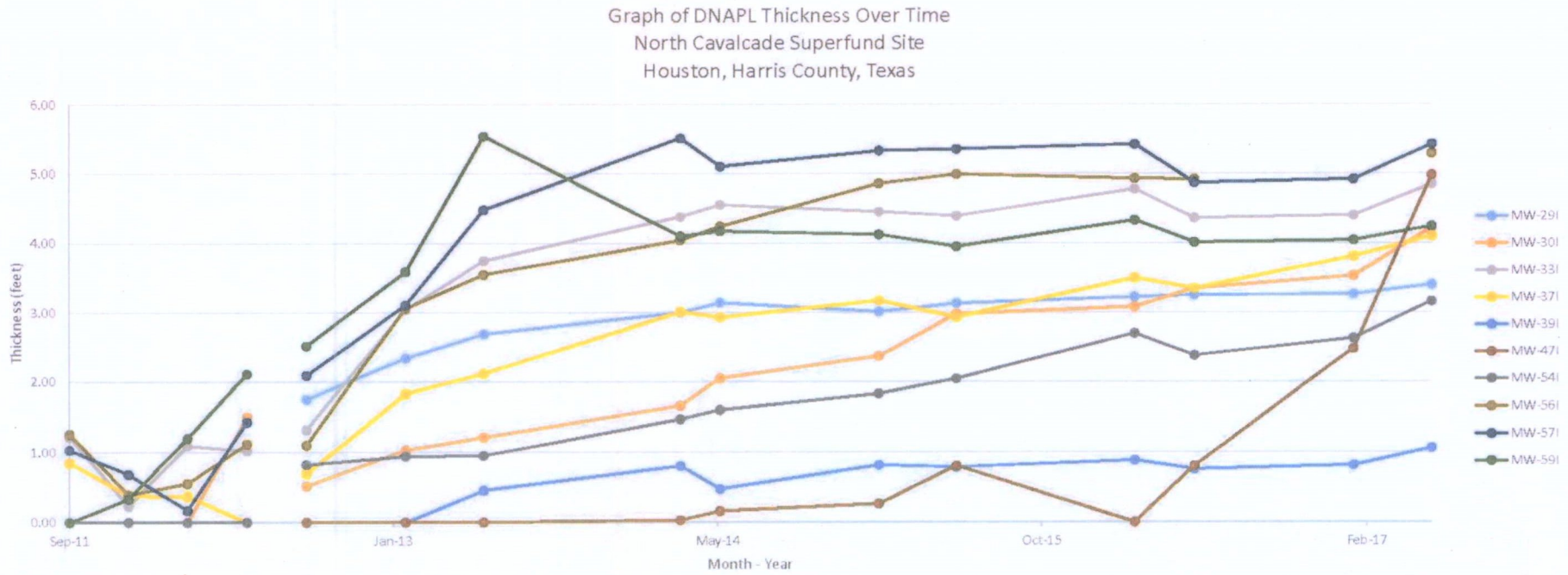
Notes
MIP-C5 is a temporary groundwater point installed as part of the remedy protectiveness assessment.
-- = no exceedances
a. March 31, 2017 TRRP Tier 1 PCLs located at: https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20PCL%20Tables%20March31.pdf.
b. Compound also has a federal MCL.

Figure G-1: Monitoring Locations and Site Features[4]



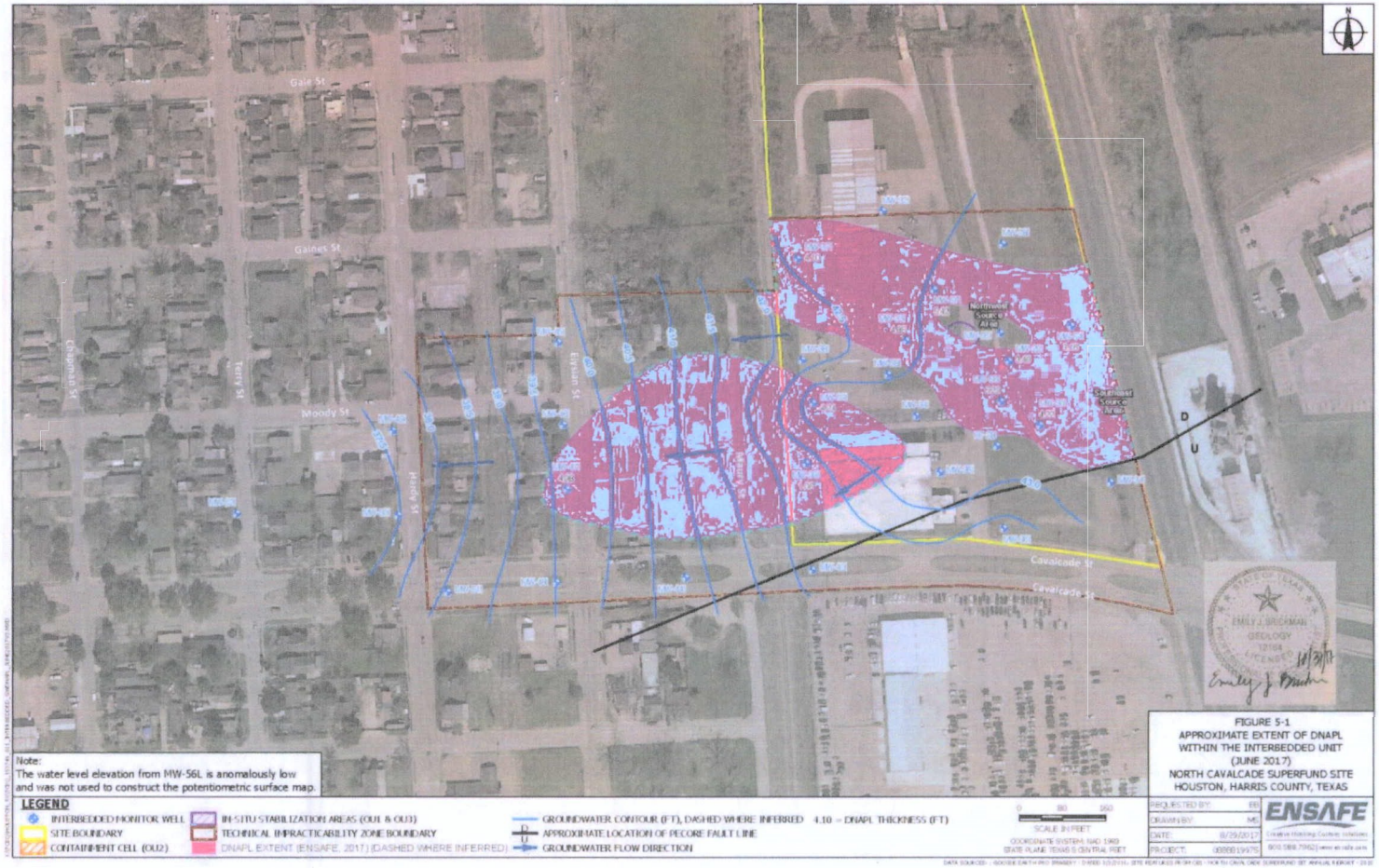
[4] Figure 2 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

Figure G-2: Graph of DNAPL Thickness over Time[5]



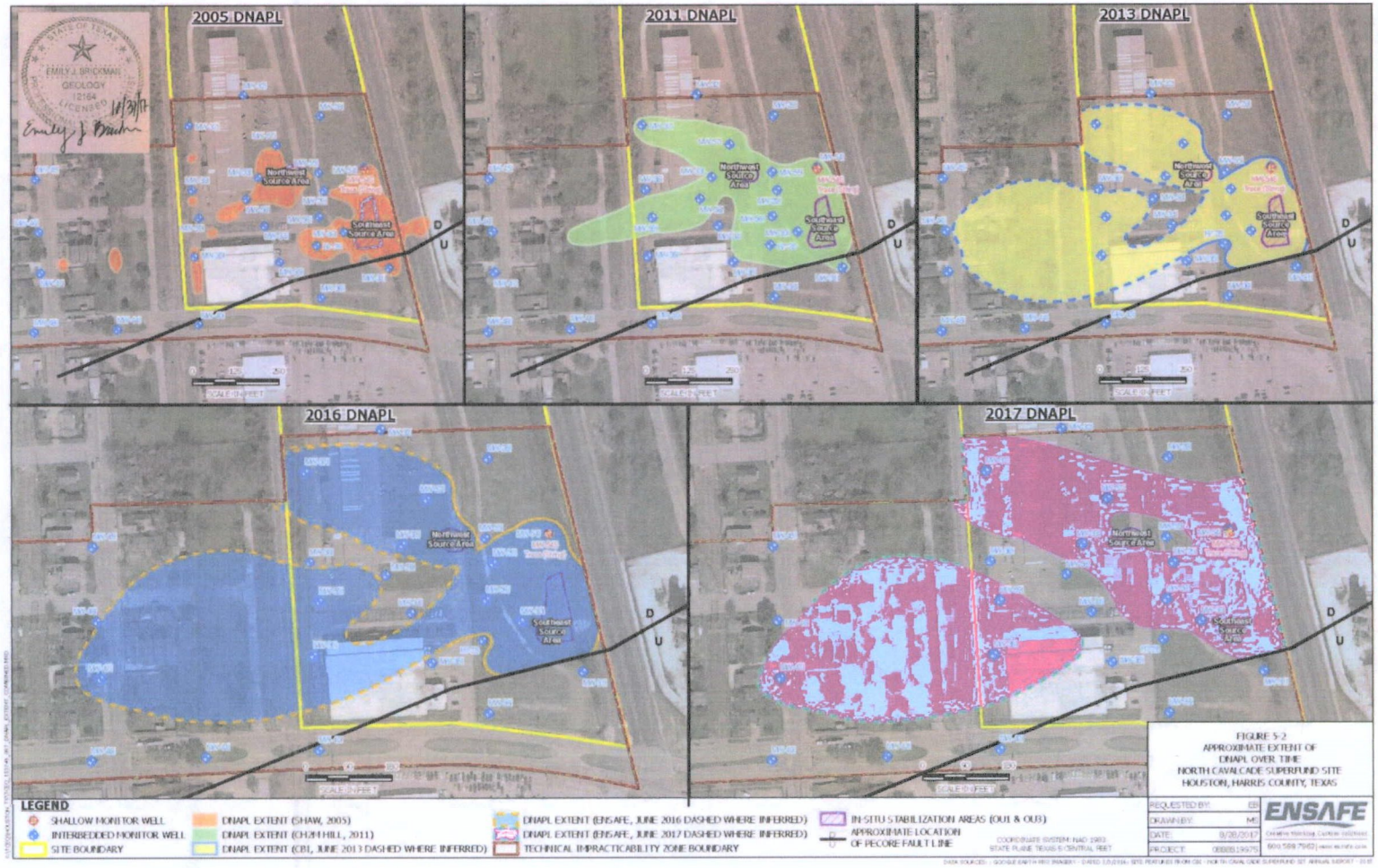
[5] Figure 6 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

Figure G-3: Current DNAPL Extent[6]



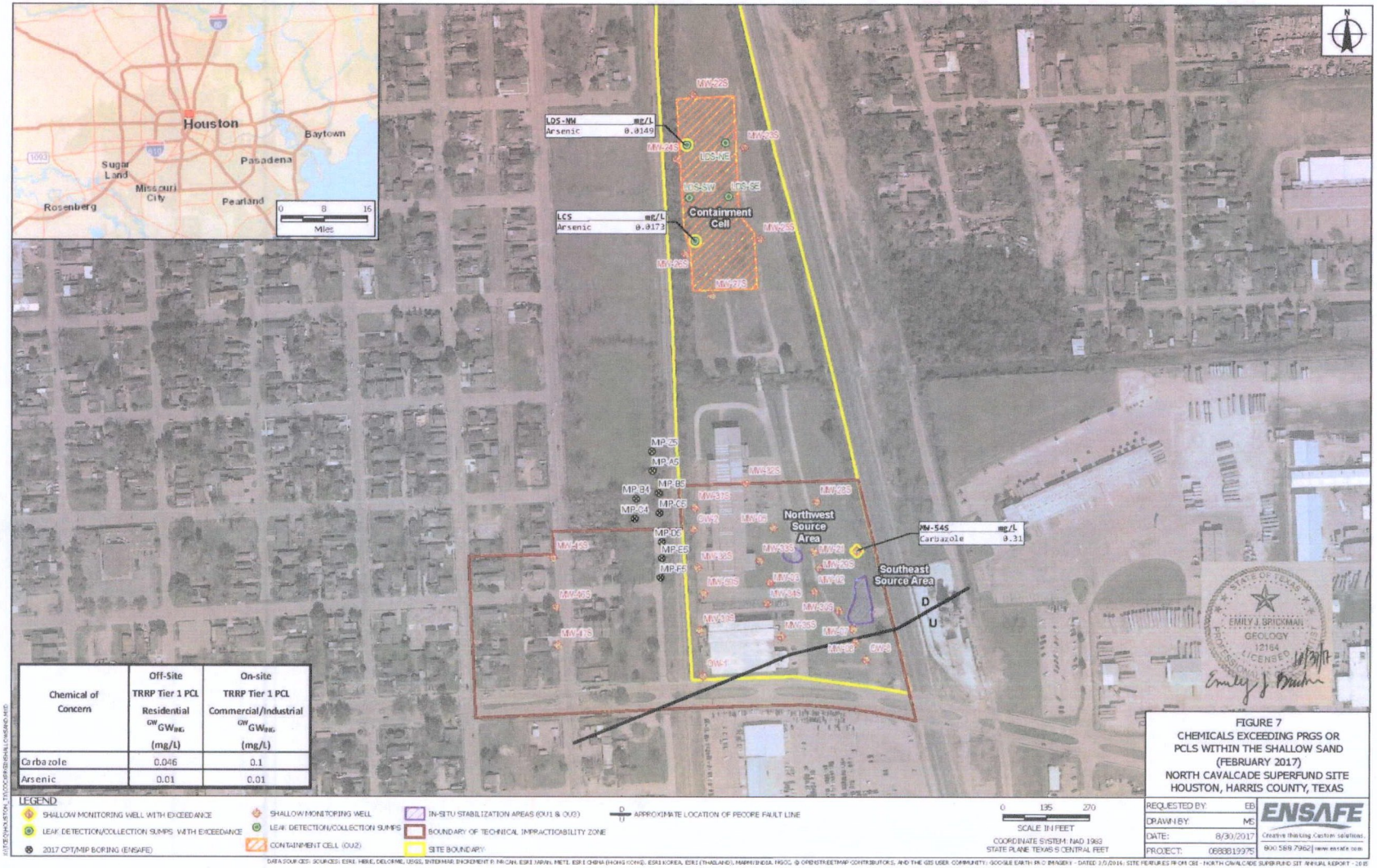
[6] Figure 5-1 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

Figure G-4: DNAPL Extent Over Time[7]



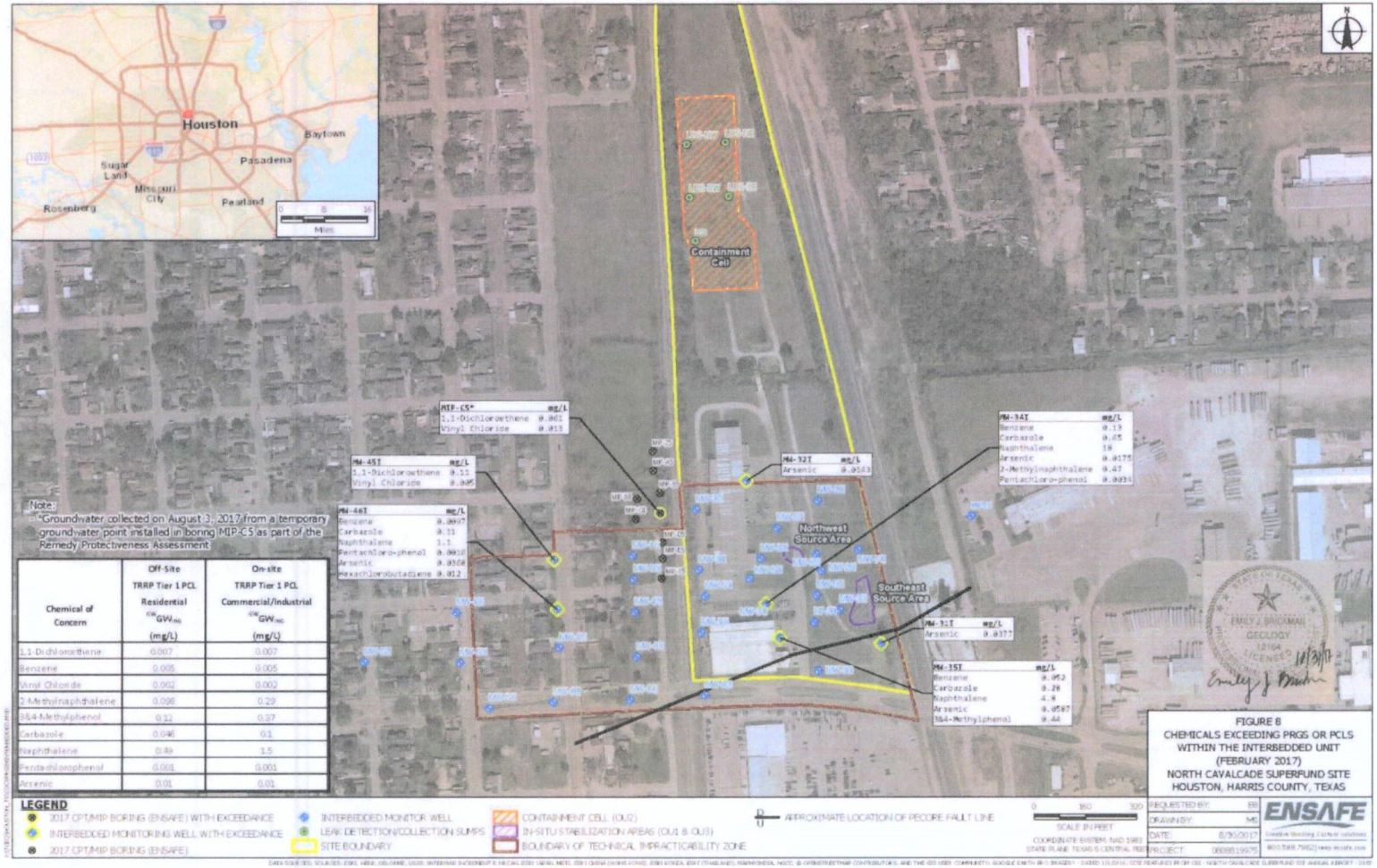
[7] Figure 5-2 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

Figure G-5: Shallow Sands Exceedances[8]



[8] Figure 7 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

Figure G-6: Interbedded Exceedances[9]



[9] Figure 8 in the Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017).

APPENDIX H – DETAILED ARARS REVIEW TABLES

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

Groundwater ARARs

The 2009 AROD identified federal MCLs under the Safe Drinking Water Act (SDWA) and Texas TRRP Tier 1 PCLs as state ARARs for the groundwater COCs. As shown in Table H-1, there have been no changes to the primary ARARs for benzene, benzo(a)pyrene or naphthalene since the signing of the ROD in 1988.

Table H-1: Previous and Current ARARs for Groundwater COCs

COCs[a]	2009 AROD Performance Standards (µg/L)	Current ARARs (µg/L)	ARAR Change
Benzene	5	5[b]	None
Benzo(a)pyrene	0.2	0.2[b]	None
Naphthalene	1,500 (commercial/industrial) 490 (residential)	1,500[c] (commercial/industrial) 490 (residential)	None

Notes:

a. COCs from 2009 AROD.
b. Based on the SDWA primary MCL. Current SDWA standards can be found at: https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants (accessed 1/11/2018).
c. TRRP Tier 1 PCLs (March 31, 2017) located at: https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20PCL%20Tables%20March31.pdf (accessed 1/11/2018).

NA = chemical-specific ARARs in the form of MCLs have not been established for these COCs. Thus, EPA developed health-based criteria for these COCs.
µg/L = micrograms per liter

Soil ARARs

There are no chemical-specific soil ARARs for the Site identified in the decision documents for OU2.

APPENDIX I – SCREENING-LEVEL RISK REVIEW

Changes in Standards and To-be Considered Criteria
The chemical-specific ARARs for groundwater presented in the 2009 AROD were reviewed and demonstrate that the most current federal and state drinking water standards are being used to monitor the TI Zone boundary (Appendix H).

Changes in Toxicity and Other Contaminant Characteristics
The 2009 AROD established an industrial-based soil cleanup goal for site COCs. To determine if these cleanup goals remain valid, a screening-level health evaluation was conducted by comparing the cleanup goals to EPA's 2017 regional screening levels (RSLs). As shown in Table I-1 the cleanup goals remain valid for an industrial land use because they are equivalent to cancer risks that fall within EPA's risk management range of 1×10^{-6} to 1×10^{-4} and the noncancer HQs are below EPA's threshold of 1.0. The cleanup goals were also compared to EPA's residential RSLs for soil to determine if institutional controls are necessary. As shown in Table I-2, the cleanup goal for benzo(a)pyrene exceeds EPA's cancer risk management range and the HQ of 1.0 for residential use, which supports the need for institutional controls.

Table I-1: Industrial Health Evaluation of OU2 Soil Cleanup Goals

COC	1988 ROD and 1994 ESD (mg/kg)	Industrial RSL[b] (mg/kg)		Cancer Risk[b]	Noncancer HQ[c]
		1×10^{-6} Risk	HQ=1.0		
Benzene	0.04	5.1	420	8×10^{-9}	0.0001
Benzo(a)pyrene	30	2.1	220	1×10^{-5}	0.1

Notes
a. Current EPA RSLs, dated November 2017, are available at https //www epa gov/risk/regional-screening-levels-rsls-generic-tables-november-2017 (accessed 1/11/2018).
b. The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1×10^{-6} risk:
cancer risk = (cleanup level ÷ cancer-based RSL) × 10^{-6}
c. The noncancer HQ was calculated using the following equation:
HQ = cleanup level – noncancer-based RSL

mg/kg = milligrams per kilogram

Table I-2: Residential Health Evaluation of OU2 Soil Cleanup Goals

COC	2009 AROD (mg/kg)	Residential RSL[b] (mg/kg)		Cancer Risk[b]	Noncancer HQ[c]
		1×10^{-6} Risk	HQ=1.0		
Benzene	0.04	1.2	82	3×10^{-8}	0 0005
Benzo(a)pyrene[d]	30	0.11	18	**3×10^{-4}**	**1.7**

Notes
a. Current EPA RSLs, dated November 2017, are available at https //www.epa gov/risk/regional-screening-levels-rsls-generic-tables-november-2017 (accessed 1/11/2018).
b. The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1×10^{-6} risk:
cancer risk = (cleanup level – cancer-based RSL) × 10^{-6}
c. The noncancer HQ was calculated using the following equation:
HQ = cleanup level ÷ noncancer-based RSL
d. The 1994 ESD indicated 30 mg/kg as the soil cleanup goal for cPAHs. This comparison uses the RSL for benzo(a)pyrene which may be overly conservative.
Bold = exceedance of a 1×10^{-4} cancer risk or a noncancer HQ of 1.
mg/kg = milligrams per kilogram

Toxicity criteria have changed for some COCs since EPA established groundwater criteria. The groundwater cleanup goals were based on ARARs and the ARARs have not changed. The cleanup goals were compared to EPA's RSLs for tapwater to determine if the groundwater criteria represent concentrations that fall within EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} or are below the noncancer HQ of 1.0 (Table I-3). The results of the analysis demonstrate that the industrial and residential groundwater criteria for naphthalene exceed EPA's upper bound of the cancer risk management range and the HQ of 1.0.

Table I-3: Health Evaluation of Groundwater Cleanup Goals

COC	2009 AROD Cleanup Goals (µg/L)	Tap Water RSL[a] (µg /L)		Cancer Risk[b]	Noncancer HQ[c]
		1×10^{-6} Risk	HQ=1.0		
Benzene	5	0.46	33	1×10^{-5}	0.2
Benzo(a)pyrene	0.2	0.025	6.0	8×10^{-6}	0.03
Naphthalene (on-site industrial)	1,500	0.17[d]	6.1	**9×10^{-3}**	**246**
Naphthalene (off-site residential)	490	0.17[d]	6.1	**3×10^{-3}**	**80**

Notes

a. Current EPA RSLs, dated November 2017, are available at https //www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017 (accessed 1/11/2017).

b. The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1×10^{-6} risk:
cancer risk = (cleanup goal – cancer-based RSL) × 10^{-6}

c. The noncancer HQ was calculated using the following equation:
HQ = cleanup goal – noncancer-based RSL

d. EPA has not established cancer and noncancer toxicity criteria for this chemical. However, EPA has adopted toxicity values developed by the California Environmental Protection Agency for use in screening-level evaluations.

µg/L = micrograms per liter

NA = toxicity values not established by EPA.

-- = cancer risk or noncancer HQ could not be calculated due to absence of toxicity value.

Bold = cancer risk exceeds 1×10^{-4} or noncancer HQ exceeds 1.0.

Changes in Risk Assessment Methods

EPA has completed an update of standard default exposure factors (EPA, 2014). Thus, many of the exposure assessment input parameters in the original risk assessment are different than the currently recommended values. Overall, these changes do not have a significant impact on the conclusions of the risk assessment and do not affect the protectiveness of the remedy.

The June 2008 Focused Feasibility Study conducted a screening level vapor intrusion pathway using the Johnson and Ettinger Model. The results of the modeling indicated that the highest concentrations in groundwater close to building footprints did not exceed screening levels and that vapor intrusion is unlikely to be a potential exposure pathway at this Site. The 2013 FYR compared groundwater concentrations observed in shallow sand wells to concentrations calculated in 2008 using the Johnson and Ettinger Model. It concluded that the 2012/2013 concentrations did not suggest vapor intrusion as a current exposure pathway. It also recommended the vapor intrusion pathway be evaluated at the time of each FYR. Although DNAPL and elevated contamination exists in the interbedded zone, the shallow zone is the zone closest to a foundation. The vapor intrusion pathway was evaluated as part of this FYR using the most current shallow zone data. A screening-level vapor intrusion evaluation was conducted using the EPA's Vapor Intrusion Screening Level (VISL) calculator. Table I-4 shows naphthalene concentrations observed in shallow wells in 2017.

Table I-4: Naphthalene Concentrations Observed in Shallow Wells in 2017

	2017 (µg/L)
MW-22S	0.13
MW-23S	0.061J
MW-24S	0.024U
MW-25S	0.099J
MW-26S	0.078J
MW-27S	0.023U
MW-28S	240
MW-32S	0.023U
MW-37S	0.11J
MW-54S	1,400
OW-1	0.024U
OW-2	0.042 J

Notes:
µg/L = micrograms per liter
J = estimate
U = Not detected at reported quantitation limit
Source: 2017 annual report

As shown in Table I-4, the 2017 maximum concentration of naphthalene on site was observed at MW-54S which is located about 300 feet upgradient of the closest building and about 100 feet north of the southeast source area (Figure G-5). MW-54S is located near the railroad tracks and near a subsurface gas line; no excavations were conducted in this area due to the tracks and gas line. A minor accumulation of source material may still exist under the railroad, which may be the source for the naphthalene concentrations. However, no buildings exist in this area due to the railroad tracks. As shown in Table I-5, this concentration is equivalent to a screening-level residential risk greater than EPA's cancer risk management range and the noncancer HQ for both industrial and residential land use exceeds 1.0. Several other wells are located closer to the on-site building and downgradient of the source areas, however these wells were not sampled in 2017. Table I-6 shows naphthalene concentrations in wells near the buildings sampled most recently in 2014. These results support that the recommendation for further evaluation of the on-site vapor intrusion pathway following EPA guidance requiring the use of multiple lines of evidence to determine if this exposure pathway requires further remedial action.

The off-site (TI Boundary) evaluation demonstrates that off-site concentrations of benzene and naphthalene show that vapor intrusion is not a current exposure pathway; risks and HQs are below EPA risk management levels (Table I-5).

Table I-5: Screening-Level Vapor Intrusion Evaluation of 2017 Groundwater Data

COC	Maximum Groundwater Concentration February 2017 (µg/L)[a]	2017 VISL Calculator [b] (average groundwater temperature 25°C)			
		Industrial Exposure		Residential Exposure	
		Cancer Risk	Noncancer HQ	Cancer Risk	Noncancer HQ
On Site					
Benzene	1.3 (MW-28S)	2×10^{-7}	0.002	8×10^{-7}	0.009
Naphthalene	1,400 (MW-54S)	7×10^{-5}	**2**	**3×10^{-4}**	**8**
Off Site (TI Boundary)					
Benzene	<0.2 (MW-45S, 46S and 47S)	3×10^{-8}	0.0004	1×10^{-7}	0.002
Naphthalene	<0.024 (MW-47S)	1×10^{-9}	0.00003	5×10^{-9}	0.0001

Notes.

a. Annual Operation and Maintenance Report, Fiscal Year 2017 (September 2016 – August 2017). North Cavalcade Street Federal Superfund Site. Houston, Harris County, Texas. Prepared for TCEQ by ENSAFE. October 27, 2017.

b. VISL calculator version 3.5 accessed 1/12/2018 at https //www.epa gov/vaporintrusion/vapor-intrusion-screening-levels-visls.

Bold = exceedance of a 1×10^{-4} cancer risk or a noncancer HQ of 1.

-- = EPA has not classified these COCs as carcinogenic.

Table I-6: Naphthalene Concentrations Observed in Shallow Wells Near On-site Buildings in 2014

	2014 (µg/L)	Notation
MW-30S	380	+
MW-34S	240	+;JL-SUR
MW-35S	0.42	+;JL-SUR
MW-39S	0.52	+;JL-SUR

Notes:
+ = Detected above the quantitation limit shown
JL = Estimated value, and bias for estimate is likely low.
SUR = surrogate

Changes in Exposure Pathways

There has been some new construction of residential structures within and outside of the TI boundary to the west of the Site. However, the screening-level evaluation indicates that vapor intrusion from volatile COCs in the shallow groundwater is not a current exposure pathway.

Expected Progress Toward Meeting RAOs

Long-term monitoring at the Site is ongoing. EPA and TCEQ are currently evaluating the data to determine if the TI Zone boundary requires expansion. Therefore, long-term monitoring will be reviewed during the next FYR period to determine if the remedy is progressing as expected toward meeting RAOs.