c) Net present value of capital and O&M costs.

4.2 Individual Analysis of Alternatives

The individual analysis of alternatives consists of evaluating each of the four remedial alternatives developed for the Jones Road site against eight of the nine evaluation criteria described above. The procedures described by the USEPA FS costing guidance, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000), were used to develop order-of-magnitude cost estimates for each alternative and treatment/discharge option. These order-of-magnitude cost estimates are provided in **Appendix C**. The estimates are considered accurate to +50/-30 percent for the quantities and methods assumed, and were prepared to provide guidance in project evaluation and implementation from information available at the time of the estimate. The actual cost of the selected alternative will depend on the actual labor and material costs, the actual site and weather conditions during the activities, the final project schedule, the final engineering design, and other variable factors. The following paragraphs describe each alternative against eight of the nine criteria.

4.2.1 Alternative 1 – No Further Action

The No Further Action alternative constitutes the absence of any remedial actions. No Further Action is considered in this evaluation as a baseline for comparison to all other potential remedial actions, as required by the NCP.

4.2.1.1 Description

Under this alternative, no measures would be taken to address soil or groundwater contamination, and no measures would be taken to prevent human exposure to them.

4.2.1.2 Assessment

Overall Protection of Human Health and the Environment. No Further Action at the Jones Road site would not protect human health or the environment. Future use of groundwater from contaminated wells would expose humans to contaminants above the MCLs. Further migration of PCE in groundwater would be expected to result in additional contaminated residential or PWS wells.

Compliance with ARARs. No Further Action would not achieve compliance with ARARs.

Long Term Effectiveness and Permanence. No Further Action would not be effective in the long term or permanent. It would allow the existing plume to migrate and potentially impact downgradient wells or deeper WBUs in the future. There would be no way of confirming future impacts without a long term monitoring program.

Reduction of TMV through Treatment. No Further Action would not reduce TMV through treatment. Any natural attenuation that did occur would not be confirmed.

Short Term Effectiveness. Under the No Further Action alternative, there would not be a potential risk of exposure to construction workers, or of adverse impacts to the environment resulting from construction or implementation of the alternative. It would not be effective for addressing existing contaminated wells.

Implementability. No Further Action requires no additional administrative coordination, labor, equipment, or materials.

Costs. There are no costs associated with the No Further Action alternative.

4.2.2 Alternative 2 – In Situ Treatment

The in situ treatment alternative would involve treating the soil and groundwater without removing them from their in situ places. The treatments would be as recommended in the Final Treatability Study Report (**Appendix A**).

4.2.2.1 Description

Institutional controls as described in the introduction to **Section 3.0** would be implemented. ISCO would be applied to contaminated soil and groundwater in the source area. A pilot study will be conducted to determine which in situ treatment will be most effective and appropriate for the source area soil and groundwater and the deep groundwater plume. For cost estimating purposes, it is assumed that ISCO will be chosen for source area groundwater and bioaugmentation will be chosen for the deep groundwater plume.

4.2.2.2 Assessment

Overall Protection of Human Health and the Environment. In situ treatment would provide protection of human health and the environment by destroying contaminants without bringing them to the surface where humans can be exposed to them. Institutional controls would be necessary for overall protection of human health and the environment until monitoring verifies COC concentrations below MCLs. Potential ecological risks of site were evaluated according to the Tier 1 Exclusion Criteria Checklist (30 TAC 350.77(b)). Based on this checklist, no action is required at the Jones Road site to protect ecological receptors.

Compliance with ARARs. In situ treatment could achieve full compliance with all ARARs. It has the potential to lower contaminant levels to below the MCLs. Because all reactions would take place in situ, many of the ARARs would not apply for this alternative. Monitoring would provide a record of progress toward the MCLs in wells within the plume.

Long Term Effectiveness and Permanence. In situ treatment would be effective in the long term and would potentially be permanent. The wells subjected to in situ treatment would need to be monitored for potential rebound of contaminant concentrations as residual contaminants beyond the effective reach of the in situ treatments may disperse back into the wells over time.

Reduction of TMV through Treatment. In situ treatment would reduce toxicity and volume through the chemical oxidation or biodegradation of contaminants. Both methods transform the hazardous contaminants into non-hazardous breakdown products and non-toxic residues. Mobility would not be affected. The degree of TMV reduction would depend on treatment application rate and effectiveness.

Short Term Effectiveness. In situ treatment would be effective in the short term because chemical oxidation reaction rates are fast. It is expected that the bioaugmentation treatments will reduce contaminants at a slower rate, but with greater potential for continuing reductions over the longer term. The short term risks associated with in situ treatment application should be manageable with a well implemented health and safety plan.

Implementability. In situ treatment would require administrative coordination to maintain permissions to monitor private water wells. Labor, equipment and materials would be required for injecting the ISCO in the source area and bioaugmentation in the deep groundwater plume. ISCO and bioaugmentation are commercially available technologies that have been used at numerous contaminated soil and groundwater sites. The known characteristics of the Jones Road site present no unique difficulties. Smaller amounts of labor, equipment and materials would be needed for the periodic groundwater monitoring. It is technically and administratively feasible.

Costs. Estimated costs associated with in situ treatment are detailed in **Appendix C**. These costs were estimated assuming a 30-year period of performance and a discount rate of 7%. The cost estimate assumes the monitoring results will allow reductions in the frequency of monitoring from quarterly, to annually, to once every five years over time. The total net present value (NPV) cost of Alternative 2 is estimated at $2,710,000, with a range from (-30%) $1,897,000 to (+50%) $4,065,000.

4.2.3 Alternative 3 – Hydraulic Containment/Pump and Treat

The hydraulic containment/pump and treat alternative would involve pumping groundwater from the subsurface in both the source area and the deeper groundwater zones at high enough rates to prevent further migration of PCE in groundwater. The pumped groundwater would then be treated by air stripping to remove VOCs. Alternative 3 does not directly address soil.

4.2.3.1 Description

Institutional controls as described in the introduction to **Section 3.0** would be implemented. For the shallow groundwater at the source area (less than 50 feet bgs) and deeper groundwater (more than 50 feet bgs), contaminated groundwater would be extracted to hydraulically control the migration of PCE. The extracted groundwater would be treated by air stripping to remove the PCE and the treated groundwater would be reinjected or disposed through the local sanitary sewer system or to an outfall under TPDES permit.

4.2.3.2 Assessment

Overall Protection of Human Health and the Environment. Hydraulic containment/pump and treat would provide protection of human health by removing contaminants from groundwater. Institutional controls would close the groundwater exposure pathway to protect human health. Potential ecological risks of site were evaluated according to the Tier 1 Exclusion Criteria Checklist (30 TAC 350.77(b)). Based on this checklist, no action is required at the Jones Road site to protect ecological receptors.

Compliance with ARARs. Hydraulic containment/pump and treat could achieve full compliance with all ARARs. It would prevent further plume migration and lower contaminant levels over time to below the MCLs.

Long Term Effectiveness and Permanence. Hydraulic containment/pump and treat would be effective in the long term and would potentially be permanent. Groundwater would need to be monitored for potential rebound of contaminant concentrations as residual contaminants from low permeability layers may dissolve back into the groundwater over time. Operation of the pump and treat system poses some risk due to spills or breakdowns.

Reduction of TMV through Treatment. Hydraulic containment/pump and treat would reduce TMV through removal and treatment of contaminated groundwater. Removing contaminants reduces toxicity. The hydraulic containment/pump and treat reduces mobility. The combination of the two would reduce volume.

Short Term Effectiveness. Hydraulic containment/pump and treat would provide short term effectiveness to control groundwater flow and contain the groundwater plumes. Long term secondary benefits include reduction in TMV.

Implementability. Hydraulic containment/pump and treat would require administrative coordination to maintain permission to install extraction wells, injection wells, piping, and treatment plants. Significant labor, equipment and materials would be required for installing the systems. Groundwater extraction and air stripping are well developed technologies and commercially available. Smaller amounts of labor, equipment and materials would be needed

for periodic groundwater monitoring and influent and effluent monitoring to verify continuing effectiveness. Hydraulic containment/pump and treat is technically and administratively feasible.

Costs. Estimated costs associated with hydraulic containment/pump and treat are detailed in **Appendix C**. These costs were estimated assuming a 30-year period of performance and a discount rate of 7%. The cost estimate assumes the monitoring results will allow reductions in the frequency of monitoring from semiannually, to annually, to once every five years over time. The total net present value (NPV) cost of Alternative 3 is estimated at $4,668,000, with a range from (-30%) $3,268,000 to (+50%) $7,002,000.

4.2.4 Alternative 4 – In Situ Enhancements to Pump and Treat

The in situ enhancements to the pump and treat alternative would involve pumping groundwater from the subsurface in both the source area and the deeper groundwater zones. In situ enhancements would be added through direct injection and wells to enhance removal or destruction of PCE in the soil and groundwater.

4.2.4.1 Description

This alternative is substantially similar to Alternative 3 with the addition of in situ enhancement such as that described in Alternative 2. Institutional controls as described the introduction to **Section 3.0** would be implemented. ISCO would be applied to soil and shallow groundwater in the source area to destroy source area contaminants. This activity would be performed as described in Alternative 2. Bioaugmentation would be applied to the deeper zones of groundwater with lower PCE concentrations to both destroy contaminants and enhance natural attenuation of contaminants. This activity would be performed as described in Alternative 2. Pumping of groundwater for hydraulic control and treatment would be performed as described in Alternative 3, with exceptions made for periods of in situ treatment application to allow time for the applied treatments to effectively destroy contaminants.

4.2.4.2 Assessment

Protection of Human Health and the Environment. In situ enhancement to pump and treat would provide protection of human health and the environment by destroying contaminants in situ or removing contaminants from groundwater. Institutional controls would protect human health by closing the groundwater pathway. Potential ecological risks of site were evaluated according to the Tier 1 Exclusion Criteria Checklist (30 TAC 350.77(b)). Based on this checklist, no action is required at the Jones Road site to protect ecological receptors.

Compliance with ARARs. In situ enhancement to pump and treat could achieve full compliance with all ARARs. It would prevent further plume migration and more quickly lower contaminant levels to below the MCLs than pump and treat alone.

Long Term Effectiveness and Permanence. In situ enhancement to pump and treat would be effective in the long term and would potentially be permanent. Groundwater would need to be monitored for potential rebound of contaminant concentrations as residual contaminants beyond the effective reach of the in situ enhancement may dissolve into the groundwater over time. Operation of the pump and treat system poses some risk due to spills or breakdowns.

Reduction of TMV through Treatment. In situ enhancement to pump and treat would reduce TMV through destruction in situ, and removal and treatment ex situ of contaminated groundwater.

Short Term Effectiveness. In situ enhancement to pump and treat would be effective in the short term because hydraulic containment would control plume migration and in situ enhancement would be applied to destroy the highest concentrations of contaminants in groundwater.

Implementability. In situ enhancement to pump and treat would require administrative coordination to maintain permissions to install extraction wells, injection wells, piping, and treatment plants. Substantial labor, equipment and materials would be required for installing the system and applying the in situ enhancements. Smaller amounts of labor, equipment and materials would be needed for the periodic groundwater monitoring to verify continuing effectiveness. In Situ enhancement to pump and treat is technically and administratively feasible.

Costs. Estimated costs associated with in situ enhancement to pump and treat are detailed in **Appendix C**. These costs were estimated assuming a 30-year period of performance and a discount rate of 7%. The cost estimate assumes there will be two rounds of in situ enhancement applied, and that monitoring results will allow reductions in the number of wells sampled and the frequency of monitoring from quarterly to annually to every five years over time. The total net present value (NPV) cost of Alternative 4 is estimated at $5,849,000, with a range from (-30%) $4,094,000 to (+50%) $8,774,000.

4.3 Comparative Analysis

The purpose of the comparative analysis of alternatives is to evaluate the relative performance of each alternative under each of the nine evaluation criteria. **Table 5** presents the comparative analysis of alternatives. **Table 5** also presents a summary of the costs associated with each alternative. A comparative summary of the alternatives is presented below.

4.3.1 Overall Protection of Human Health and the Environment

The overall protection of human health and the environment is a threshold criteria and must be met in order for the alternative to be eligible for selection as a remedial action. Alternative 1 –

No Further Action, does not meet this threshold; therefore, it cannot be selected. All of the other alternatives meet this minimum and are eligible for selection.

Alternative 2 protects human health and the environment by in situ destruction of contaminants, which will shorten the required monitoring period. Alternative 3 contains, pumps, and treats contaminated groundwater, removing contaminants to protect human health. Alternative 4 adds in situ enhancements to Alternative 3 to reduce active treatment time.

4.3.2 Compliance with ARARs

Compliance with ARARs is also a threshold criteria and must be met in order for the alternative to be eligible for selection as a remedial action. In certain circumstances, an ARAR waiver may be granted in lieu of compliance. Alternative 1 – No Further Action, does not meet this threshold and cannot be selected. All other alternatives meet this minimum or are potentially eligible for an ARAR waiver. Alternatives are listed in order of comparative advantage with respect to ARAR compliance.

Alternative 2 complies with ARARs by destroying contaminants in situ by chemical oxidation or biodegradation to reduce concentrations to levels below the PRGs. No subsidence district issues would be applicable.

Alternative 3 complies with ARARs by removing contaminants from the groundwater with a hydraulic containment/pump and treat system to reduce concentrations to levels below PRGs. This would be slower than Alternative 4. There are potential conflicts with subsidence district concerns.

Alternative 4 complies with ARARs by destroying contaminants in situ and removing contaminants from groundwater with a hydraulic containment/pump and treat system to reduce concentrations to levels below PRGs. There are potential conflicts with subsidence district concerns.

4.3.3 Long Term Effectiveness and Permanence

Long term effectiveness and permanence is a balancing criteria that facilitates comparison of alternatives. Alternative 1 would not be effective or permanent. Among the remaining alternatives, greater long term effectiveness and permanence are attributed to those alternatives that remove or destroy a greater mass of contaminants by the end of the 30-year evaluation period.

Alternative 4 is the most effective and permanent alternative because it addresses source area and hot spot contaminants while maintaining hydraulic control of the contaminant plumes. Alternative 3 does not address source area or hot spot contamination, but controls plume

migration. It is not considered as effective as Alternative 4. Alternative 2 addresses source area and hot spot contamination, but does not control plume migration.

4.3.4 Reduction of TMV through Treatment

Reduction of TMV through treatment is a balancing criteria that facilitates comparison of alternatives. Alternative 1 contains no treatment, so it is least favored by this comparison. Among the remaining alternatives, the degree to which treatment reduces TMV is evaluated to rank the alternatives.

Alternative 4 ranks best for reduction of TMV through treatment because contaminants would be destroyed in situ and removed by the hydraulic containment/pump and treat system.

Alternative 2 would rank next because it employs in situ destruction of contaminants, and would likely destroy a larger mass of contaminants within 30 years than Alternative 3.

Alternative 3 ranks slightly lower because the hydraulic containment/pump and treat system by itself would remove contaminants more slowly.

4.3.5 Short Term Effectiveness

Short term effectiveness is a balancing criterion that facilitates comparison of alternatives. Alternative 1 would not be effective, so it is the least favored by this comparison. Among the remaining alternative, preference is given to alternatives with fewer potential risks to workers and the community during implementation, and to alternatives that are effective in a shorter time period.

Alternative 4 ranks best for short term effectiveness because contaminants would be destroyed in situ or removed by the hydraulic containment/pump and treat system, leading to the shortest expected time to achieve the PRGs. There would be some short term risks during construction and ISCO application.

Alternative 2 would rank next because it employs in situ destruction of contaminants, but has no ongoing hydraulic containment/pump and treat aspect to address contaminants from beyond the reach of the in situ treatment application. There would be some short term risks during ISCO and bioaugmentation application.

Alternative 3 ranks slightly lower because the lack of in situ contaminant destruction would leave more contaminants in the groundwater at any comparable future time. There would be some short term risks during construction.

4.3.6 Implementability

Implementability is a balancing criteria that facilitates comparison of alternatives. Alternative 1 – No Further Action, is inherently implementable as no actions are required, so is most favored by this comparison. Among the remaining alternatives, technical feasibility, administrative feasibility, and availability of services and materials are evaluated to rank the alternatives.

Alternative 2 ranks first (best) in implementability because the in situ treatment applications could be accomplished within the first four years, with only monitoring necessary later.

Alternative 3 ranks next because the hydraulic containment/pump and treat system would require significant time to construct and operations would continue with adjustments as necessary over time.

Alternative 4 ranks last because it combines the implementation of in situ treatment application with the complexity of constructing and operating a hydraulic containment/pump and treat system over time.

4.3.7 Costs

Cost is a balancing criteria that facilitates comparison of alternatives. Alternative 1 has no associated costs, so is most favored by this comparison. Among the remaining alternatives, costs are evaluated in multiple ways for comparison, capital costs, O&M costs, periodic costs, and the NPV cost of the capital, O&M, and periodic costs over a 30-year evaluation period.

In terms of NPV costs over a 30-year period, Alternative 4 – In Situ Enhancements to Pump and Treat is the most expensive, and Alternative 2 – In Situ Treatment is the least expensive.

In terms of capital costs, Alternative 4 is the most expensive, and Alternative 2 is the least expensive.

In terms of O&M costs, Alternative 4 is the most expensive, and Alternative 2 is the least expensive.

In terms of periodic costs, Alternative 4 is the most expensive, and Alternative 3 is the least expensive.

4.4 Summary

In considering the Alternatives, it may be useful to consider some of the things that all of the action alternatives (2 through 4) have in common:

Preliminary design investigations will be performed.

Institutional controls will be established.

Groundwater will be monitored.

Five year reviews will take place.

These items account for approximately $2,000,000, which will be part of whichever remedial alternative is selected.

In terms of addressing the source area soil, the alternatives propose in situ chemical oxidation (Alternatives 2 and 4), and institutional controls (Alternatives 2 through 4). In situ chemical oxidation would work if adequate contact can be made between ISCO chemicals and the contaminants in soil.

In terms of addressing the source area groundwater (less than 50 feet bgs), the alternatives propose hydraulic containment/pump and treat (Alternatives 3 and 4), in situ treatment (Alternatives 2 and 4), and institutional controls (Alternatives 2 through 4). Hydraulic containment/pump and treat would be the most flexible to implement, with multiple wells and monitoring points that could be adjusted to suit changing conditions. In situ treatment would be most effectively directed at "hot spots" of higher concentration.

In terms of addressing the deep groundwater plume (deeper than 50 feet bgs), the alternatives propose hydraulic control/pump and treat (Alternatives 3 and 4), in situ treatment (Alternatives 2 and 4), and institutional controls (Alternatives 2 through 4). Hydraulic containment/pump and treat would be the most flexible, with multiple extraction wells, monitoring points, and injection wells that could be adjusted to suit changing conditions. In situ treatment would be most effectively directed at "hot spots" of higher concentration.

Alternative 2 would be preferred if a minimally disruptive remedy is required. If contaminant migration can be proven to be contained within or near the present day limits without additional engineering controls, then Alternative 2 may be the ideal solution. Alternative 4 would be preferred if the greatest certainty of success and flexibility is desired.

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Figures

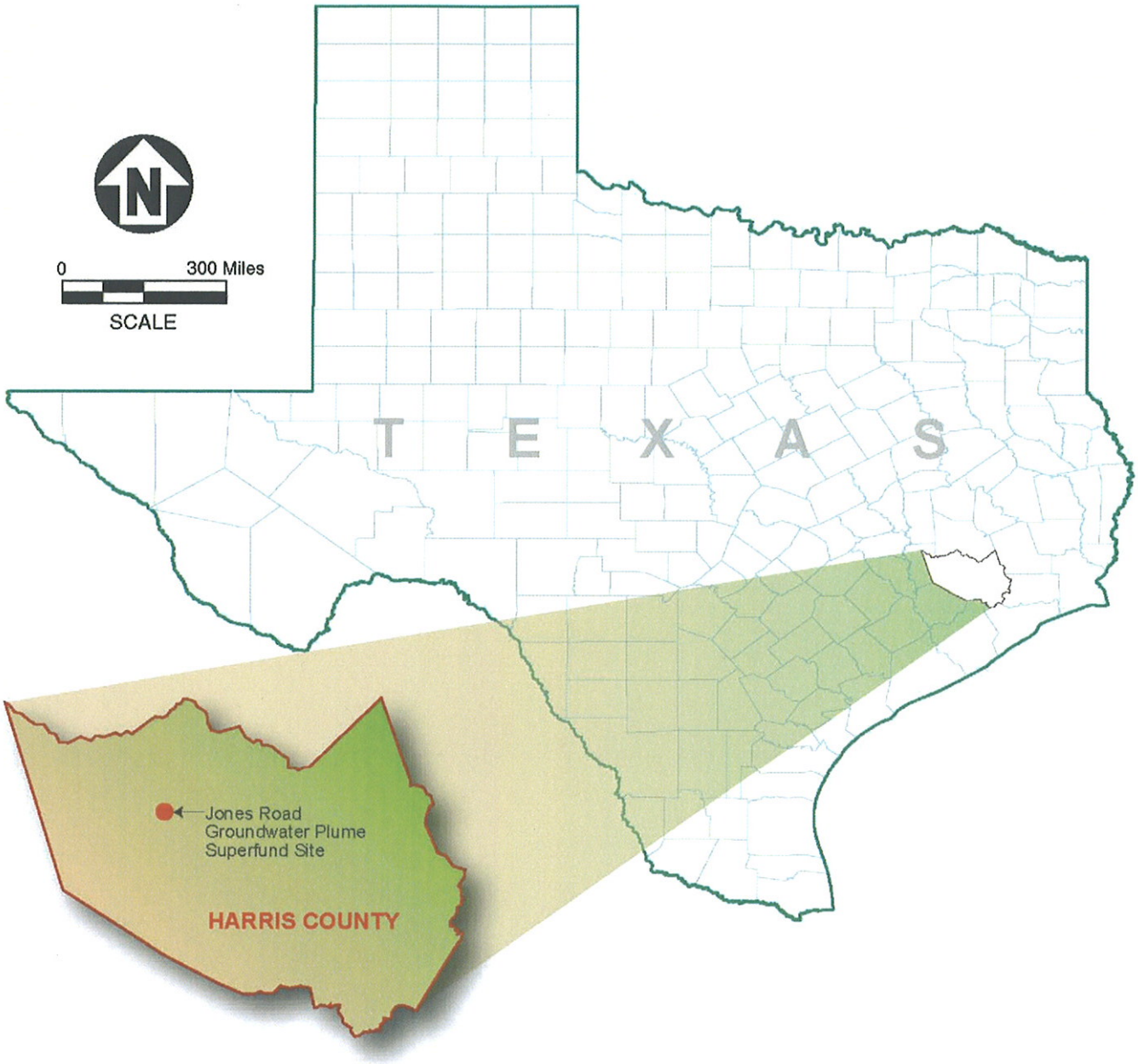


IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	HOUSTON, TX	L. JONES	08/06/08	R. PERRY	---	R. PERRY	---	129389-A6

PLOT DATE: 08/06/08
FORMAT REVISION 9/17/02

REFERENCE:

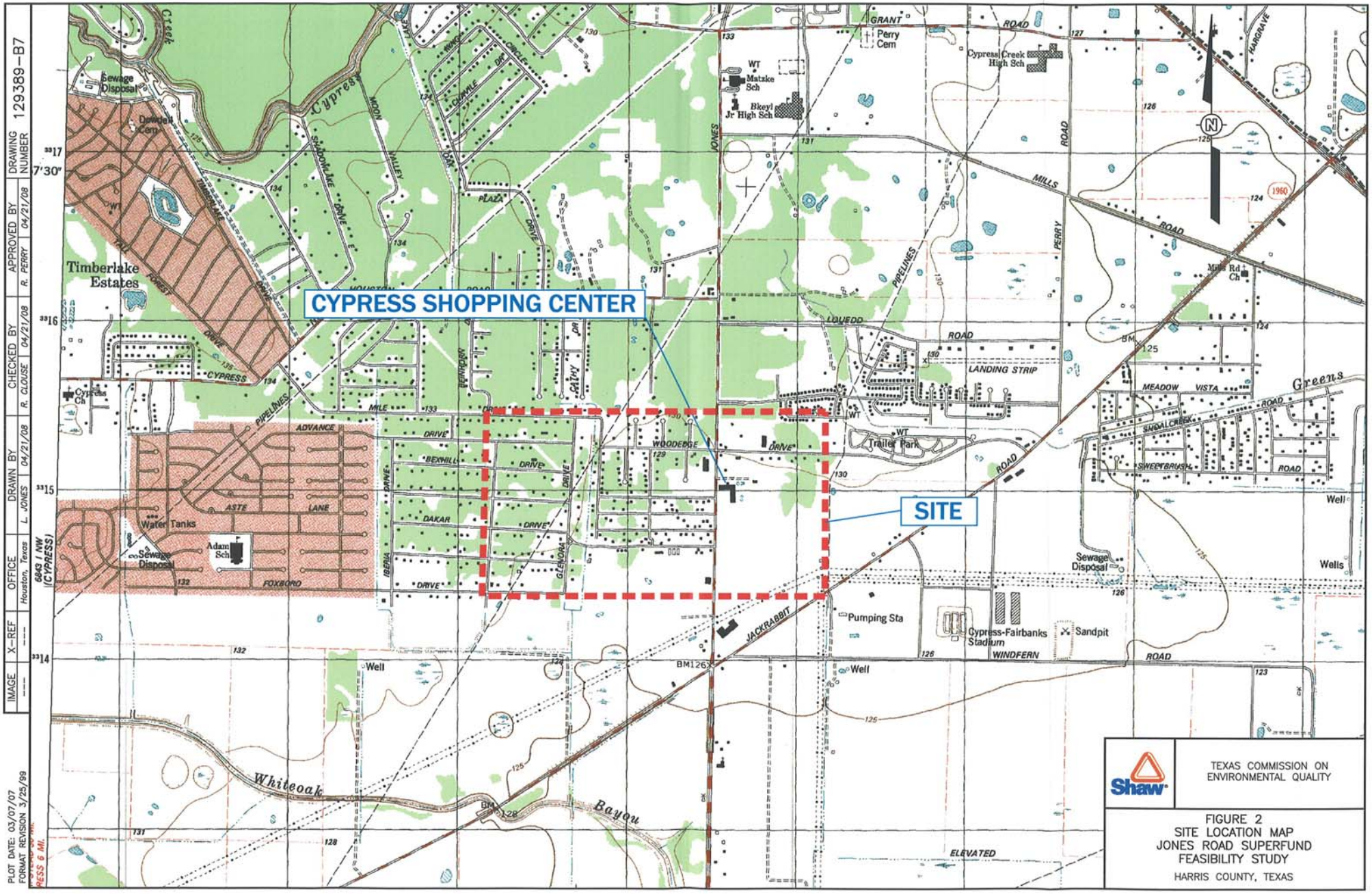
Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 1

VICINITY MAP
JONES ROAD SUPERFUND
FEASIBILITY STUDY

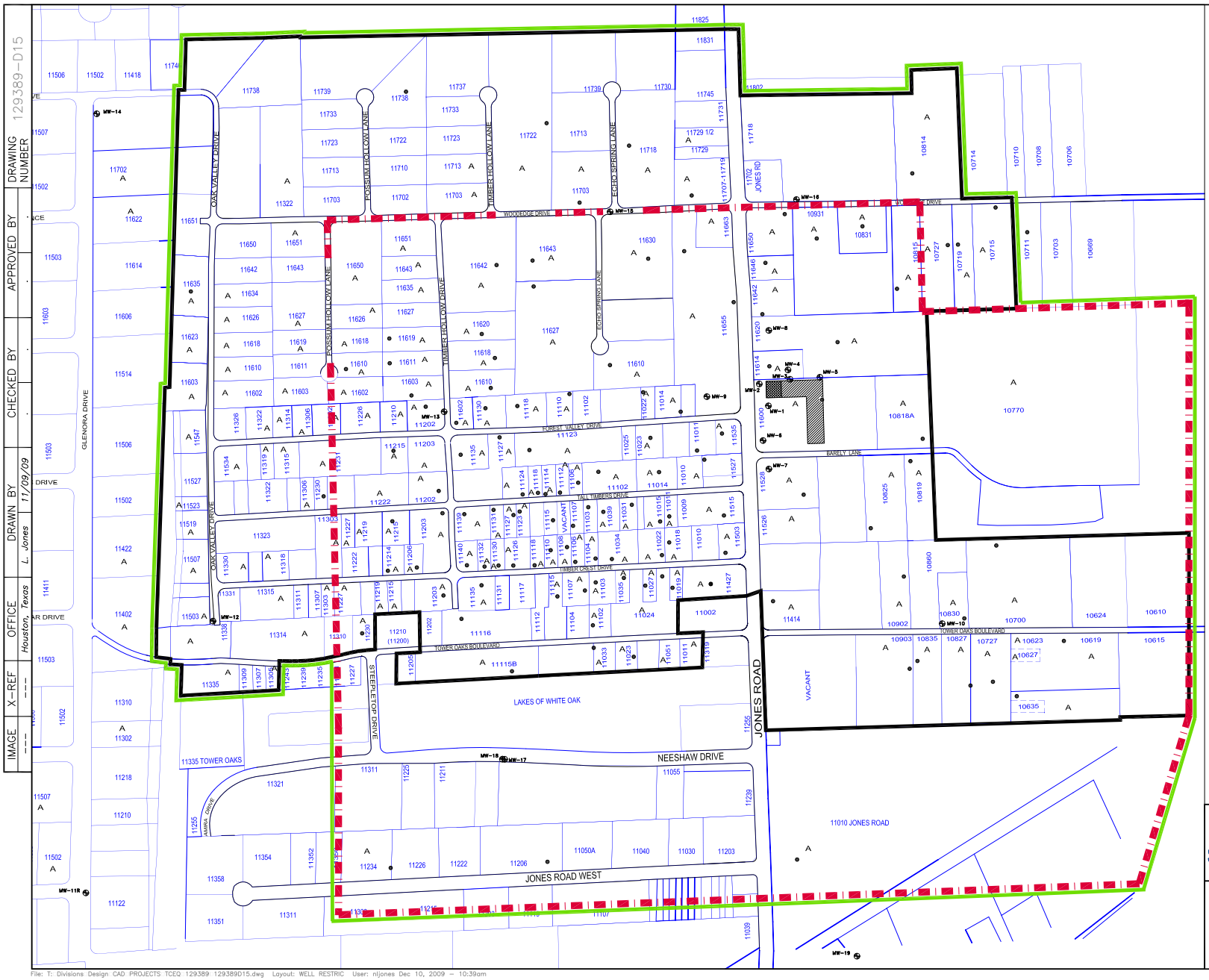
HARRIS COUNTY, TEXAS



Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 2
SITE LOCATION MAP
JONES ROAD SUPERFUND
FEASIBILITY STUDY
HARRIS COUNTY, TEXAS



EXPLANATION:

- PROPERTY BOUNDARY
- FINAL WATERLINE SERVICE AREA BOUNDARY, HARRIS COUNTY MAY DENY WELL PERMITS
- DRILLING RESTRICTION AREA (TDLR)
- MONITOR WELL LOCATION
- APPROXIMATE PRIVATE WELL LOCATION
- A ACCESS AGREEMENT
- LOCATION OF STRIP CENTER (CYPRESS SHOPPING CENTER)
- LOCATION OF FORMER BELL DRY CLEANERS
- AREA OF INSTITUTIONAL CONTROLS (NO USE OF GROUNDWATER) BY HARRIS COUNTY

NOTE: MAP IS SUBJECT TO CHANGE DUE TO PROPERTY TRANSACTIONS.

N

SCALE
0 200 400 600 FEET

Prepared for:

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 3
RESIDENTIAL WELLS AND RESTRICTION AREAS
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Houston, Texas	L. Jones 11/09/09	.	.	129389-D15

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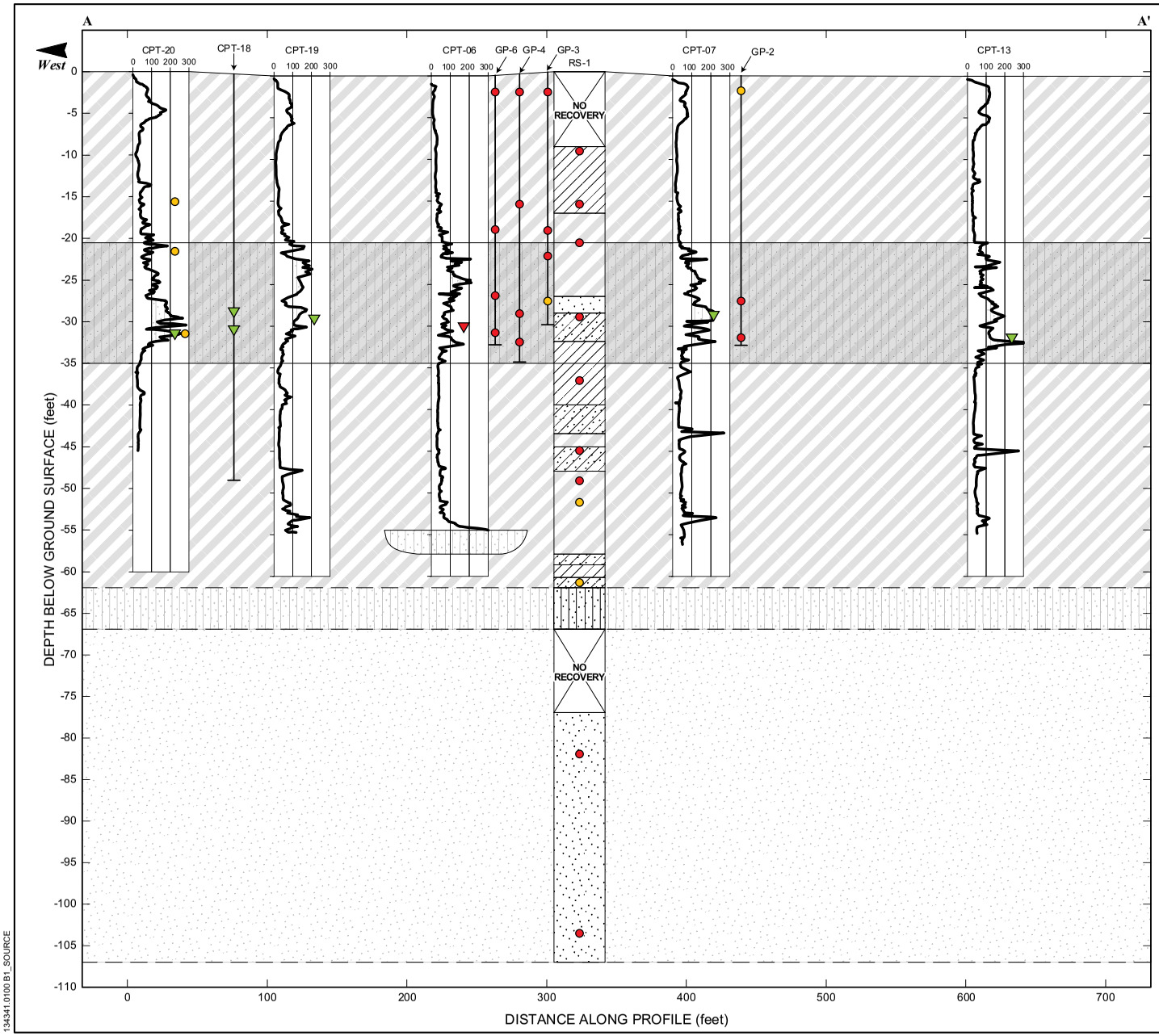

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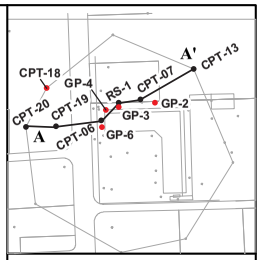
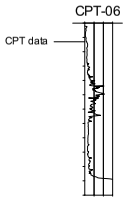
Lithology Graphics

- USCS Sand (SP)
- USCS High Plasticity Clay (CH)
- USCS Low Plasticity Clay (CL)
- USCS Clayey Sand (SC)
- USCS Silty Sand (SM)
- Interbedded Sand (SP), Silt (ML), and Silty Clay (CL)
- Tip Resistance (TSF)
- Lithology Boundary
- Approximate Lithology Boundary
- CPT Cone Penetration Test (analytical data from 8-9/2003)
- GP Geoprobe® (analytical data from 10/2003)
- RS Rotosonic (analytical data from 7/2006)
- PCE Concentration > 5 ppb In Soil
- PCE Concentration ≥ 0.5 ppb to ≤ 5 ppb In Soil
- PCE Concentration < 0.5 ppb In Soil
- PCE Concentration > 5 ppb In Groundwater
- PCE Concentration ≥ 0.5 ppb to ≤ 5 ppb In Groundwater
- PCE Concentration < 0.5 ppb In Groundwater



Site Map Scale 1 inch equals 385 feet

Explanation



Note: Soil samples collected below 25 feet bgs were within the saturated zone.

0 50 100

Horizontal Scale (feet)

Vertical Exaggeration: 6x

Figure 4
Cross Section A-A'
Jones Road Superfund
Feasibility Study
(Source Area)

Shaw

Jones Road Superfund Site
Harris County TX

JOB NUMBER	PLATE NUMBER
131429	Plate A-2

134341.0100 B1_SOURCE

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
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PLOT DATE: 06/29/09
FORMAT REVISION 3/25/99

REFERENCE:

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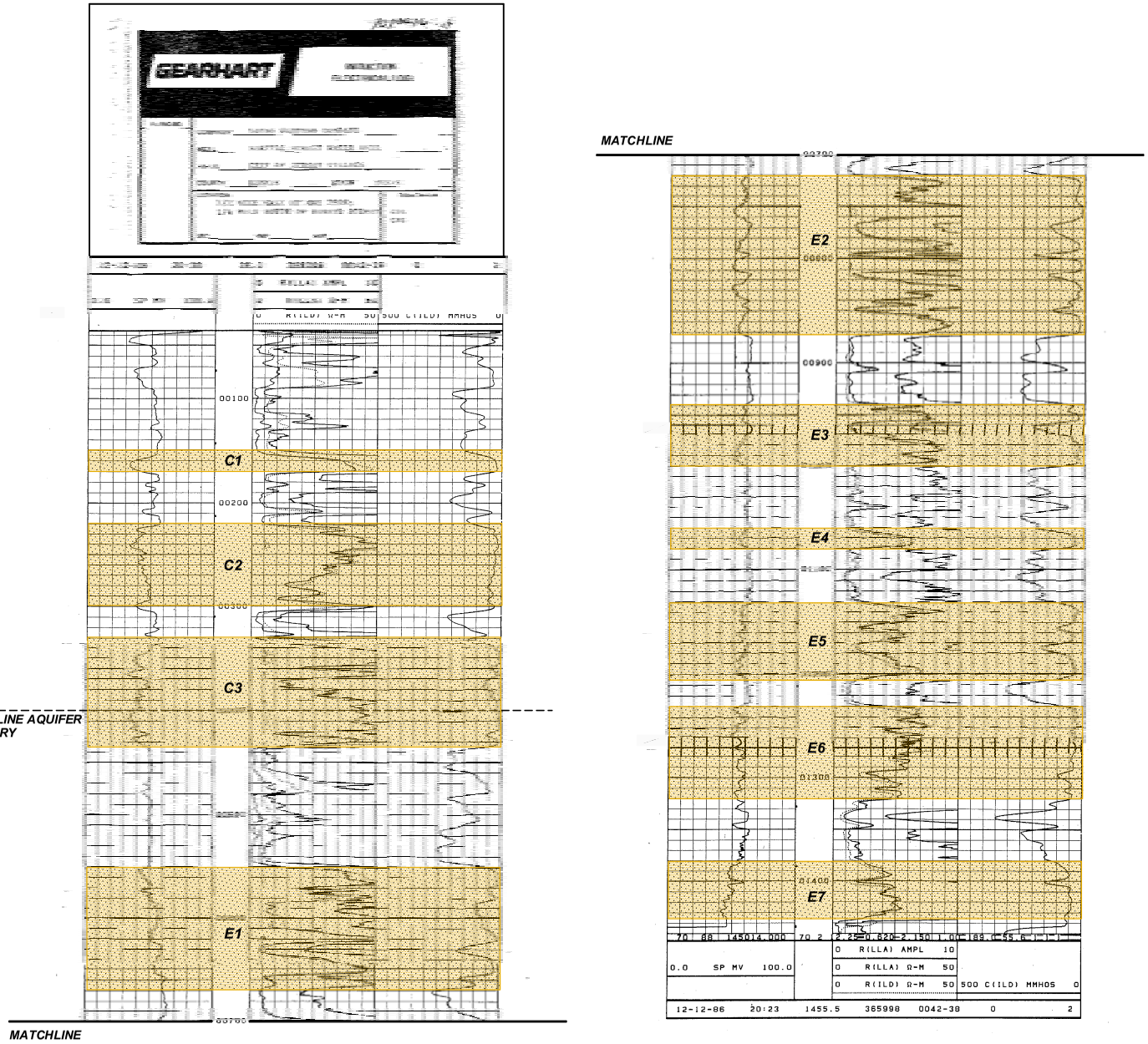
FOR LAYNE WESTERN COMPANY
CITY OF JERSEY VILLAGE HARRIS CO., TEXAS



NOTES:

1.) C1, C2, C3,... DENOTE WATER BEARING UNITS WITHIN THE THE CHICOT AQUIFER.

2.) E1, E2, E3,... DENOTE WATER BEARING UNITS WITHIN THE EVANGELINE AQUIFER.

3.) WELL LOG G1010016A PRESENTS TYPICAL WATER BEARING UNIT (WBU)/STRATIGRAPHIC DISTRIBUTIONS WITHIN THE CHICOT AND EVANGELINE AQUIFERS IN THE JONES ROAD AREA. THE WBUs ARE COMPRISED OF LATERALLY DISCONTINUOUS, FLUVIAL, NON-MARINE, SINUOUS SAND CHANNELS AND OVER BANK DEPOSITS. DUE TO THE DEPOSITIONAL ENVIRONMENT, THE VERTICAL DISTRIBUTION OF WBUs SHOWN ON WELL LOG G1010016A MAY NOT CORRELATE WITH OTHER WELL LOGS IN THE AREA.

SCALE AS SHOWN

Shaw®

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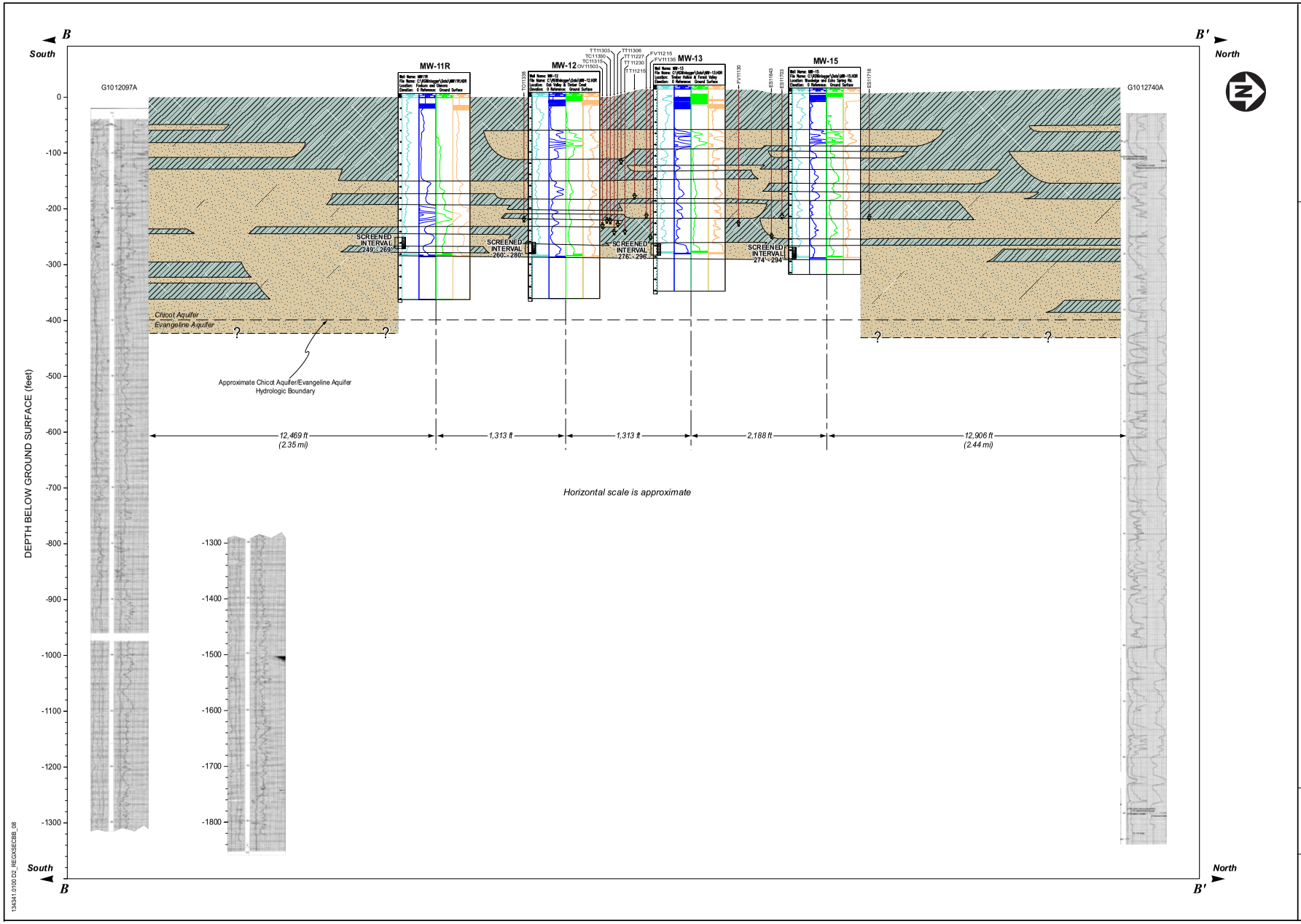
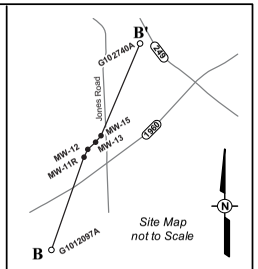
FIGURE 4A
TYPE LOG
ELECTRICAL LOG OF WELL G1010016A
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY
HARRIS COUNTY, TEXAS





Explanation

MW-13

Resistivity data

Lithology Graphics

Sand

Clay

Lithology Boundary

Approximate Lithology Boundary

PCE Concentration > 5 ppb In Groundwater

PCE Concentration ≥ 0.5 ppb to ≤ 5 ppb In Groundwater

PCE Concentration < 0.5 ppb In Groundwater

PCE Concentration Not Sampled

Well Screen

0

100

Vertical Scale (feet)

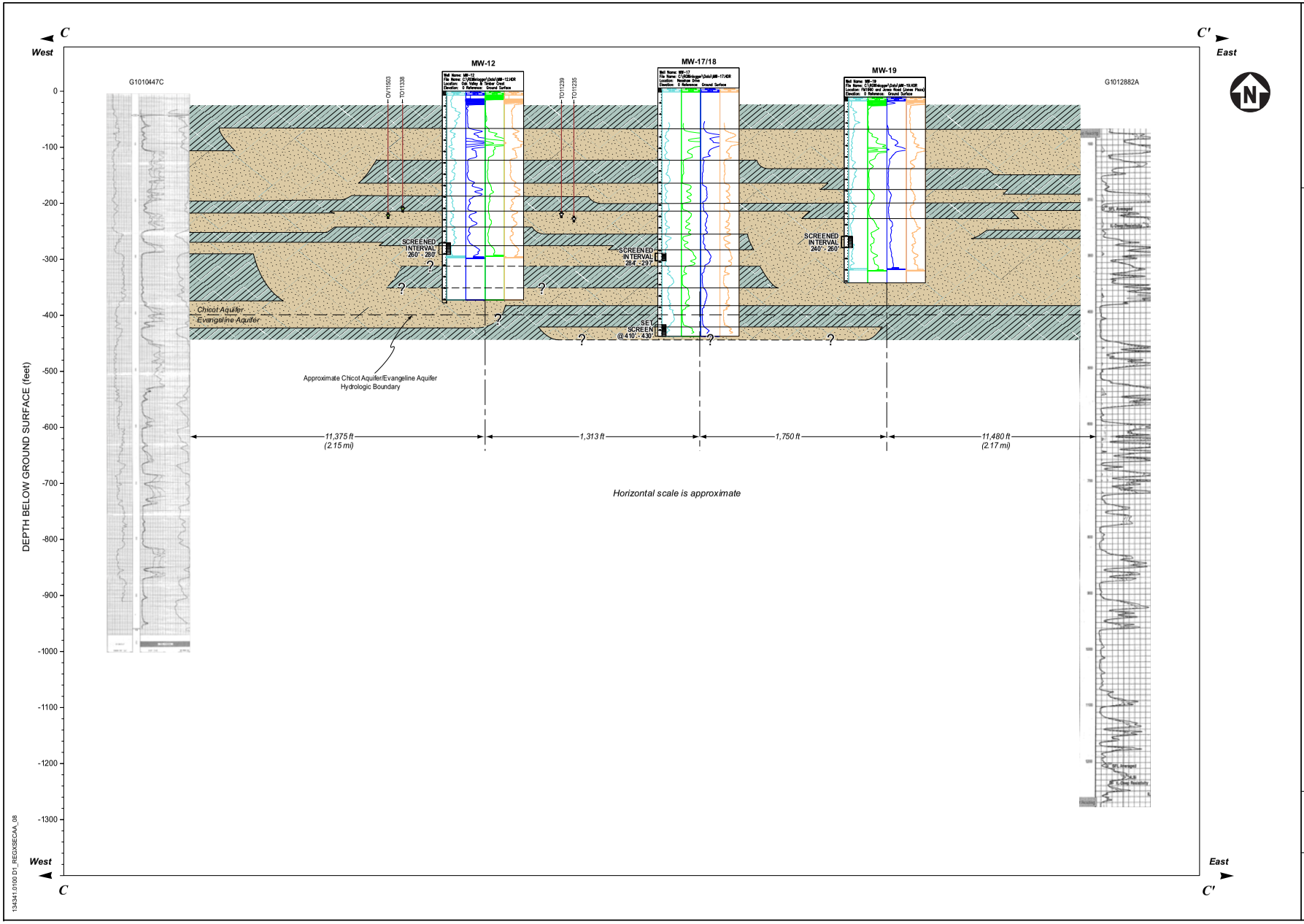
Figure 5
Cross Section B-B'
Jones Road Superfund
Feasibility Study

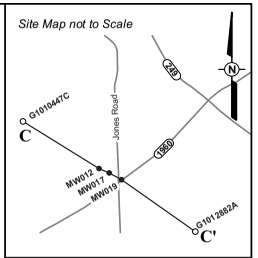
Shaw

Jones Road Superfund Site
Harris County TX

JOB NUMBER	PLATE NUMBER
129389	Plate _

134341.0100 D2_REGXSECBB_08





Explanation

MW-13

Resistivity data

Lithology Graphics

- Sand
- Clay
- Lithology Boundary
- Approximate Lithology Boundary
- PCE Concentration < 0.5 ppb In Groundwater
- PCE Concentration Not Sampled
- Well Screen

0 — 100

Vertical Scale (feet)

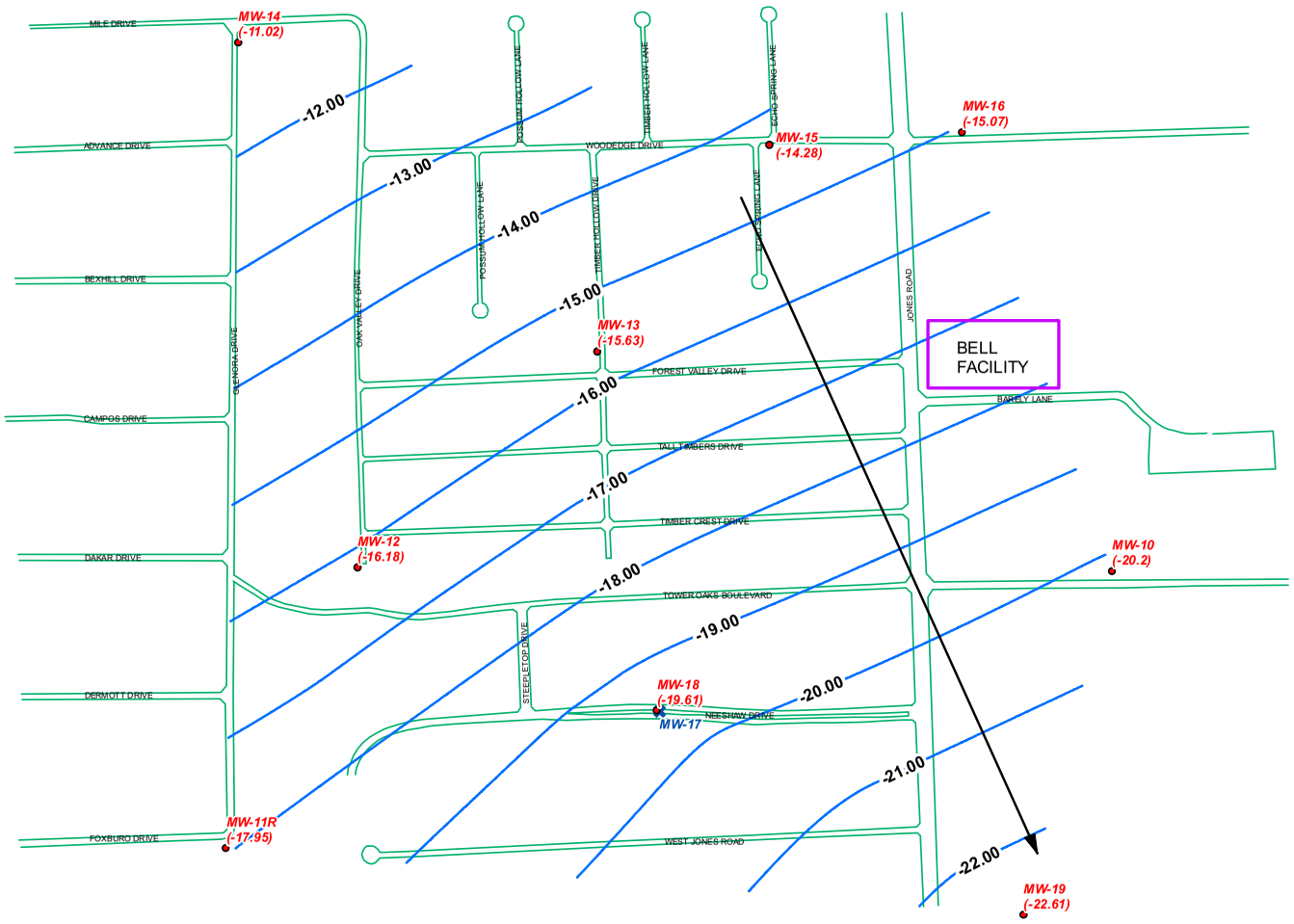
Figure 6
Cross Section C-C'
Jones Road Superfund Feasibility Study

Shaw

Jones Road Superfund Site
Harris County TX

JOB NUMBER	PLATE NUMBER
129389	Plate _

134341.0100 D1_REGXSECAA_08



Potentiometric contours were computer generated using ArcGIS 9.2 software.

LEGEND

- Chicot Monitor Well Location
- Evangeline Monitor Well Location
- Direction of Groundwater Flow
- Potentiometric Contour
- Streets
- MW-15 (-14.28) Monitor well ID Groundwater Elevation in Feet Mean Sea Level

NOTES:

1. Well sites were gauged on 08/03/2007.
2. MW-17 is completed in the Evangeline Aquifer and was not included in this potentiometric map.
3. Datum - Sea level

0 250 500 1,000 Feet

Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
12100 PARK 35 CIRCLE, BUILDING D
AUSTIN, TEXAS 78753

FIGURE 7

POTENTIOMETRIC SURFACE MAP
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	FILE PATH
Houston, TX	B. Lu 04/29/09			T:\GIS\JonesRd\GISDocs\ProjectMaps\FS_GW_Contours.mxd

Plot Date: 11/09

EXPLANATION:

- CPT-07 CPT LOCATION (AUGUST–SEPTEMBER 2003)
- CPT-49 CPT LOCATION (AUGUST 2004)
- MW-3 MONITOR WELL LOCATION (NOVEMBER 2001)
- MW-5 MONITOR WELL LOCATION (JANUARY 2002)
- MW-9 MONITOR WELL LOCATION (AUGUST/SEPTEMBER 2003)
- GP-8 GEO-PROBE (OCTOBER 2003)
- GP-7a GEO-PROBE (JULY 2006)
- B2 SOIL BORING LOCATION (JULY/NOVEMBER 2001)
- AMBIENT AIR/SUB-SLAB VAPOR SAMPLE (FEBRUARY 2008)
- RS-1 CHICOT ROTOSONIC WELL LOCATION (JULY 2006)
- WATER WELL LOCATION
- SEPTIC SYSTEM
- STORM SEWER

SCALE

0 80 160 240 FEET

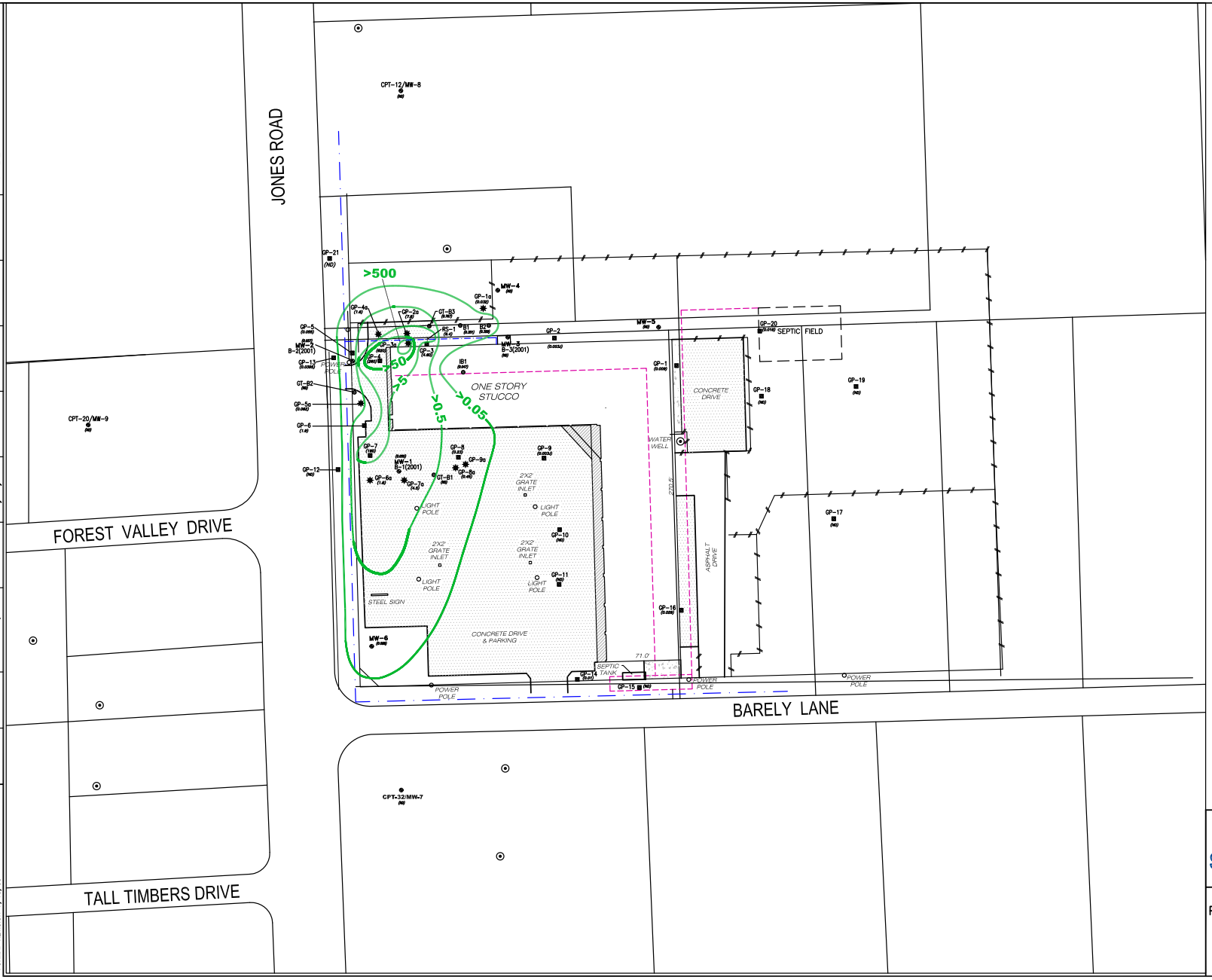
Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
12100 PARK 35 CIRCLE
AUSTIN, TEXAS

FIGURE 8
SAMPLE LOCATIONS
JONES ROAD SUPERFUND
FEASIBILITY STUDY
HARRIS COUNTY, TEXAS

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
129389-D12	---	---	11/04/09 L. JONES	HOUSTON, TX	---	---

PLOT DATE: 11/04/09
FORMAT REVISION 7/15/03



LEGEND:

- MW-3 ⊕ MONITOR WELL LOCATION
- GP-8 ■ GEO-PROBE (OCTOBER 2003)
- GP-7a ✱ GEO-PROBE (JULY 2006)
- B2 ● SOIL BORING LOCATION (JULY, NOVEMBER 2001)
- RS-1 + CHICOT ROTOSONIC WELL LOCATION (JULY 2006)
- ⊙ WATER WELL LOCATION
- PCE IN SOIL CONCENTRATION CONTOUR (mg/kg)
- SEPTIC SYSTEM
- STORM SEWER

NOTES:

1. LOCATION GP-9a WAS ONLY TESTED FOR SOIL PROPERTIES.
2. ALL CONCENTRATIONS ARE IN MILLIGRAMS PER KILOGRAMS (mg/kg).

SCALE

0 40 80 120 FEET

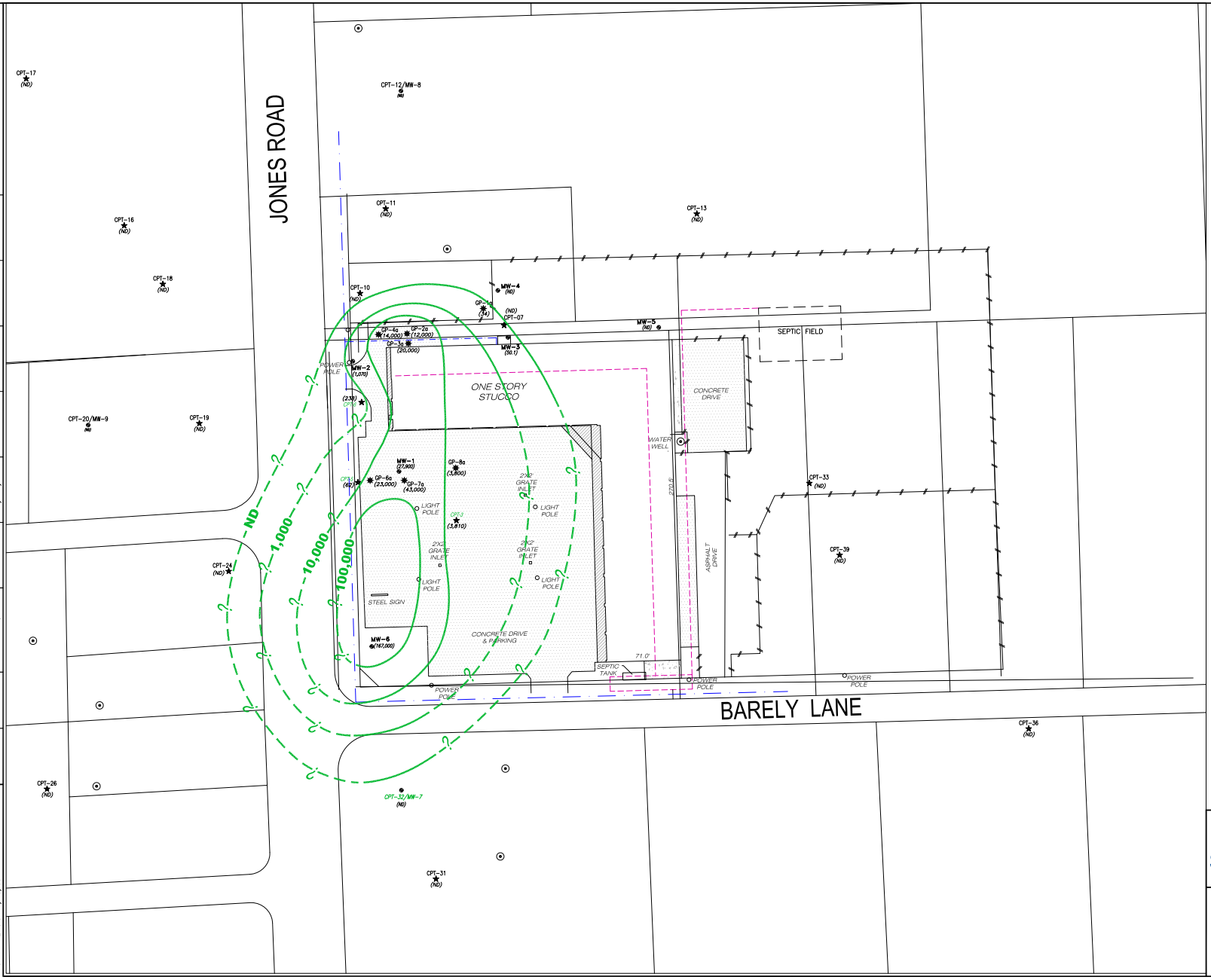
Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 9
PCE DISTRIBUTION IN SOILS <50 FEET BGS
(SOURCE AREA)
JONES ROAD SUPERFUND
FEASIBILITY STUDY
HARRIS COUNTY, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	HOUSTON, TX	L. JONES 11/04/09	---	---	129389-D13

PLOT DATE: 11/04/09
FORMAT REVISION 7/15/03



EXPLANATION:

- CPT-07 ★ CPT LOCATION
- MW-3 ⊕ MONITOR WELL LOCATION
- ⊙ WATER WELL LOCATION
- PCE ISOCONCENTRATION CONTOUR (µg/L) (DASHED WHERE INFERRED)
- SEPTIC SYSTEM
- STORM SEWER

NOTES:

1. ALL CONCENTRATIONS ARE IN MICROGRAMS PER LITER.
2. MONITORING WELL CONCENTRATIONS SHOWN ARE FOR FEBRUARY 2008.
3. CPT CONCETRATIONS ARE FROM 2003.
4. GP CONCENTRATIONS ARE FROM 2006.

SCALE
0 40 80 120 FEET

Shaw

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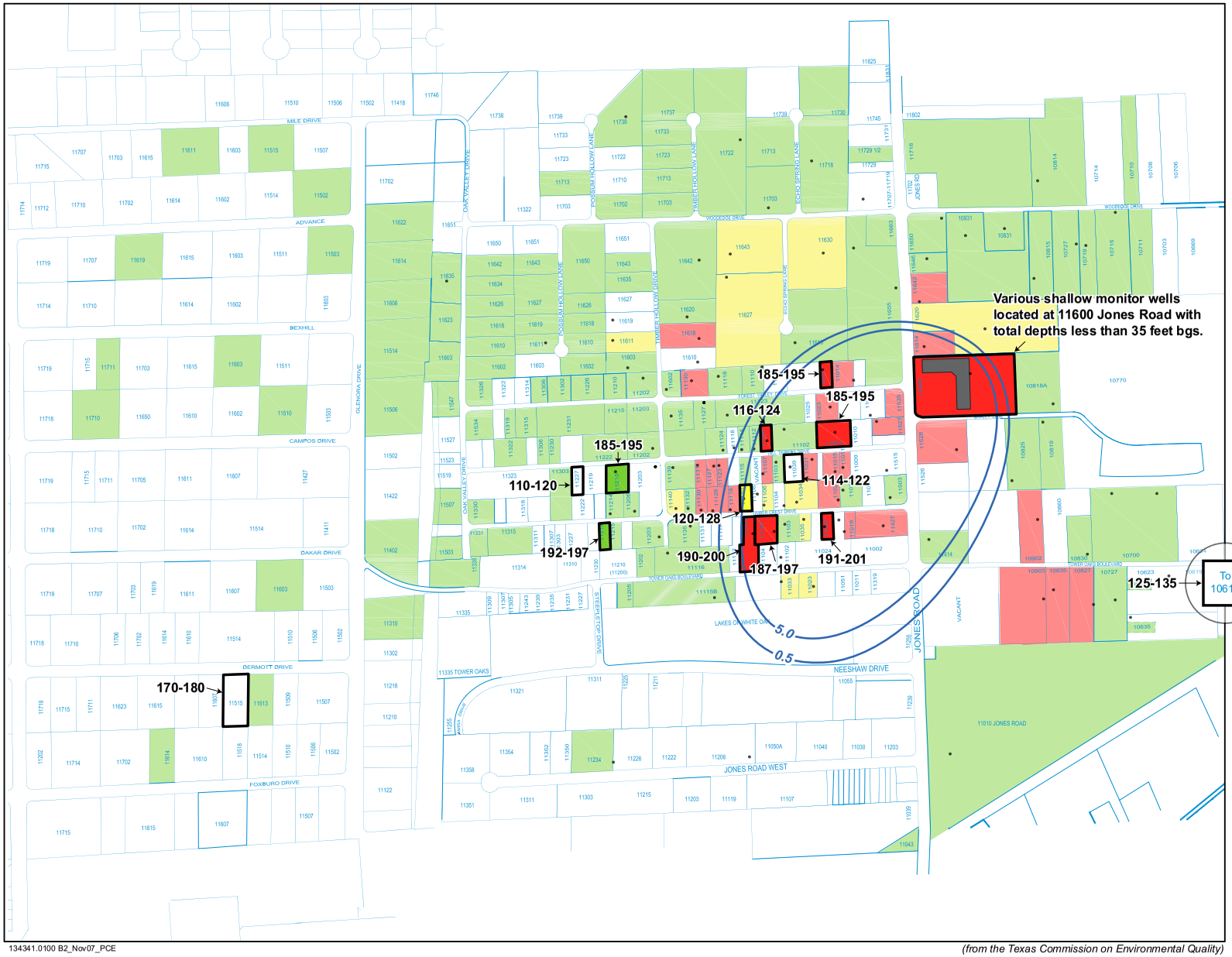
FIGURE 10
PCE DISTRIBUTION IN GROUNDWATER
<50' FEET BGS (SOURCE AREA)
JONES ROAD SUPERFUND
FEASIBILITY STUDY
HARRIS COUNTY, TEXAS

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
129389-D14	---	---	L. JONES 11/04/09	HOUSTON, TX	---	---

PLOT DATE: 11/04/09
FORMAT REVISION 7/15/03



EXPLANATION

- Property boundary
- Approximate private well location
- Not sampled
- PCE < 0.5ppb (Quantitation limit)
- PCE >= 0.50ppb to <= 5.0ppb
- PCE > 5.0ppb (MCL)
- 183-195 → Lot with Well < 200 feet bgs
  - Screen interval or total depth
- Bell Facility: 11600 Jones Road
- Inferred Isoconcentration Contour (ppb)

Notes:
Sample results from November 2007

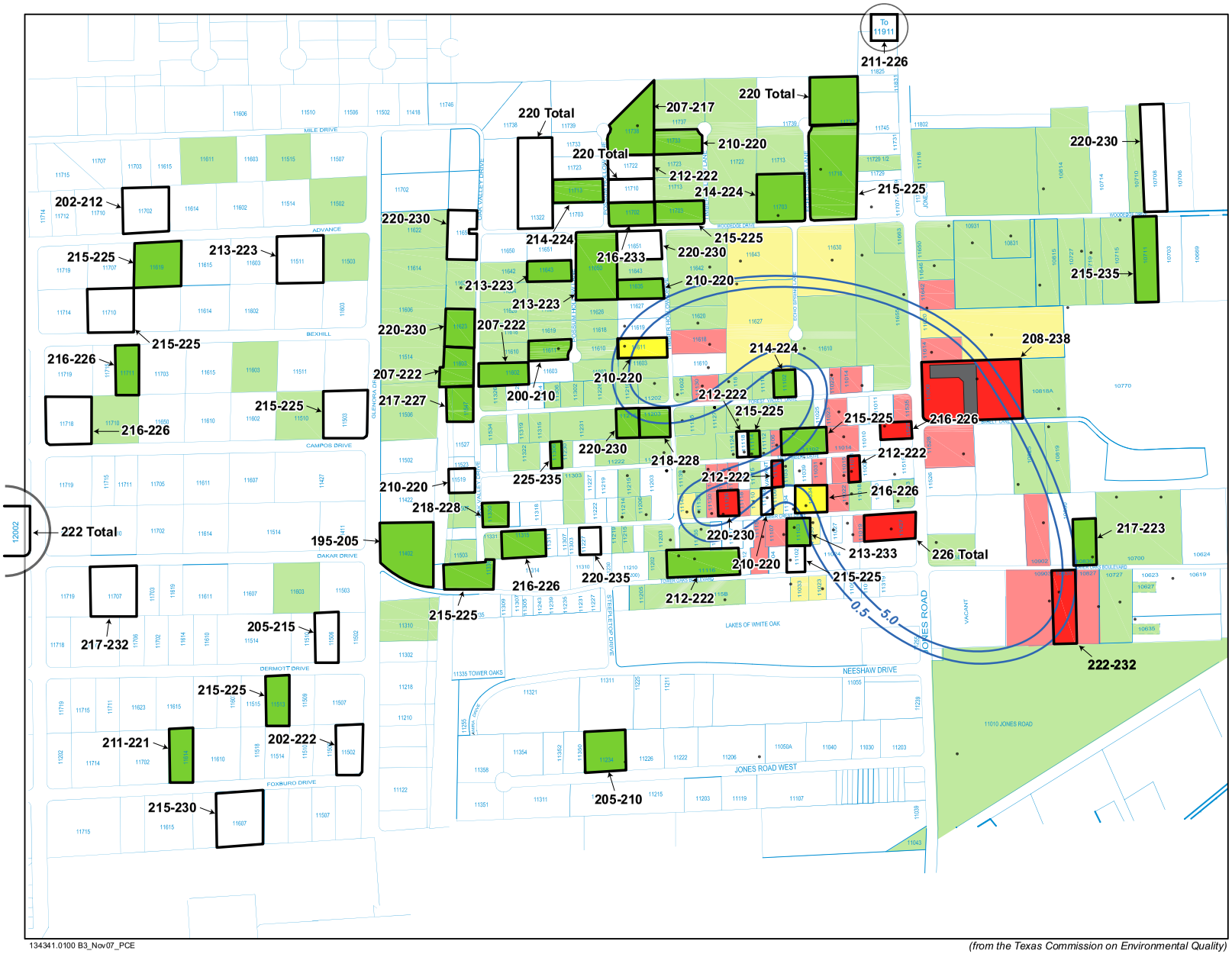
N

0 250 500 FT
SCALE

Figure 11
PCE Distribution in Groundwater
< 200 Feet bgs
Jones Road Superfund
Feasibility Study
Harris County, Texas

134341.0100 B2_Nov07_PCE

(from the Texas Commission on Environmental Quality)



EXPLANATION

- Property boundary
- Approximate private well location
- Not sampled
- PCE < 0.5ppb (Quantitation limit)
- PCE >= 0.50ppb to <= 5.0ppb
- PCE > 5.0ppb (MCL)
- 216-226 Lot with Well 200 to 230 feet bgs
  - Screen interval or total depth
- Bell Facility: 11600 Jones Road
- Inferred Isoconcentration Contour (ppb)

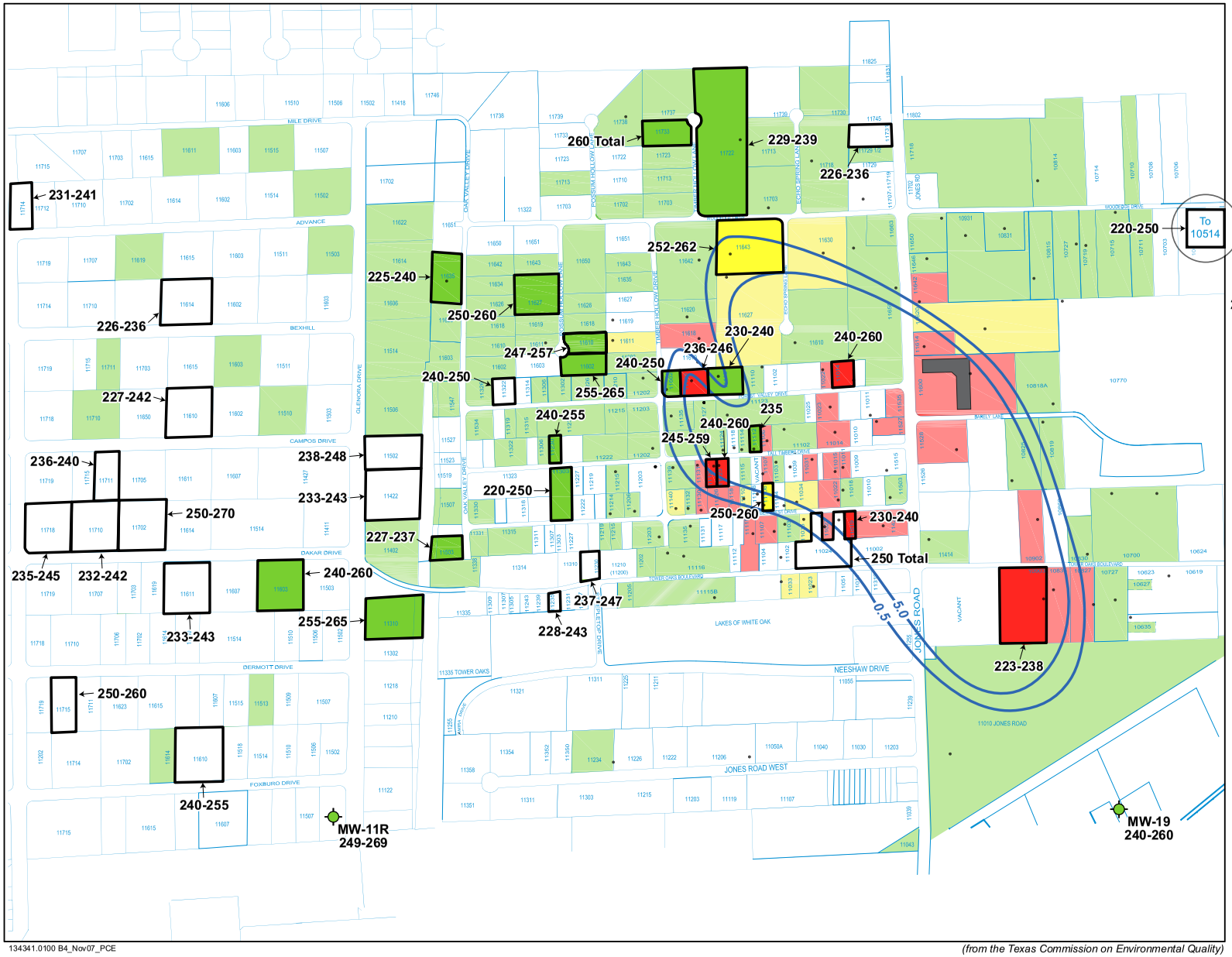
Notes:
Sample results from November 2007

0 250 500 FT
SCALE

Figure 12
PCE Distribution in Groundwater
200 to 230 Feet bgs
Jones Road Superfund
Feasibility Study
Harris County, Texas

134341.0100 B3_Nov07_PCE

(from the Texas Commission on Environmental Quality)



EXPLANATION

- Property boundary
- Approximate private well location
- Not sampled
- PCE < 0.5ppb (Quantitation limit)
- PCE >= 0.50ppb to <= 5.0ppb
- PCE > 5.0ppb (MCL)
- 250-260 — Lot with Well 231 to 260 feet bgs
  - Screen interval or total depth
- Bell Facility: 11600 Jones Road
- Inferred Isoconcentration Contour (ppb)
- MW-11R 249-269 — Monitor Well and Screen Interval

Notes:
Sample results from November 2007

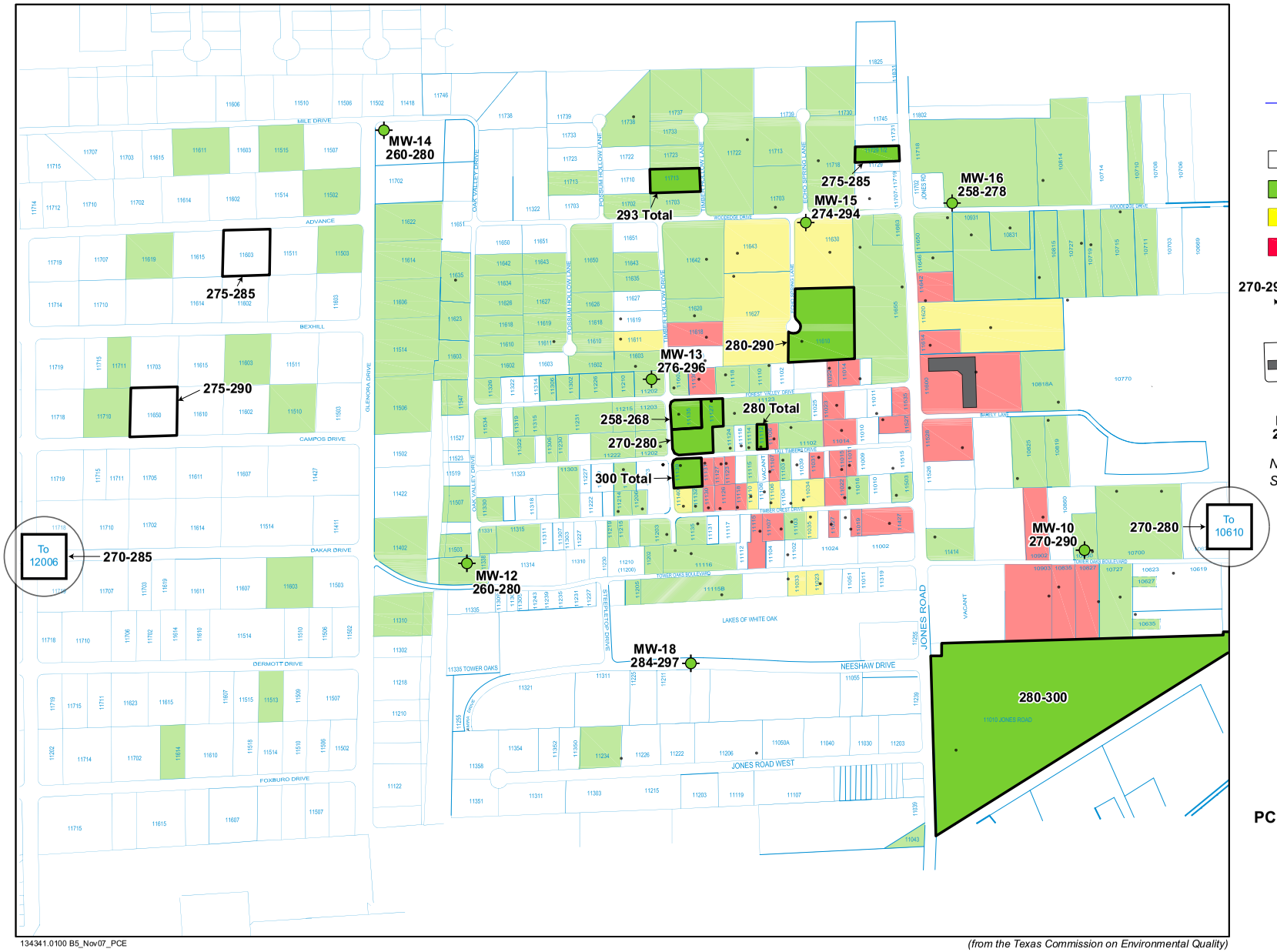
N

0 250 500 FT
SCALE

Figure 13
PCE Distribution in Groundwater
231 to 260 Feet bgs
Jones Road Superfund
Feasibility Study
Harris County, Texas

134341.0100 B4_Nov07_PCE

(from the Texas Commission on Environmental Quality)



EXPLANATION

- Property boundary
- Approximate private well location
- Not sampled
- PCE < 0.5ppb (Quantitation limit)
- PCE >= 0.50ppb to <= 5.0ppb
- PCE > 5.0ppb (MCL)
- 270-290 → Lot with Well 261 to 300 feet bgs
  - Screen interval or total depth
- Bell Facility: 11600 Jones Road
- MW-10 270-290 — Monitor Well and Screen Interval

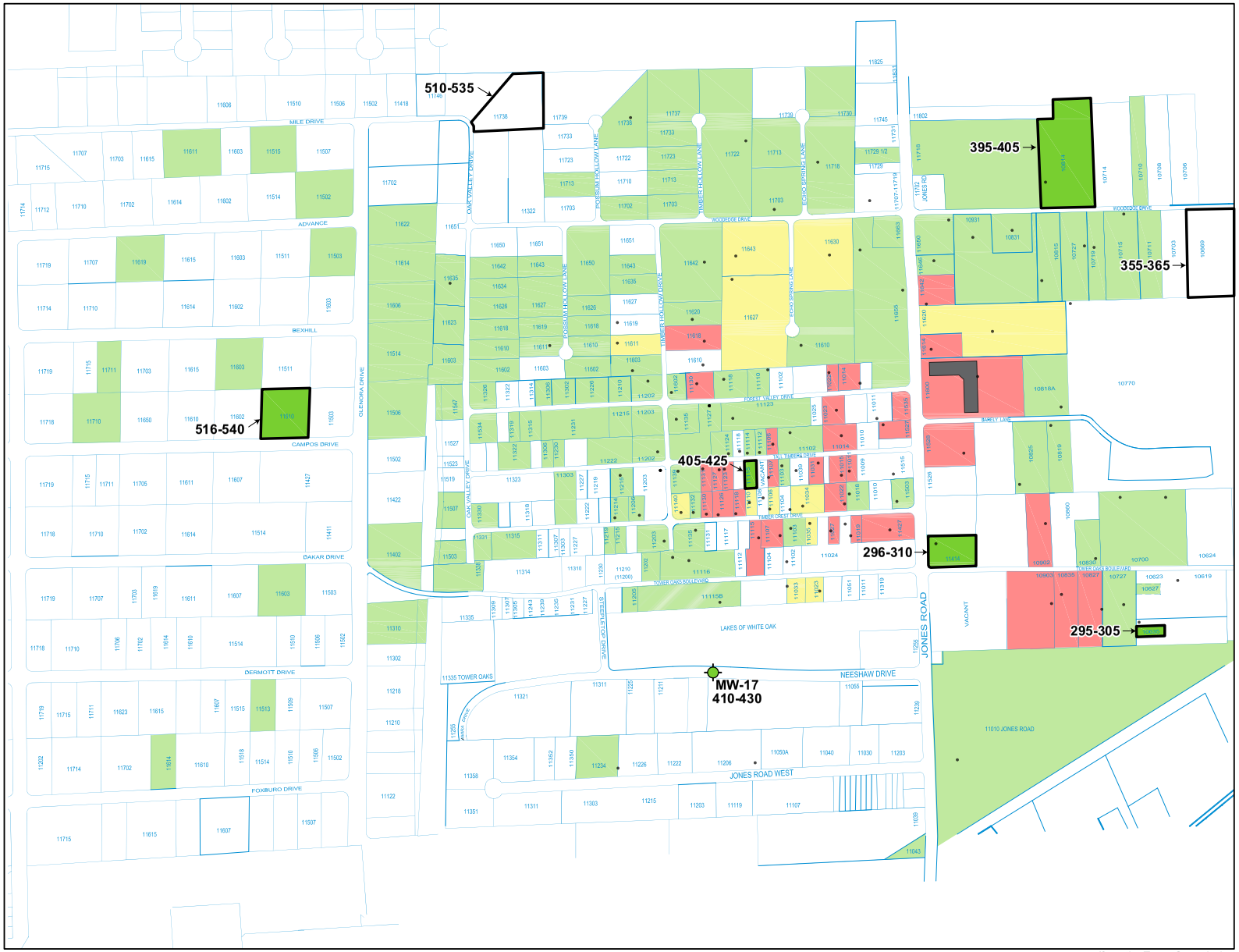
Notes:
Sample results from November 2007

0 250 500 FT
SCALE

Figure 14
PCE Distribution in Groundwater
261 to 300 Feet bgs
Jones Road Superfund
Feasibility Study
Harris County, Texas

134341.0100 B5_Nov07_PCE

(from the Texas Commission on Environmental Quality)



EXPLANATION

- Property boundary
- Approximate private well location
- Not sampled
- PCE < 0.5ppb (Quantitation limit)
- PCE >= 0.50ppb to <= 5.0ppb
- PCE > 5.0ppb (MCL)
- 399-409 → Lot with Well 301 to 535 feet bgs
  - Screen interval or total depth
- Bell Facility: 11600 Jones Road
- MW-17 410-430 — Monitor Well and Screen Interval

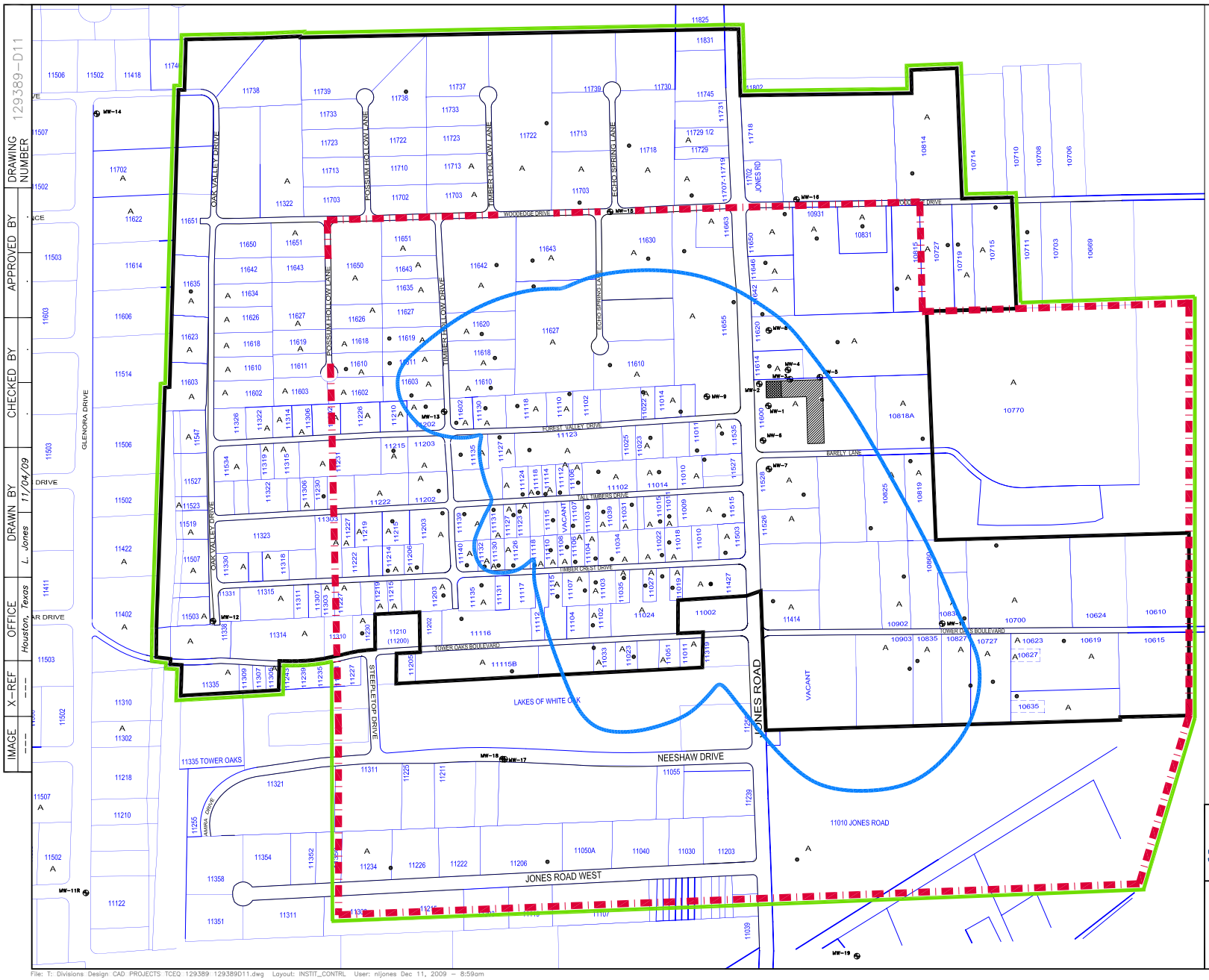
Notes:
Sample results from November 2007

0 250 500 FT
SCALE

Figure 15
PCE Distribution in Groundwater
300 to 535 Feet bgs
Jones Road Superfund
Feasibility Study
Harris County, Texas

134341.0100 B5_Nov07_PCE

(from the Texas Commission on Environmental Quality)



EXPLANATION:

- PROPERTY BOUNDARY
- FINAL WATERLINE SERVICE AREA BOUNDARY, HARRIS COUNTY MAY DENY WELL PERMITS
- DRILLING RESTRICTION AREA (TDLR)
- MONITOR WELL LOCATION
- APPROXIMATE PRIVATE WELL LOCATION
- A ACCESS AGREEMENT
- LOCATION OF STRIP CENTER (CYPRESS SHOPPING CENTER)
- LOCATION OF FORMER BELL DRY CLEANERS
- AREA OF INSTITUTIONAL CONTROLS (NO USE OF GROUNDWATER) BY HARRIS COUNTY
- OVERLAPPING EXTENT OF DEEP GROUNDWATER PLUMES

NOTE: MAP IS SUBJECT TO CHANGE DUE TO PROPERTY TRANSACTIONS.

N

SCALE
0 200 400 600 FEET

Prepared for:

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 16
AREA OF INSTITUTIONAL CONTROLS
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Houston, Texas	L. Jones 11/04/09	.	.	129389-D11

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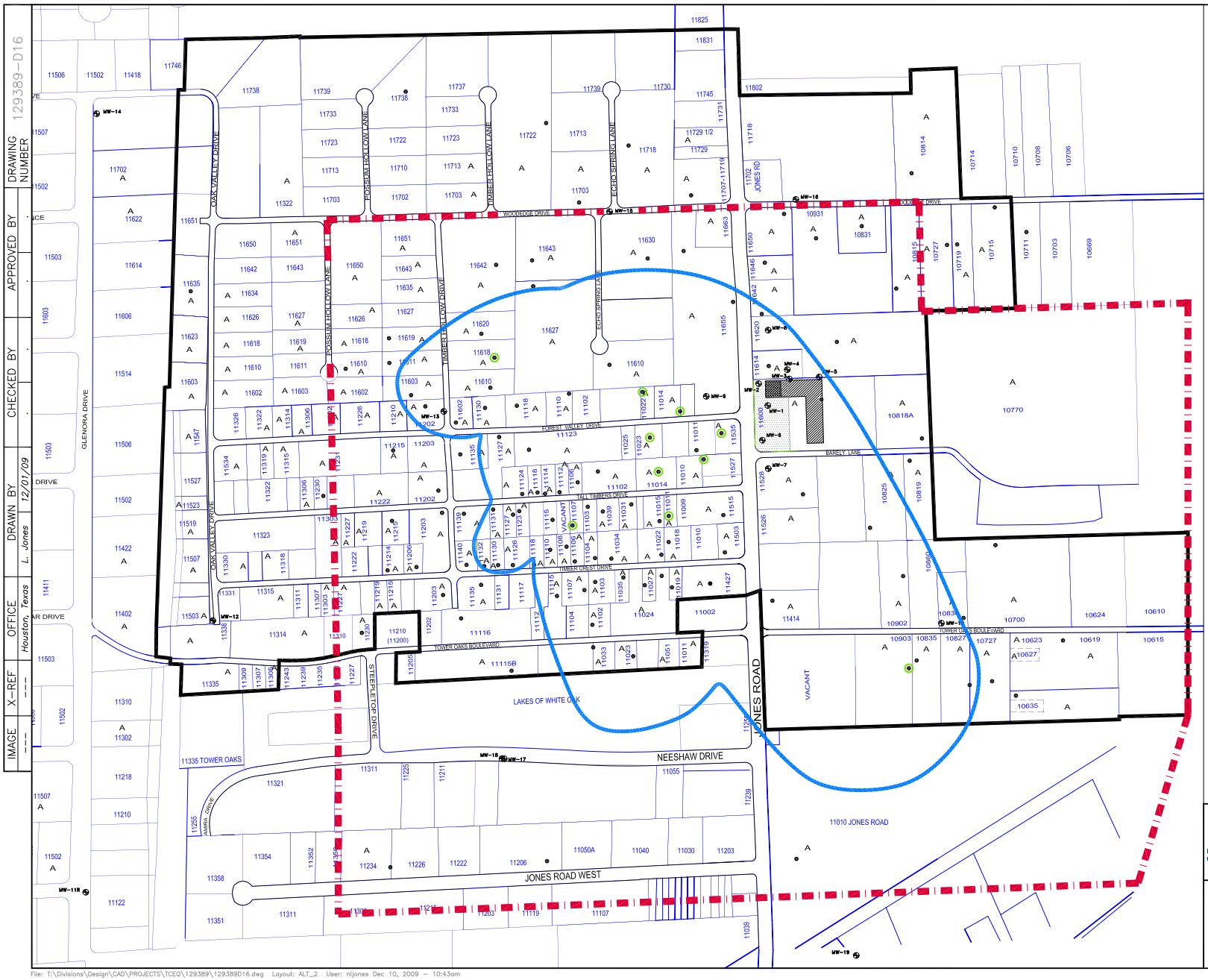

EXPLANATION:

- PROPERTY BOUNDARY
- FINAL WATERLINE SERVICE AREA BOUNDARY, HARRIS COUNTY MAY DENY WELL PERMITS
- DRILLING RESTRICTION AREA (TDLR)
- MONITOR WELL LOCATION
- APPROXIMATE PRIVATE WELL LOCATION
- ACCESS AGREEMENT
- LOCATION OF STRIP CENTER (CYPRESS SHOPPING CENTER)
- LOCATION OF FORMER BELL DRY CLEANERS
- OVERLAPPING EXTENT OF DEEP GROUNDWATER PLUMES
- INSITU OXIDATION FOR SHALLOW SOIL AND GROUNDWATER
- INSITU BIOAUGMENTATION FOR DEEPER GROUNDWATER (FIRST APPLICATION)

NOTE: MAP IS SUBJECT TO CHANGE DUE TO PROPERTY TRANSACTIONS.

SCALE 0 200 400 600 FEET

Prepared for:

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 17
ALTERNATIVE 2:
INSITU TREATMENT
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Houston, Texas	L. Jones 12/01/09	.	.	129389-D16

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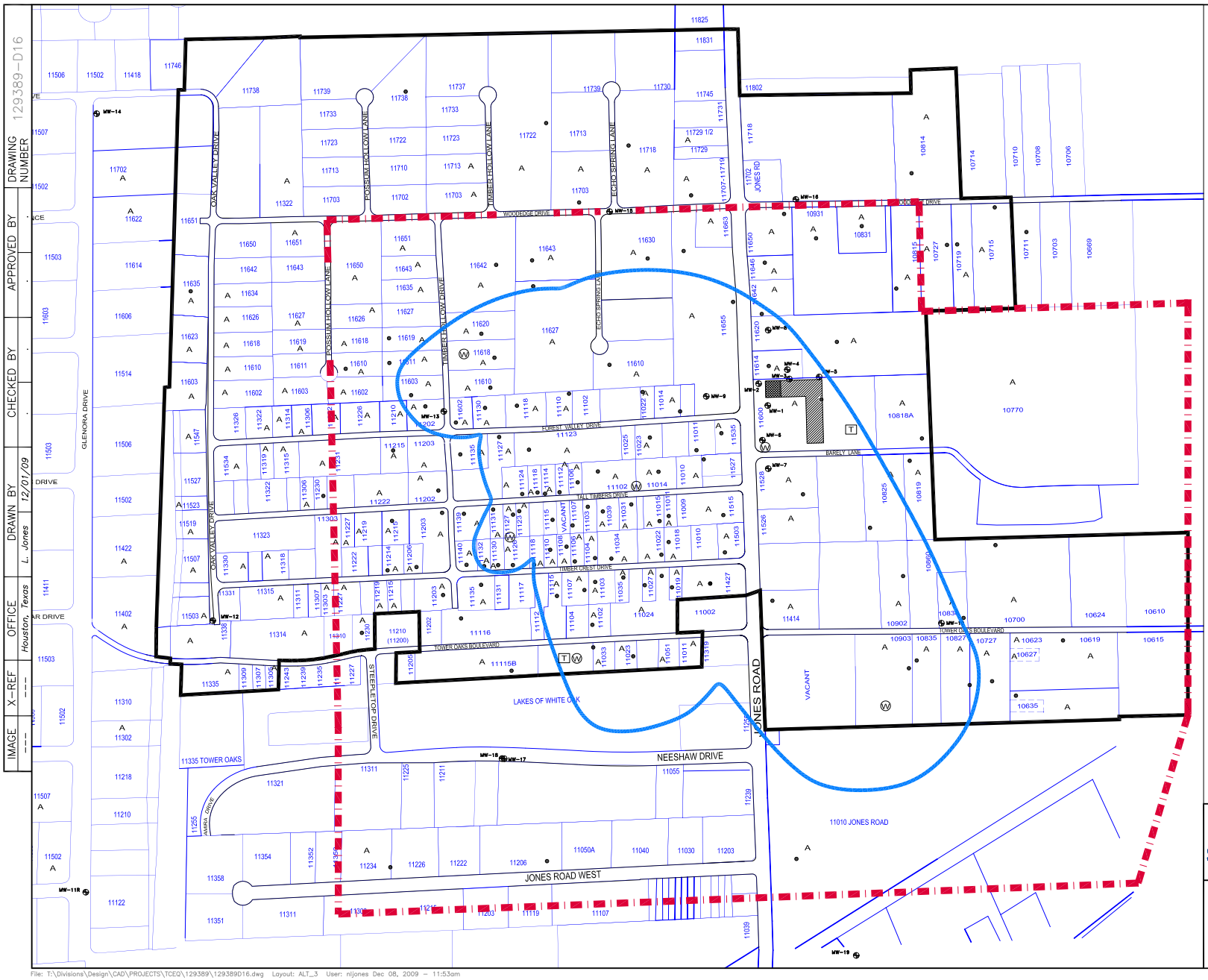

EXPLANATION:

- PROPERTY BOUNDARY
- FINAL WATERLINE SERVICE AREA BOUNDARY, HARRIS COUNTY MAY DENY WELL PERMITS
- DRILLING RESTRICTION AREA (TDLR)
- MONITOR WELL LOCATION
- APPROXIMATE PRIVATE WELL LOCATION
- A ACCESS AGREEMENT
- LOCATION OF STRIP CENTER (CYPRESS SHOPPING CENTER)
- LOCATION OF FORMER BELL DRY CLEANERS
- OVERLAPPING EXTENT OF DEEP GROUNDWATER PLUMES
- W HYDRAULIC CONTAINMENT WELL LOCATION
- T TREATMENT PLANT

NOTE: MAP IS SUBJECT TO CHANGE DUE TO PROPERTY TRANSACTIONS.

N

SCALE

0 200 400 600 FEET

Prepared for:

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Shaw

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FIGURE 18
ALTERNATIVE 3:
HYDRAULIC CONTAINMENT / PUMP AND TREAT
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
129389-D16	.	.	L. Jones 12/01/09	Houston, Texas	---	---

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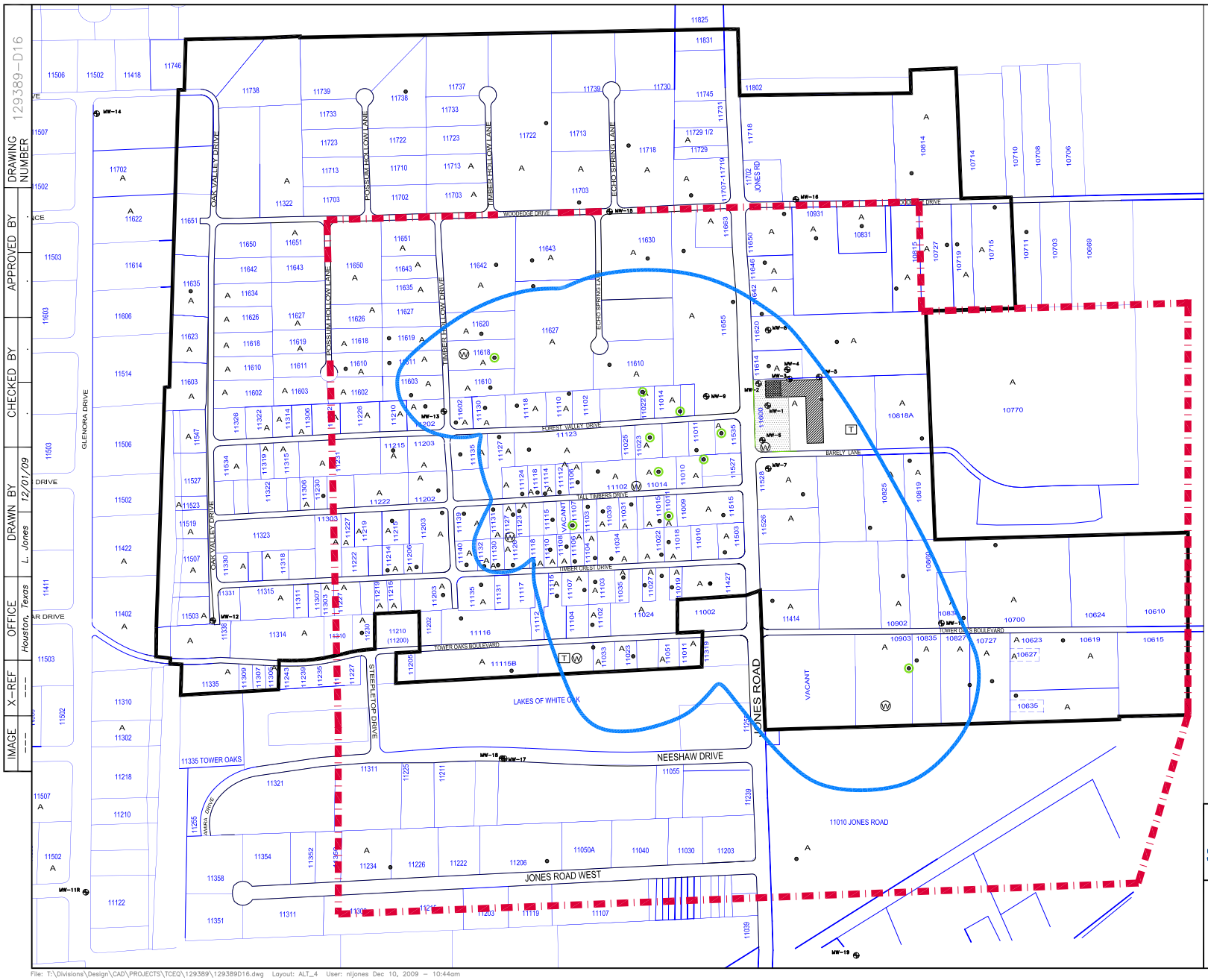

EXPLANATION:

- PROPERTY BOUNDARY
- FINAL WATERLINE SERVICE AREA BOUNDARY, HARRIS COUNTY MAY DENY WELL PERMITS
- DRILLING RESTRICTION AREA (TDLR)
- MONITOR WELL LOCATION
- APPROXIMATE PRIVATE WELL LOCATION
- A ACCESS AGREEMENT
- LOCATION OF STRIP CENTER (CYPRESS SHOPPING CENTER)
- LOCATION OF FORMER BELL DRY CLEANERS
- OVERLAPPING EXTENT OF DEEP GROUNDWATER PLUMES
- W HYDRAULIC CONTAINMENT WELL LOCATION
- T TREATMENT PLANT
- INSITU OXIDATION FOR SHALLOW SOIL AND GROUNDWATER
- INSITU BIOAUGMENTATION FOR DEEPER GROUNDWATER (FIRST APPLICATION)

NOTE: MAP IS SUBJECT TO CHANGE DUE TO PROPERTY TRANSACTIONS.

N

SCALE
0 200 400 600 FEET

Prepared for:

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Shaw

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FIGURE 19
ALTERNATIVE 4:
INSITU ENHANCEMENTS TO PUMP AND TREAT
JONES ROAD SUPERFUND SITE
FEASIBILITY STUDY

HARRIS COUNTY, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Houston, Texas	L. Jones 12/01/09	.	.	129389-D16

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Tables

Table 1
Chronology of Site Investigations and Significant Events
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Date	Event
January 4, 1988	The Texas Water Commission (TWC) issued a *Notice of Registration for Solid Waste Management* (not a waste management permit) to Dae (Jimmy) Kim doing business as (DBA) Bell Dry Cleaners (Bell) at 11600 Jones Road. The notice recognized the Bell facility as a Small Quantity Generator of hazardous waste associated with the dry cleaning industry (40 Code of Federal Regulations Part 261; waste codes F001, F002, F004, and F005).
September 1, 1993	The TWC changed its name to The Texas Natural Resource Conservation Commission (TNRCC).
November 4, 1994	Associated Environmental Consultants, Inc. submitted *Phase 1 Environmental Assessment Report for Shopping Center Located at 11600 Jones Road*. The report was prepared for Metro Bank, N.A., and found no indication of the obvious presence or potential for contamination of the site based on property ownership review, examination of aerial photographs, available regulatory information, physical inspection of the site, and preliminary asbestos study. The report documented the presence of two 30-gallon drums and one aboveground storage container containing tetrachloroethylene (PCE) associated with the Bell laundry operation, and the PCE was reported to be recycled or disposed by Safety-Kleen of Houston, Texas. New and used motor oil, antifreeze, solvent for parts washing, used batteries, and used oil filters were associated with operations at Advanced Auto Repair. The auto repair related wastes were reported to be recycled or disposed by States Environmental Oil Services, Inc.
December 20, 2000	The Texas Department of Health (TDH) reported results from the public water system at Finch's Gymnastics USA to contain concentrations of PCE above the EPA established drinking water standards (0.005 ppm). Monthly sampling was conducted in January through May of 2001 by the TDH confirming these initial test results.
February 6, 2001	The TNRCC Drinking Water Monitoring Team, Public Drinking Water Section, submitted a *Tetrachloroethene Maximum Contaminant Level Exceedance* letter to Finch Gymnastics (10903 Tower Oaks Boulevard), advising Finch Gymnastics to "investigate the source of contamination, hire a competent engineer to review treatment alternatives, and/or seek alternative sources for water to prevent customer exposure and the risk of a violation".
June 5, 2001	Geo-Tech Environmental, Inc. (Geo Tech) submitted a *Phase 1 Environmental Site Assessment report for* the 11600 Jones Road site for Sterling Bank on behalf of Bell "to assist in the underwriting of a proposed mortgage loan of the property". During inspection of the property leakage from the dry cleaning machine was noted to be draining into the storm drains behind the Bell facility. The Phase 1 report recommended a subsurface soil and groundwater investigation around the dry cleaner to determine if facility operations impacted the area.
July 9, 2001	Geo-Tech submitted a *Limited Site Assessment* report for the Bell facility. Three soil borings were installed and subsequently converted into temporary monitor wells. Soil and groundwater samples taken from the west and front side of the Bell facility were impacted with PCE and degradation products. The report recommended that the owners enter into the TNRCC Voluntary Cleanup Program (VCP) to remediate the site and obtain a certificate of completion.
July 30, 2001	The TNRCC Drinking Water Monitoring Team, Public Drinking Water Section, submitted a *Prevention of a Violation of the Tetrachlorethene Standard* letter to Finch's Gymnastics USA & Childcare (10903 Tower Oaks), commending Finch's for providing "an alternative water source (bottled water) to their customers before formal notice of violation was issued for exceeding the standard for tetrachloroethene (PCE)". The letter also confirmed receipt of notification from Finch's that bottled water was in use, and that the TNRCC would continue to monitor the water supply (well water) on an annual basis, and that public notification would not be required.

Table 1
Chronology of Site Investigations and Significant Events
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Date	Event
August 2001	Geo-Tech submitted *Voluntary Cleanup Program Site Investigation Report* to the TNRCC documenting previous work completed at the Bell facility during the *Phase 1 Environmental Site Assessment* (Geo-Tec, June 2001) and the *Limited Site Assessment* (Geo-Tec, July 2001).
October 24, 2001	Dae Kim DBA Bell Dry Cleaners and Henry T.T. Lucky, Inc. (property owner of 11600 Jones Road) entered an agreement with the TNRCC to participate in the Texas Voluntary Clean Up Program (VCP).
December 12, 2001	Geo-Tech submitted a *Letter Report* to the VCP Project manager at TCEQ to document the installation of three permanent monitor wells (MW-1 through MW-3) and two soil borings (B-1 and B-2) at the Bell facility on November 2, 2001. Soil and groundwater analytical results indicated impacts by PCE and degradation products.
February 7, 2002	Geo-Tech submitted a letter report to the TNRCC Voluntary Cleanup Program on behalf of the Bell facility owner, Dae Kim. The letter report provided updates of Limited Site Assessment activities performed at the Bell facility on November 2, 2001 and additional investigation performed on January 4, 2002. During the additional investigation, one soil boring (IB-1) and three additional permanent monitor wells (MW-4 through MW-6) were installed. Soil boring IB-1 was installed inside the Bell facility. PCE, TCE, DCE, and VC were detected in shallow (less than 35 feet bgs) soil and groundwater samples at concentrations above Texas Risk Reduction Program (TRRP) Tier 1 Protective Concentration Levels for soil and groundwater ingestion in a residential setting.
February 14, 2002	The TNRCC Superfund Site Discovery and Assessment Program (SSDAP) sampled the water well and inside sink at Finch's Gymnastics U.S.A. and Childcare (Finch's) at 10903 Tower Oaks Boulevard, Houston, Texas. The sample results revealed PCE levels above the United States Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 5 parts per billion (ppb).
March 13 through 20, 2002	The TNRCC SSDAP conducted sampling of 43 wells in the Jones Road area. The samples were submitted to the Lower Colorado River Authority in Austin, Texas for analysis of VOCs using EPA Method 524.2. The analytical results revealed organic concentrations above background and/or the practical quantitation limit (PQL).
March 6, 2002	The TNRCC submitted a notification letter to Bell informing them that Finch's well had been impacted by PCE, and that if Bell was a potential source of the PCE, then Bell would be required to take additional measures to prevent exposure to affected water. The notification also indicated that if Bell failed to take the appropriate measures, the TNRCC would take the required measures to prevent exposure, and seek cost recovery from Bell in the future. The letter also requested a greatly accelerated schedule for pursuing delineation of the plume from the Bell site.
March 11, 2002	The TNRCC submitted a notification letter to Bell that the VCP would require him to perform emergency response actions to protect public health and safety from the threat caused by the PCE contaminated water.
March 14 through 20, 2002	Groundwater sampling of 44 area water wells within a 0.25-mile radius of the Bell facility performed by the TNRCC and Bell's consultant, Geo-Tech Environmental with review, validation, and DUS of the samples performed by Shaw. Bell's treatment system contractor installed eight granular activated carbon (GAC) filters on the wells that were contaminated with PCE, including Finch's water well. However, Bell failed to pay the contractor, and the contractor subsequently removed the GAC filters. The TNRCC replaced the GAC filters at the time of their removal by the contractor. Up to this date, approximately 150 wells or the 216 wells identified within a 0.5-mile radius of Bell were sampled, and at least 16 wells were discovered to be impacted by PCE at concentrations above the MCL.

Table 1
Chronology of Site Investigations and Significant Events
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Date	Event
March 26, 2002	The TNRCC submitted a letter instructing Bell to install and maintain carbon filters at additional sites and to conduct vapor monitoring at three sites.
March 27, 2002	The TNRCC submitted a letter to Bell indicating that Bell must submit a signed schedule for identifying all wells within a 0.5-mile radius of the Bell facility for sampling the wells located in the neighborhood on the west side of Jones Road. Bell was also instructed to schedule the installation of GAC filters on any wells impacted by PCE. Bell was to provide the schedule information to the VCP by April 1, 2002, or the VCP would initiate the fifteen day notice period for the termination of the VCP agreement.
March 27, 2002	The TNRCC submitted a letter to Lucky asking Lucky to submit a written statement by April 1, 2002 indicating that Lucky was committed to performing the emergency response measures described in the March 26 and 27, 2002 letters to Bell if Bell chose not to continue participation in the VCP. If Bell withdrew from the VCP and Lucky failed to commit to continue the VCP, then VCP would initiate termination of the VCP agreement with Lucky.
April 1, 2002	Lucky submitted a letter to the TNRCC stating that Lucky and Bell were committed to performing the required emergency response measures by April 12, 2002.
April 16, 2002	Bell and Lucky failed to perform the required emergency response measures, and withdrew from the VCP. The TNRCC submitted a letter notifying Lucky that the TNRCC would withdraw from the VCP agreement.
May 1, 2002	The TNRCC issued Emergency Order Docket No. 2002-0584-IHW-E to the estate of Dae Kim DBA Bell Dry Cleaners and Henry T.T. Lucky, Inc. The order specified action including (1) install and maintain filtration systems on impacted wells and prepare a sampling plan for the same; (2) sample and analyze all wells within a 0.5-mile radius of the site; (3) install filtration systems on any new wells found to be impacted; (4) perform an investigation to determine the source and delineate the plume; (5) submit a groundwater investigation report; (6) perform more investigation if deemed necessary by the Executive Director.
May 13 through 20, 2002	A *Focused Site Inspection* was performed at the site. 52 groundwater samples were collected to substantiate the release and migration of contaminants. Groundwater samples were analyzed by the LCRA.
June 10, 2002	The dry cleaning machine at the Bell facility was emptied of PCE and transported to another dry cleaning facility for use. This date marks the last use of PCE at the Bell facility.
September 1, 2002	The TNRCC changed its name to The Texas Commission on Environmental Quality (TCEQ).
September 12, 2002	The TCEQ Litigation Division issued a *Superfund Referral* requesting that the Bell case be referred to the Superfund Program based on "(1) documented releases of hazardous substances and hazardous wastes; (2) the site is inactive with respect to the management and disposal of hazardous waste since Bell no longer uses PCE in its process; (3) Bell have inadequate funds to address the cleanup; and (4) enforcement is no longer and effective option for addressing the contamination at the site".
September 18, 2002	The TCEQ prepared a *Compliance Evaluation Investigation* (CEI) report documenting several Notice of Violation (NOV) reports issued to Bell for mismanagement of waste materials. The NOVs were related to improper documentation of waste disposal records. Review of partial records provided by Bell indicates that Safety-Kleen Systems (SK) transported 5,115 lbs in 1999; 1,755 lbs in 2000; 1,157 lbs in 2001; and 787 lbs of waste PCE in 2002.
October 2002	Groundwater sampling event. TCEQ installed GAC filtration systems on 21 water wells where PCE concentrations were detected above the MCL.

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Date	Event
October 17, 2002	TCEQ presented a questions and answers meeting with the public regarding the Jones Road Groundwater Plume.
December 2002	PCE, DCE, and chloromethane were detected in a sample collected from a public water supply (PWS) well located at Finch's Gymnastics USA and Childcare at concentrations exceeding the United States Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 5 parts per billion (ppb). Bottled drinking water was subsequently provided to the facility patrons and staff.
January 2003	Groundwater sampling event. TCEQ installed GAC filtration systems on 21 water wells where PCE concentrations were detected above the MCL.
January 24, 2003	The Texas Department of Licensing and Regulation notified all licensed drillers in Harris, Waller, Grimes, Ft. Bend, Brazoria, Galveston, Montgomery, San Jacinto, Chambers and Liberty counties, of more stringent specifications for drilled water wells within the Jones Road Groundwater Plume area. Department of Health (TDH) reported results from the public water system at Finch's Gymnastics USA to contain concentrations of PCE above the EPA established drinking water standards (0.005 ppm).
January 30, 2003	The TCEQ SSDAP Remediation Program issued an interoffice memorandum summarizing the Jones Road ground water plume. The memo indicated that 228 wells were sampled in the area, and 23 wells had detections of PCE at or above the EPA MCL of 5 ppb. The memo also indicated that GAC filtration systems had been installed 23 wells, and that 18 wells contained PCE concentrations below the MCL. The boundaries of the plume as the southern end of Echo Spring (northern boundary); Tower Oaks (southern boundary); Timber Hollow (western boundary); and eastern side of Jones Road (eastern boundary).
February 3 through 10, 2003	Groundwater sampling event of approximately 250 locations.
April 2003	The TCEQ prepared Hazard Ranking System Documentation Record for the Jones Road Ground Water Plume (CERCLIS Site ID Number TXN 000 605 460) in cooperation with Region VI of the EPA. The Hazard Ranking Score for the site was determined to be 46.5
April 30, 2003	The Jones Road site was proposed for addition to the NPL.
May 19 through 23, 2003	May 2003 Groundwater sampling event.
June 10, 2003	Interoffice Memorandum from the TCEQ Jones Road DQO Team to the TCEQ Superfund Team Leader (Jim Sher) recommending additional investigation at the Jones Road site. The recommendations included delineation of the shallow groundwater plume from its source (Bell); quarterly monitoring of select residential water wells and maintenance of filter systems; gathering and assimilation of additional well, hydrological, and other data; and investigation of additional source areas. Delineation recommendations included installation of 46 Cone Penetrometer Test (CPT) points to a depth of approximately 40 to 60 feet bgs; installation of 14 temporary monitor wells, collection of 65 shallow groundwater samples; and laboratory analysis by a mobile laboratory.
July 2003	Jones Road area was surveyed and base maps were subsequently prepared using survey information.

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August 19, 2003	Shaw prepared a Health and Safety Plan (HASP) for surface soil sampling, drilling, installation of monitor wells, residential water sampling, and surveying. The HASP detailed the procedures to be followed during site activities in accordance with the Occupational Safety and Health Administration (OSHA), Shaw standard operating procedures, and all other federal, state, and local procedures applicable to the type of remedial investigation tasks performed at the Jones Road site.
August 4 through 12, 2003	August 2003 quarterly groundwater and treatment system monitoring event. One hundred forty-one (141) groundwater samples, 18 field duplicate samples and 6 field blank sample were analyzed by LCRA Environmental Laboratory Services. The analytes requested for water samples were Volatile Organic Compounds (VOCs) by Environmental Protection Agency (EPA) Method 524.2, metals (calcium, iron, magnesium, and manganese) by EPA 200.7, sulfide by EPA 376.2, and sulfate by EPA 300.0.
August 25, 2003	Field activities for the remedial investigation began. Thirty-seven CPT test borings and three monitor wells were installed. Soil and groundwater samples were collected. Documented in an April 2004 report.
August 30, 2003	Shaw submitted a *Remedial Investigation Work Plan*, and a *Field Sampling Plan (FSP)* for soil and groundwater investigations at the site. The FSP presented the requirements and standard operating procedures for conducting field operations and all sampling, handling, and collection activities at the Jones Road site.
September 29, 2003	Jones Road Groundwater Plume Site was listed on the National Priority List (NPL).
September 30, 2003	Shaw meeting with TCEQ. Discussed water well sampling data collected during August 2003 sampling event; remedial investigation work and data collected; elevation and position survey of data points; preparation of maps presenting the sampling data; identification of soil sampling locations; installation of remaining monitor wells; Geoprobe sampling in concert with Color Tec screening and mobile laboratory; engineering investigation of Finch's water well system; CLP sampling personnel and equipment/supplies; identification of subsurface utilities; rental of office/warehouse space for routine quarterly sampling events; and historical database search with aerial photographs/historical use of adjoining properties (to 11600 Jones Road).
October 1 through 14, 2003	TCEQ internet and telecom search to locate contacts of the Harris County Permit Department for drawings and specifications of the septic system installation at 11600 Jones Road.
October 17, 2003	The TCEQ prepared *Amendments to the Field Sampling Plan*. The purpose of the document was to amend the original FSP prepared by Shaw, dated August 30, 2003, to include anticipated shallow soil and groundwater investigations associated with the Bell facility. The original FSP was intended for collection of deep groundwater samples from private wells in the area, and not shallow soils and groundwater. Specifically, the FSP amendment describes the methods/processes for collection of soil and groundwater using a Geoprobe Rig (direct push technology (DPT)), shallow groundwater samples, soil samples, photoionization detector screening, Color Tec screening, mobile laboratory analysis of soil and groundwater, and Contract Laboratory Program (CLP) analysis of soil samples.
October 22, 2003	Soil sampling was conducted at 21 geoprobe locations. Groundwater samples were collected at selected locations. Documented in an April 2004 report.
November 10 through 20, 2003	November 2003 quarterly groundwater and treatment system sampling event.
November 18, 2003	TCEQ community meeting with slide presentation of conceptual site model for the 11600 Jones Road area.

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Date	Event
February 12 through 20, 2004	February 2004 quarterly groundwater and treatment system sampling event.
February 16, 2004	Shaw submitted a *Remedial Investigation Work Plan Addendum* , and a *Field Sampling Plan Addendum* to address collection and comparison of inorganic water quality parameters.
April 20, 2004	TCEQ community meeting with slide presentation, including a three dimensional visualization model of the source area based on soil and groundwater data.
April 28, 2004	Shaw submitted *Remedial Investigation - Geoprobe; October 2003* to the TCEQ. 21 soil borings (GP-1 to GP-21) were installed to a maximum depth of 35 feet bgs during the period from October 22 - 29, 2003. The purpose of the investigation was to identify potential discharge points to the shallow soil, including a storm drainage grate outside the back door of the Bell facility, roadside ditches that receive stormwater from the grate, areas associated with the septic system (field and tank), areas where sewer pipes are located, and the foundation of the building. All soil and groundwater samples were collected using DPT drilling methods. Soil samples were analyzed by an off-site fixed-based laboratory performing under the Contract Laboratory Program (CLP) of the EPA. Selected soil and groundwater samples were analyzed by an on-site mobile laboratory (ESN) which was mobilized to the site for a limited time. 17 groundwater samples, 40 soil samples, 1 field blank, 1 equipment rinsate blank, and 1 decon water sample were analyzed by ESN mobile laboratory. The analytes requested were VOCs by SW-846 Method 8260B . The soil samples were reported on a wet-weight basis. This was a variance obtained from TCEQ as this was a mobile laboratory set up for quick turnaround. The results of the mobile laboratory analyses were compared to a field screening technique which also reported results on a wet-weight basis. The purpose of the investigation was to delineate and identify "hot spot source" areas of contamination into the shallow soils (upper 35 feet) in the immediate vicinity of the Bell facility and to assess the Color Tec field screening method on soil matrix samples against analysis performed by an on-site mobile laboratory. Color Tec method was determined to have poor comparison to laboratory methods for soils. Laboratory results indicated impact to soil in 9 of 21 DPT borings from four different sample zones (1-2 feet bgs; 16-19 feet bgs; 19-30 feet bgs; and 30-35 feet bgs).
April 29, 2004	Shaw submitted *Remedial Investigation - CPT; August/September 2003,* to document field activities performed August 25 through September 8, 2004 around the Bell Facility. 37 Cone Penetrometer Test (CPT) borings (CPT-1 through CPT-7 and CPT-10 through CPT-37) were installed to obtain electronic soil boring logs and to collect select groundwater samples. No soil samples were collected. The CPT borings were installed to approximate depths of 60 feet bgs. Groundwater samples were submitted to Severn Trent Laboratories in Houston, Texas for analysis of VOCs using Method 8260. The groundwater samples were also tested using the Color Tec field screening method to determine the accuracy of the Color Tec method to fixed laboratory analysis. The correlation was determined to be excellent. Analytical results revealed detectable PCE, TCE, DCE, and VC concentrations within water samples collected approximately 30 feet bgs in the interbedded zone near the Bell facility. One sample collected from CPT-32 (south of Bell across Barely Street) was detected at a depth of approximately 50 feet bgs. Monitor wells MW-7 through MW-9 were installed based on the CPT investigation data.
May 2004.	EPA awarded a technical assistance grant (TAG) to the Jones Road Coalition for Safe Drinking Water.
May 3 through 13, 2004	May 2004 quarterly groundwater and treatment system sampling event.

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May 17, 2004	Shaw submitted *Remedial Investigation - Water Well Inventory Survey, May 2004*. The report was prepared to document information about active or past drinking water sources through interviews with individuals, and to submit TCEQ well inventory forms for their completion and return to the TCEQ. 47 locations were included in the survey, and a summary table of the information was prepared, along with an updated base map with approximate well locations and water use status.
June 30, 2004	Shaw submitted *Remedial Investigation - Water Well Inspections to Support Planning for Water Level Measurement Collection*. The report was prepared to verify the status of select existing private water wells in the Jones Road area, and to assess their potential use as data collection points for water level measurements. The report was also prepared to evaluate the wells for potential retrofit for water level measurement purposes. Field inspections were performed on June 15, 2004.
July 22, 2004	Shaw submitted *Remedial Investigation - Data Logger Assessment to Support Planning for Water Level Measurement Collection* report. The report was prepared to assess and evaluate the viability of using data loggers to obtain digital water level data from water wells in the Jones Road area. The report also compared costs and technical specifications of various different data logger brands.
August 9 through 27, 2004	August 2004 quarterly groundwater and treatment system sampling event.
Date Unknown	TCEQ staff conducted file searches and collected available water drillers logs in the project area. Well construction information was determined to be available for only 30 to 40% of the wells in the area. Initial records search of public water supply (PWS) files were performed, and four geophysical logs were located with a 2- to 3-mile radius of the Bell facility. Shaw conducted a detailed file review and collected additional geophysical logs and hydrologic testing information associated with PWS wells located within a 3-mile radius of the Bell facility.
August 26, 2004	Shaw submitted *3D Visualization Development*. A three dimensional visualization model of the source area was prepared based on soil and groundwater data. The purpose of the model was to provide a visualization to better understand the spatial relationships of the impacts to soil and groundwater, and provide a spatial data analysis tool to support the planning of future investigations.
August 26, 2004	Shaw submitted *Remedial Investigation - General Groundwater (Inorganic) Quality Characterization and Comparison, March 2004*. The purpose of the investigation was to characterize general inorganic groundwater quality parameters from select monitor wells and private water wells, and also to compare water quality between wells to assess whether the groundwater from different wells represented the same, similar, or different water- bearing units to help assess the nature and extent of contaminant migration. Groundwater samples were collected from 3 monitor wells and 15 private wells. The groundwater samples were submitted for analysis of magnesium, iron, calcium, sodium, potassium, barium, zinc, boron, chloride, alkalinity, nitrate, sulfate, total dissolved solids (TDS), total organic carbon (TOC), phosphate, fluoride, biological oxygen demand (BOD), and chemical oxygen demand (COD).
September 22, 2004	Shaw meeting with TCEQ. Discussed preparation of maps to illustrate PCE distribution in groundwater; preparation of an inventory of all reports related to the project; recommendations for the pending CPT investigation; drilling methods for installation of the proposed deep monitor wells; waste classification related to deep well installation; water well retrofit for installation of data loggers; hydrologic data gathering performed by TCEQ; Shaw's key personnel to be assigned to the Feasibility Study process; surveying related to the water well retrofits and CPT installations; investigation at Finch's Gym; and status of report deliverables.
October 19, 2004	The Texas Department of State Health Services presented the draft report on the assessment of the Jones Road Groundwater Plume at a Community meeting.

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November 2 through 18, 2004	November 2004 quarterly groundwater and treatment system sampling event.
November 10, 2004	Shaw submitted *Remedial Investigation - CPT; August 2004* , to document field activities performed August 25 through 27, 2004. Ten CPT borings (CPT40 through CPT49) were installed near the 10902 Tower Oaks property and 10819 Barely Lane, which was an area suspected to be a separate source of groundwater contamination (other than 11600 Jones Road). Soil samples were not collected as part of this assessment. All collected groundwater samples were submitted to Liberty Analytical, in Cary, North Carolina as part of the EPA Contract Laboratory Program (CLP). All sample analyses were run for volatile organic compounds (VOCs) using the CLP Method OLCO3.2. In addition, field screening of groundwater samples for PCE was also performed in the field using the Color-Tec procedure. Results of the laboratory showed no PCE concentrations above the contract required quantitation limit (CRQL), and that additional source areas are not located in the locations where samples were collected.B88
December 8, 2004	Shaw submitted *Interim Report for Well Head Retrofit/Cleanout* . The report documented work performed by Wellco Drilling Services to retrofit five water wells to accommodate the installation of pressure transducers for electronic water level measurement purposes. Specifically, the report documented all equipment removed from the wells, the amount of drop pipe installed, and the depth from surface where each pressure transducer was installed. For each well, Wellco removed the existing production pipe; video taped the inside of the wells; ran natural gamma geophysical logs to assess the integrity of the wells and to determine the screened intervals/total depths; installed one-inch diameter PVC drop tubes; installed pressure transducers through the drop tubes; and installed new well caps.
January 20, 2005	Martin Survey Associates, Inc., Houston, Texas, performed a survey of position and top-of-casing elevations of nine private wells and monitor wells MW-6 through MW-9. Martin also performed a survey of CPT-40 through 49 locations.
February 7 through 16 and March 1, 2005	February 2005 quarterly groundwater and treatment system sampling event.
February 9, 2005	Martin Survey Associates, Inc. updated the survey maps/data by adding the locations and top-of-casing elevations of deep monitor wells MW-10 through MW-19. Previous existing survey data included locations and elevations of shallow monitor wells MW-6 through MW-9, CPT borings CPT-40 through CPT-49, and nine private water wells in the general study area.
February 17, 2005	Shaw submitted 2-Dimensional and 3-Dimensional figures for August 2004 groundwater sampling results.
February 22, 2005	Shaw submitted *First Three-Month Water Level Measuring Event Report, January 2005.* The report summarized water level elevation data collected from electronic pressure transducers installed in five water wells completed within the Chicot Aquifer. The purpose of the investigation was to determine the effects of private well pumpage on the aquifer; observe seasonal impact on groundwater levels; and determine the groundwater flow direction and gradient within the Chicot Aquifer. The transducers were installed during the period from October 4 through November 18, 2004, and were programmed to collect continuous groundwater elevation data on 15 minute intervals. The data were reported through January 4, 2005, and revealed that the Chicot aquifer is very prolific and pumping, atmospheric pressure, and rainfall has little effect upon water levels. The general groundwater flow direction was determined to be south.
April 6, 2005	During a project meeting between TCEQ and Shaw E&I, it was decided to install nine deep monitor wells in the Chicot aquifer and one deep monitor well in the Evangeline aquifer.

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Date	Event
May 2 through 18, 2005	May 2005 quarterly groundwater and treatment system sampling event.
May 26, 2005	Shaw submitted *Revised RI Planning/RI Scope Memorandum* . The memorandum presented a range of remedial strategies that may be applicable to the site with discussion of the relative advantages and disadvantages of each, and recommendations for collection of additional data during future RI investigations. The range of remedial strategies discussed included (1) No Further Action; (2) Institutional Controls; (3) Monitored Natural Attenuation; (4) Containment (caps & covers, subsurface horizontal barriers, and hydraulic containment); (5) In-Situ Treatment (soil vapor extraction, chemical oxidation, bioremediation, chemical reduction); and (6) Excavation. The memorandum also discussed the role of groundwater modeling in future understanding of the site and application of treatment technologies. Recommendations included acquisition of additional data including soil oxidant demand (SOD) tests, sieve analysis, polymerase chain reaction (PRC) to determine the type of bacteria in the subsurface, dissolved organic gasses, groundwater field parameters (pH, oxidation-reduction potential (ORP) and dissolve oxygen (DO) collection), soil total organic carbon (TOC), and treatability studies.
June 8 & 9, 2005	Shaw submitted access request letters for drilling, staging drilling equipment and storing investigation derived waste at multiple properties in the Jones Road area, related to installation of deep monitor wells into the Chicot Aquifer.
June 9, 2005	Shaw submitted *Traffic Control Plan; Chicot and Evangeline Monitor Well Installation* , to the Harris County Public Infrastructure Department Permitting Division for installation of seven deep monitor wells in road right-of-ways. The traffic control plan specified hours of operation, communication devices, warning signs, and locations where the proposed wells were to be installed.
June 9, 2005	TCEQ presented a community meeting to present a proposed water line installation.
June 28, 2005	The TCEQ submitted *Jones Road Revised Conceptual Site Model* to Shaw for general information about the site. The CSM provided a site description, data acquisition up to June 2005, regional geology/hydrology, initial CSM scenarios, description of exposure pathways and routes, data gaps, fate and transport characteristics, and observations supporting the revised CSM. Several model scenarios were considered, but the most likely scenario was determined to be vertical migration of PCE as dense non-aqueous phase liquid (DNAPL) to deeper aquifers, and lateral migration of dissolved phase PCE to shallow and deep aquifers.
July 28, 2005	Shaw submitted *Addendum to the Field Sampling Plan; June 2005* . The scope of the field work outlined in the addendum to the Remedial Investigation Work Plan was to further characterize the dense, non-aqueous phase liquids (DNAPL) and dissolved-phase contaminants in groundwater units at the site, and collect treatability samples for use in the feasibility study. The addendum specified sampling to be performed using standard investigative methods including geoprobe boring installation, rotosonic drilling, mud rotary drilling, and field screening using the Color-Tec method developed by Ecology and Environment, Inc.
August 4, 2005	TCEQ Community Meeting Handout.
August 4 through 16, 2005	August 2005 quarterly groundwater and treatment system sampling event.

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October 5, 2005	Shaw submitted *Final Groundwater Elevation Data Report, October 2004 - August 2005.* The report summarized water level elevation data collected from electronic pressure transducers in five water wells. This report was a continuation of the investigation reported in *First Three-Month Water Level Measuring Event Report, January 2005* (Shaw, February 22, 2005), with the extended investigation period October 2004 through August 2005. Slight water level elevation changes throughout the year were suspected to be related to pumping demand upon the aquifer during peak use seasons (summer) and less use seasons (winter). Groundwater flow direction remained unchanged to the south, with an average groundwater gradient of 0.011032 foot/foot.
October 31 through November 4, 2005	Installed deep replacement monitor well MW-11R and deep monitor well MW-19. The screen for monitor well MW-11R was installed from 249 to 269 feet bgs, and the screen for monitor well MW-19 was installed from 240 to 260 feet bgs.
November 9 through 16, 2005	November 2005 quarterly groundwater and treatment system sampling event.
February 6 through 16, 2006	February 2006 quarterly groundwater and treatment system sampling event.
February 10, 2006	Shaw received authorization from Harris County to construct a temporary water line in the road right-of-way from 11603 to 11610 Possum Hollow Lane. An application for construction was submitted by Shaw on January 31, 2006.
March 8, 2006	Wellco Services installed a temporary water line from a water well at 11610 Possum Hollow Lane to 11603 Possum Hollow Lane. The water well at 11603 Possum Hollow Lane became inoperable and the owner was not allowed to install a new well.
March 10, 2006	Wellco Services replaced a down-hole submersible pump in the water well at 11106 Tall Timbers Drive.
March 23, 2006	Shaw submitted *Chicot Monitor Well Installation Report; July - November 2005*, which documented the installation of 10 deep monitor wells MW-10 through MW-19. Monitor wells MW-10, MW-11R, MW-12 through MW-16, MW-18, and MW-19 were installed within the Chicot Aquifer. Monitor well MW-17 was installed within the upper portion of the Evangeline Aquifer. The wells were installed during intermittent periods from July 6, 2005 through November 3, 2005.
April 16, 2006	Shaw submitted *Draft Remedial Investigation Report.* The report summarized investigations performed to date at the site and identified several data gaps. The draft report was not finalized, and additional assessments were performed following submittal of the draft document prompting preparation of a second (revised) Remedial Investigation Report in 2008.
May 8 through 18, 2006	May 2006 quarterly groundwater and treatment system sampling event.
July 18 through 22, 2006	July 2006 sampling event (resampling event for May 2006 quarterly groundwater and treatment system sampling event select sample locations).
August 8 through 24, 2006	August 2006 quarterly groundwater and treatment system sampling event.
August 24, 2006	Shaw submitted *2006 Addendum to the Field Sampling Plan, July 2006*. The Addendum Field Sampling Plan (FSP) presented the additional requirements and procedures for installation of one Chicot monitoring well using rotosonic drilling; and installation of nine geoprobe soil borings.

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September 7, 2006	Water well at 11234 Jones Road was diagnosed by Wellco Drilling Services and determined to need a pump replacement.
November 6 through 15, 2006	November 2006 quarterly groundwater and treatment system sampling event.
December 22, 2006	The pump and ancillary equipment in the water well at 11234 Jones Road replaced.
January 24, 2007	Shaw submitted *July 2006 Geoprobe Investigation, Former Bell Dry Cleaner Property, 11600 Jones Road* documenting the installation of nine DPT borings (GP-1A through GP-9A) to depths of approximately 50 feet bgs. Soil and groundwater samples were collected for analysis of PCE. The highest PCE concentrations were detected in soil in borings GP-2A and GP-3A behind the former dry cleaning facility (near the back door on either side of the septic system line. PCE concentrations generally increased with depth.
February 6 through 14, 2007	February 2007 quarterly groundwater and treatment system sampling event.
February 12, 2007	Shaw submitted *Treatability Study Work Plan* for conducting a bench-scale treatability study for the site. The purpose of the work plan was to describe remedial technologies and methodologies for treatability studies that would be useful for in-situ remediation of VOCs in soil and groundwater. The work plan presented treatment options using activated persulfate in-situ chemical oxidation (ISCO), potassium permanganate ISCO, bio-stimulation, bioaugmentation, and abiotic treatment using zero valent iron.
May 2, 2007	Shaw submitted *Attempted Well Installation, Former Bell Dry Cleaner Property, 11600 Jones Road* documenting failed attempts to install a deep monitor well in the source area in July 2006. The well was proposed to determine the extent and concentrations of PCE in soil and groundwater below the source area and to provide a well for future monitoring, application of treatment reagents, or to provide a groundwater withdrawal point for extraction and treatment of groundwater. The original plan was to install a well to a depth of approximately 320 feet bgs. However, the drilling method (Rotosonic) was not successful due to drill pipe failure during attempted installation of well RS-1 (107 feet bgs total depth), and RS-2 (97 feet bgs total depth). Soil samples were collected but water samples were not. PCE was detected in samples to a depth of 82 feet bgs, with the highest concentrations detected at 45 feet bgs. No PCE was detected between 82 feet bgs and 107 feet bgs (total depth of investigation). However, heat generated during drilling may have liberated VOCs from the soil samples. No dense non-aqueous phase liquid (DNAPL) was detected during the sampling event.
May 3, 2007	TCEQ community meeting slide presentation.
May 7 through 16, 2007	May 2007 quarterly groundwater and treatment system sampling event.
May 18, 2007	The steel down-hole pump conductor tubing was removed and replaced with PVC conductor tubing in the water well located at 11107 Timbercrest. The steel tubing was corroded and had a nickel-sized hole in one of the tubing joints. The old tubing was subsequently disposed after confirmation rinsate sampling.

Table 1
Chronology of Site Investigations and Significant Events
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Date	Event
July 20, 2007	Shaw submitted *Vapor Intrusion Study Work Plan* for performing a vapor intrusion study at the former Bell Dry Cleaner site at 11600 Jones Road. The work plan proposed collection of two ambient air vapor samples within the former dry cleaning facility, and collection of two sub-slab vapor samples from two shallow soil borings installed immediately below the facility floor.
August 7 through 13, 2007	August 2007 quarterly groundwater and treatment system sampling event.
October 4, 2007	Shaw submitted *JR11600 Pre-Design Information*, which included a letter report, field notes, water flow diagram, meter readings taken August 6-10, 2007, photographic documentation of the public water supply system, and historical analytical results for the water well located at 11600 Jones Road.
October 16, 2007	Shaw submitted *Final Treatability Report* documenting a bench-scale treatment study performed on select soil and groundwater samples collected at the 11600 Jones Road site. The study included applications of ISCO, bio-stimulation/bioaugmentation, and abiotic treatment using zero-valent iron. The study concluded that ISCO using potassium permanganate would be most effective for removing source area PCE, and that bio-stimulation/bioaugmentation could be used to treat deeper zones.
November 5 through 14, 2007	November 2007 quarterly groundwater and treatment system sampling event.
November 12, 2007	Shaw submitted *Deep Monitor Well Gauging and Rainfall Data* report, which documented alternate-week groundwater gauging of ten deep monitor wells in the Jones Road area during the months of March through August 2007. The report also documented rainfall data from a local rainfall data collection station during the months of January 2006 through August 2007.
December 11 & 12, 2007	Meeting in Austin, Texas between Shaw, TCEQ, USGS, and EPA to define the Remedial Investigation outline and discuss installation of source area monitor wells, pilot-scale treatment study, vapor intrusion study, baseline risk assessment, post waterline groundwater monitoring, preparation of a conceptual site model (CSM), and groundwater modeling.
December 13, 2007	Site walk by Shaw to determine potential locations for conducting a pilot study and for installation of source area monitor wells.
December 17, 2007	Shaw submitted a memo *Groundwater Model Required Parameters* that identified input parameters required to construct, calibrate, and run a groundwater flow and transport model for the Jones Road site.
February 4 through 13, 2008	February 2008 quarterly groundwater and treatment system sampling event.
February 5, 2008	WL Construction performed a soil investigation for the EPA to identify potential contamination exposure to workers that might be encountered during installation of the water line. Soil samples were collected at 3 locations at a depth of 16 feet bgs, north and south of the Bell facility storm drain outfall. Laboratory results indicated no detectable VOCs. No formal report has been issued.
May 5 through 14, 2008	May 2008 quarterly groundwater and treatment system sampling event.
May 15, 2008	TCEQ community meeting slide presentation.

Table 1
Chronology of Site Investigations and Significant Events
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Date	Event
May 29, 2008	Shaw submitted *Source Area Conceptual Site Model.* The CSM presented cross sections through the source area, showing the subsurface lithology and distribution of contaminants near the former Bell facility. The CSM supports previous theories of downward migration of NAPL beneath the Bell facility, with dispersion of dissolved-phase PCE within the permeable sand and silt zones.
June 6, 2008	Shaw submitted *Revised Draft Pilot Test Work Plan.* The work plan outlined treatment technologies of in-situ chemical oxidation using sodium permanganate, and in-situ bioaugmentation in two locations within the source area, at depths approximately 22 to 37 feet bgs. The work plan also described field methods to implement them in two treatment studies.
June 11, 2008	Shaw submitted *Design Information - TCEQ Small Public Water System (PWS).* The report documented an engineered design of the proposed GAC filtration system to be installed at 11600 Jones Road.
June 24, 2008	Shaw submitted *Groundwater Model Identification Report* .
July 24, 2008	Shaw submitted a *Vapor Intrusion Study* . The purpose of the study was to determine if completed pathway(s) exist for intrusion of vapors to workers in the Cypress Shopping Center (from the Bell facility), and if indoor vapors would pos an unacceptable risk of chronic health effects due to long-term exposure. 2 indoor air and 2 sub-slab air samples were collected. Results exceeded OSWER Tier II target concentrations for PCE and TCE. The report concluded that the air pathway is complete, but that the measured concentrations did not pose an unacceptable health risk to workers.
August 19, 2008	Shaw completed construction of a comprehensive database of soil and groundwater data for the site.
August 28, 2008	Shaw submitted a *Remedial Investigation Report.*
August 29, 2008	Shaw submitted a *Regional Conceptual Site Model.*
August 29, 2008	Shaw submitted a *Baseline Risk Assessment Report.*
November, 2008	Water line construction completed.
February, 2009	First post water line groundwater sampling event.
April 15, 2009	Shaw submitted a Final Remedial Investigation Report.
July 8, 2009	Shaw submitted *Simple Capture Zone Modeling.*

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Chemical Specific			
Land Disposal Restrictions (40 CFR 268)	Provides numerical treatment standards for land disposal of some hazardous wastes.	Solid/hazardous waste may be generated as part of the remedial action. Depending on concentration levels, the waste may need to be treated prior to disposal.	Potentially applicable
Safe Drinking Water Act (SDWA) as amended (42 USC 201.)	Establishes the basic framework for protection of drinking water through risk-based standards.	Groundwater in the study area has been used as drinking water.	Applicable
MCLs for Organic Contaminants (40 CFR 141)	Provides primary drinking water standards including MCLs and maximum contaminant level goals (MCLGs). Establishes requirements for certain contaminants that are allowable in public water supply systems.	Contaminants in groundwater at the study area exceed the MCL for PCE.	Applicable
Texas Surface Water Quality Standards 30 TAC 307	Establishes limits for constituents for the protection of surface water quality. Requires the maintenance of the quality of water in the state consistent with public health and enjoyment, propagation and protection of terrestrial and aquatic life, operation of existing industries, and economic development of the state.	Applicable if any remedial actions will result in a discharge into or adjacent to surface water.	Potentially Applicable
Texas Industrial Solid Waste and Municipal Solid Waste Regulations 30 TAC 335	Guidelines for generators to determine if a solid waste is a hazardous waste. Requires adherence to recordkeeping and shipping requirements. Texas has been authorized by USEPA to enforce approximately 76% of the hazardous waste regulations, including the majority that may be ARARs for this site. These regulations are all found within 30 TAC 335.	Applicable to the soils and wastes to be removed is part of the remedial action, which may or may not be hazardous.	Potentially Applicable
Waste Characterization 30 TAC 335, Subchapter R	Establishes criteria for designating a waste as a hazardous waste or as one of three classes of solid waste.	Applicable for classifying wastes generated during the site remediation.	Applicable
Texas Risk Reduction Program 30 TAC 350	The Texas Risk Reduction Program (TRRP) regulates cleanup of contaminated sites. The TRRP rule was promulgated September 17, 1999, some older sites were grandfathered under the old Risk Reduction Rules (30 TAC 335). TRPP gives action levels that can be used to evaluate site data.	If the State demonstrates that a site-specific action under TRRP is more stringent than the federal standard, then that action may be considered an ARAR. The action will be applicable if demonstrated by the State to be more stringent than the Federal standard.	Potentially applicable

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Action Specific			
Occupational Safety and Health Administration (OSHA) Requirements (29 CFR 1910, 1926, and 1904)	Establishes requirements for occupational health and safety applicable to workers engaged in hazardous waste site or CERCLA response actions.	Required for workers who will be exposed to hazardous substances during remediation activities.	Applicable
DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1_500)	Establishes requirements for the transportation of hazardous materials including packaging, shipping, and placarding.	Remedial actions may require transportation of hazardous materials for treatment and/or disposal.	Potentially applicable
40 CFR 241–Guidelines for Land Disposal of Solid Wastes	Offsite solid waste land disposal units must meet the federal guidelines for the land disposal of solid wastes.	Applicability depends on waste classification for soil and groundwater treatment residuals.	Potentially Applicable
Land Disposal Restrictions (LDRs) (40 CFR 268)	Restricts certain hazardous wastes from placement or disposal on land without treatment.	Soil or secondary wastes from remedial actions that are designated as hazardous waste must be treated prior to disposal.	Potentially applicable
Subtitle D, 40 CFR 257–Criteria for Classification of Solid Waste Disposal Facility and Practices	Sets standards for land disposal facilities for nonhazardous waste.	Requirements under these regulations may be relevant and appropriate to storage of certain non-hazardous wastes or treatment system residuals if the risk they present are similar to those associated with hazardous wastes. The criteria and limitations used to identify wastes as being hazardous or nonhazardous are applicable to groundwater treatment residuals.	Potentially applicable
Subtitle C, 40 CFR 260 through 264	Regulates the generation, transport, storage, treatment, and disposal of hazardous wastes generated in the course of a remedial action. Regulates the construction, design, monitoring, operation, and closure of hazardous waste facilities.	The criteria and limitations used to identify wastes as being hazardous or nonhazardous in 40 CFR 261 are applicable to all wastes transported offsite from the Jones Road site. Determining whether wastes qualify as hazardous will often establish the applicability of other regulations.	Potentially applicable
40 CFR 264, Subparts B, C, D – Management of Hazardous Waste Facilities	Establishes minimum standards that define the acceptable management of hazardous waste for owners and operators of facilities that treat, store or dispose of hazardous waste.	Treatment or storage of hazardous waste may make these requirements relevant and appropriate.	Potentially applicable

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Action Specific			
40 CFR 264, Subparts I and J – Use and Management of Containers and Tank Systems	Subpart I sets operating and performance standards for container storage of hazardous waste. Subpart J outlines similar standards but applies to tanks rather than containers.	The requirements would be relevant and appropriate to the Jones Road site for containers or tanks used for storage of liquids, soil or other wastes as part of the remedial action.	Potentially applicable
Effluent Guidelines and Standards 40 CFR 400 series	Wastewaters from certain processes need to meet certain pretreatment requirements and concentrations before being discharged to a publicly owned treatment plant (POTW) or discharged through a permitted outfall. These standards include: - 40 CFR 437 – Centralized Waste Treatment Point Source Category - 40 CFR 445 – Landfills Point Source Category	Applicable, if a waste liquid is produced and treated during remediation prior to discharge or relevant and appropriate if groundwater is treated and discharged.	Potentially applicable
40 CFR 51–Requirements for Preparation, Adoption, and Submittal of Implementation Plans	Requires excavation activities be controlled to minimize fugitive dust emissions.	Applicable to fugitive dust emissions from excavation of contaminated soil.	Potentially Applicable
Control of Air Pollution from Visible Emissions and Particulate Matter 30 TAC 111	Requires that all reasonable precautions shall be taken to prevent particulate matter from becoming airborne, including use of water or chemicals for control of dust in the construction operations, clearing of land and on dirt roads or stockpiles.	Applicable during excavation and transport of soils, or any other activity that may generate airborne particulate matter at the Jones Road site.	Potentially Applicable
Control of Air Pollution by permits for New Construction or Modification 30 TAC 116	Requires a permit for construction or modification of any facility that may emit contaminants into the air, unless the facility qualifies for a standard exemption.	Potentially applicable for the site if the remedial action involves construction of a new soil and/or ground water treatment facility.	Potentially Applicable
General Air Quality Rules 30 TAC 101	Requires that sampling be conducted at a source that emits contaminants into the air of the state and that any emissions events that occur be reported.	Applicable for any remedial actions that will result in air emissions.	Potentially Applicable
Permits by Rule 30 TAC 106 Subchapter X: Waste Processes and Remediation 30 TAC 106.533	Equipment used to extract, handle, process, condition, reclaim, or destroy contaminants for the purpose of remediation is permitted by rule if certain design and location criteria are met (http://www.tceq.state.tx.us/permitting/air/permitbyrule/subchapterx/remediation.html).	Applicable for any remedial actions that will result in air emissions.	Potentially Applicable

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Action Specific			
TPDES Construction Stormwater Permit 30 TAC 205	Requires submission of Notice of Intent (NOI) as a large construction activity (sites greater than 5 acres) for coverage under the general permit for stormwater discharges resulting from construction. Complying with the substantive parts of this permit include preparation of a stormwater pollution prevention plan (SWPPP) and use of best management practices (BMPs) for managing stormwater, as well as other requirements. The NOI must be submitted at least 24-48 hours prior to construction. A Notice of Termination must also be submitted within 30 days after stabilization is complete. A copy of this information must also be submitted to the City, if part of the stormwater discharges to the City storm sewer.	This requirement would typically, under non-CERCLA conditions, be applicable to the Jones Road site during site remedial construction. Although submission of an NOI for construction activities conducted as part of the remedial action is not required, construction activities must comply with the substantive requirements of this regulation.	Potentially applicable
Underground Injection Control 30 TAC 331	Establishes requirements and prohibitions related to underground injection of fluids.	Obtain State approval for reinjection of treated groundwater and any treatment amendments; comply with CERCLA regulations.	Potentially applicable
Texas Pollutant Discharge Elimination System (TPDES) permit 30 TAC 308	Requires a permit for any activity that may result in discharge into or adjacent to waters in the State.	Applicable if any remedial actions will result in a discharge into or adjacent to water.	Potentially Applicable
Water Well Drillers and Water Pump Installers 16 TAC 76.1000 – 1009	Monitoring wells installed and abandoned must meet certain design requirements. Licensed drillers must install or abandon wells.	Applicable if wells are installed or abandoned	Applicable
City of Houston POTW Pretreatment Requirements City Code Sections 47-186 through 47-208 (Enforcement) 47-194 (Water Quality)	These regulations protect publicly-owned treatment works (POTWs) from accepting wastes which they are unable to effectively treat, or which may damage the POTW operation. The applicable regulations address maximum concentrations allowed in industrial discharges for certain pollutants.	Applicable if a remedial alternative includes the discharge of treated or untreated ground water into the municipal sewer system.	Potentially Applicable

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Location Specific			
Permits and Enforcement Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 121(e)	This section of CERCLA states that "no federal, state, or local permit shall be required for any portion of a CERCLA remedial action that is conducted on the site of the facility being remediated." This includes exemption from the RCRA permitting process. Note that the substantive requirements of the regulations must still be met (e.g., construction stormwater must be managed using best management practices [BMPs]).	Applicable to the Jones Road site	Applicable
Clean Air Act Section 101 40 CFR 52	Calls for development and implementation of regional air pollution control programs	Regulations promulgated under the Clean Air Act may apply to possible actions at the site that generate air emissions.	Potentially Applicable
40 CFR 50–National Primary and Secondary Ambient Air Quality Standards	Establishes Ambient Air Quality Standards	Applicable to discharges of toxic substances to the atmosphere during waste handling or treatment.	Potentially Applicable
Federal Water Pollution Control Act as amended by the Clean Water Act of 1977, Section 208(b) and 304	The proposed action must be consistent with regional water quality management plans as developed under Section 208 of Clean Water Act. Section 304 contains water quality criteria.	May be applicable to discharges to surface water	Potentially Applicable
Fish and Wildlife Coordination Act 16 USC 661 et seq. 16 USC 742 a 16 USC 2901 40 CFR 6.302	Requires consultation when a modification of a stream or other water body is proposed or authorized and requires adequate provision of fish and wildlife resources.	May be applicable to discharges to surface water	Potentially Applicable
40 CFR 131–Water Quality Standards	States are granted enforcement jurisdiction over direct discharges and may adopt reasonable standards to protect or enhance the uses and qualities of surface water bodies in the state. USEPA has authorized the State of Texas to enforce most water quality standards.	Applicable to direct discharge of treatment system effluent or other process waters.	Potentially Applicable

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Location Specific			
Texas Department of Licensing and Regulation (TDLR)	Licensed drillers/drilling companies are notified via TDLR notices/letters which define designated restricted drilling areas, and advise drillers of potential contamination and the contaminated water bearing units. Based on this information the TDLR may prescribe more stringent site-specific drilling procedures, well construction, and well completion specifications. A designated restricted drilling area does not prohibit drilling. There is no "registration" by which to initiate enforcement. The TDLR may learn of drilling in a restricted drilling area via a complaint or after a State of Texas Well Report has been submitted to the TDLR by the licensed driller. If the well report indicates the well was not constructed and completed in accordance with the TDLR specifications defined for the restricted drilling area, the TDLR may initiate enforcement based on improper well construction/completion.	Applicable to the Jones Road site if a remedial alternative includes a mechanism for establishing institutional controls restricting ground water use on and downgradient of the site.	Applicable
Harris-Galveston Subsidence District Rule 5.1 Registration of New Wells:	All new wells, except leachate wells, monitor wells, and dewatering wells, must be registered by the well owner, well operator, or water well driller prior to being drilled. The District staff will review the registration and make a preliminary determination on whether the well meets the exclusions or exemptions provided in Rule 5.7. If the preliminary determination is that the well is excluded or exempt, drilling may begin immediately upon receiving the approved registration.	Although not applicable to monitor wells or extraction/injection wells to be installed during remedial action at the site, this regulation provides a mechanism for establishing institutional controls restricting ground water use on the Jones Road site and in the vicinity of the site.	TBC
Harris-Galveston Subsidence District Rule 5.7 Exclusions and Exemptions:	a. Exemption: Single-family dwellings with wells having a nominal casing diameter of 5 inches or less are excluded from the permit requirements. b. Exemption: The permit requirements shall not apply to: (i) windmills serving a well with a casing diameter of four inches nominal or less, (ii) monitor wells, (iii) leachate wells, or (iv) dewatering wells. Although small single family wells are excluded from obtaining permit, the owner is required to register the well.	Although not applicable to monitor wells or extraction/injection wells to be installed during remedial action at the site, this regulation provides a mechanism for establishing institutional controls restricting ground water use on and downgradient of the site.	TBC

Table 2
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

ARAR Citation	Requirement	Rationale for Use	Type of Requirement
Location Specific			
Rules of Harris County for the Placement of Water Wells	Section 6 (2)(B)(i) - The county engineer shall approve the drilling of private water well if the well will not be drilled into or through an aquifer or groundwater plume that has been confirmed as contaminated by the Texas Commission on Environmental Quality or the United States Environmental Protection Agency and placement of the well will not violate the rules adopted by the Texas Commission of Licensing and Regulation under Chapters 1901 and 1902, Occupations Code.	The Jones Road Groundwater Plume Superfund Site has designated an area of no use of groundwater (shown on **Figure 3**).	Applicable
Other			
40 CFR 52–Approval and Promulgation of Implementation Plans	Requires the filing of a notice with the state regarding intent to install a new stationary source for air pollution.	A CERCLA response action is not required to obtain permits under the prevention of significant deterioration (PSD) program, but must comply with the substantive requirements of a PSD review.	TBC

Notes:
CFR - Code of Federal Regulation
DOT - Department of Transportation
MCL - Maximum Contaminant Level
NA - not applicable
NPDES - National Pollutant Discharge Elimination System
POTW - Publicly Owned Treatment Works
TAC - Texas Administrative Code
TBC - to be considered
USC - United States Code
TPDES - Texas Pollutant Discharge Elimination System

Table 3
General Description of Remedial Alternatives and Overview of Basis for Cost Estimates
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Remediation Alternatives	**Alternative 1** - No Action	**Alternative 2** - In Situ Treatment	**Alternative 3** - Hydraulic Containment / Pump and Treat	**Alternative 4** - In Situ Enhancements to Pump and Treat
SOURCE AREA SOIL				
Description of Alternative Actions for Soil in the Source Area	No Action	In Situ Treatment for soil would apply two injections of ISCO to the shallow soil in the source area. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.	Institutional Controls for soil.	In Situ Treatment for soil would apply two injections of ISCO to the shallow soil in the source area. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.
SOURCE AREA GROUNDWATER				
Description of Alternative Actions for Shallow Groundwater in the Source Area	No Action	In Situ Treatment for groundwater would apply two injections of ISCO to the shallow groundwater in the source area. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.	Hydraulic Containment / Pump and Treat for the source area assumes extraction of groundwater at MW-1 and MW-6 to establish hydraulic containment. Treatment by air stripping with GAC polishing, and discharge by reinjection. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.	In Situ Enhancements to Pump and Treat would consist of **Alternative 4** with the addition of ISCO treatment (**Alternative 3**) Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.

Table 3
General Description of Remedial Alternatives and Overview of Basis for Cost Estimates
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Remediation Alternatives	**Alternative 1** - No Action	**Alternative 2** - In Situ Treatment	**Alternative 3** - Hydraulic Containment / Pump and Treat	**Alternative 4** - In Situ Enhancements to Pump and Treat
DEEP GROUNDWATER PLUME				
Description of Alternative Actions for Deeper Groundwater	No Action	In Situ Treatment for groundwater would apply injections of bioaugmentation materials to the 10 most contaminated inactive water wells. Four applications spaced 1 year apart were assumed for estimating cost. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.	Hydraulic Containment / Pump and Treat for deeper groundwater assumes extraction from 6 new extraction wells at a rate of 20 gpm each to establish hydraulic containment. Treatment by air stripping with GAC polishing, and discharge by reinjection. Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.	In Situ Enhancements to Pump and Treat would consist of **Alternative 4** with the addition of bioaugmentation at the most contaminated inactive water wells (**Alternative 3**). Institutional controls would either prevent or restrict use of groundwater. LTM for treatment effectiveness.

Notes:
GAC - granular activated carbon
gpm - gallons per minute
ISCO - in situ chemical oxidation
LTM - long term monitoring
MNA - monitored natural attenuation.

Table 4
List of Wells Proposed for Groundwater Monitoring
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Well	Purpose of Monitoring at This Well
MW-1	Source Area Shallow PCE Plume and Attenuation
MW-2	Source Area Shallow PCE Plume and Attenuation
MW-3	Source Area Shallow PCE Plume and Attenuation
MW-4	Upgradient of Source Area Shallow PCE Plume
MW-5	Upgradient of Source Area Shallow PCE Plume
MW-6	Source Area Shallow PCE Plume and Attenuation
MW-7	Downgradient of Source Area Shallow PCE Plume
MW-8	Upgradient of Source Area Shallow PCE Plume
MW-9	Downgradient of Source Area Shallow PCE Plume
MW-10	Beneath Deep PCE Plume 261-300
MW-11R	Downgradient of Deep PCE Plume 231-260
MW-12	Downgradient and Beneath Deep PCE Plume 261-300
MW-13	Beneath Deep PCE Plume 261-300
MW-14	Upgradient and Beneath Deep PCE Plume 261-300
MW-15	Upgradient and Beneath Deep PCE Plume 261-300
MW-16	Upgradient and Beneath Deep PCE Plume 261-300
MW-17	Downgradient and Beneath Deep PCE Plume (deepest well) 301-535
MW-18	Downgradient and Beneath Deep PCE Plume 261-300
MW-19	Downgradient of Deep PCE Plume 231-260
MW-20	New Monitor Well in depth range 50-100
MW-21	New Monitor Well in depth range 50-100
MW-22	New Monitor Well in depth range 50-100
MW-23	New Monitor Well in depth range 50-100
FV11022	< 200 Inactive water well in Deep PCE Plume for Attenuation
TC11027	< 200 Inactive water well in Deep PCE Plume for Attenuation
TC11115	< 200 Inactive water well in Deep PCE Plume for Attenuation
TT11014	< 200 Inactive water well in Deep PCE Plume for Attenuation
TT11107	< 200 Inactive water well in Deep PCE Plume for Attenuation
TT11215	< 200 Inactive water well West of Deep PCE Plume
TO10830	200-230 Inactive water well East of Deep PCE Plume
WE10711	200-230 Inactive water well East of Deep PCE Plume
JR11527	200-230 Inactive water well in Deep PCE Plume for Attenuation
JR11600	200-230 Inactive water well in Deep PCE Plume for Attenuation
TC11126	200-230 Inactive water well in Deep PCE Plume for Attenuation
TO10835	200-230 Inactive water well in Deep PCE Plume for Attenuation
TT11011	200-230 Inactive water well in Deep PCE Plume for Attenuation
ES11718	200-230 Inactive water well North of Deep PCE Plume
FV11215	200-230 Inactive water well West of Deep PCE Plume
TH11611	200-230 Inactive water well West of Deep PCE Plume
TO11116	200-230 Inactive water well West of Deep PCE Plume
FV11014	231-260 Inactive water well in Deep PCE Plume for Attenuation
FV11130	231-260 Inactive water well in Deep PCE Plume for Attenuation
TC11019	231-260 Inactive water well in Deep PCE Plume for Attenuation
TO10903	231-260 Inactive water well in Deep PCE Plume for Attenuation
TT11131	231-260 Inactive water well in Deep PCE Plume for Attenuation
ES11643	231-260 Inactive water well North of Deep PCE Plume
PH11610	231-260 Inactive water well West of Deep PCE Plume
TO11230	231-260 Inactive water well West of Deep PCE Plume
TT11230	231-260 Inactive water well West of Deep PCE Plume
ES11610	261-300 Inactive water well Beneath Deep PCE Plume
TT11112	261-300 Inactive water well Beneath Deep PCE Plume
JR11010	261-300 Inactive water well Beneath Deep PCE Plume and to the South
TT11139	261-300 Inactive water well Beneath Deep PCE Plume and to the West
JR11414	301-535 Inactive water well Beneath Deep PCE Plume
TT11115	301-535 Inactive water well Beneath Deep PCE Plume

Table 4
List of Wells Proposed for Groundwater Monitoring
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Well	Purpose of Monitoring at This Well
FV11023	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
JR11528	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
JR11535	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
JR11614	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
JR11642	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
TH11618	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
TO10827	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
TO10902	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth
TO11033	Inactive water well in Deep PCE Plume for Attenuation Unknown Depth

Notes:
1. Final list of wells to monitor would be selected during remedial design.
2. TCEQ water line agreement commits to plugging and abandoning water wells.
   Owner may insist that the well be plugged and abandoned.
3. TCEQ or USEPA may need to enter into a new agreement to continue using a water well.
4. Well integrity may determine whether a well is useful for monitoring or remediation.
5. Wells listed seem likely candidates for monitoring.

Table 5
Comparative Analysis of Remedial Alternatives
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Evaluation Criteria	**Alternative 1** - No Further Action	**Alternative 2** - In Situ Treatment	**Alternative 3** - Hydraulic Containment / Pump and Treat	**Alternative 4** - In Situ Enhancements to Pump and Treat
Threshold Criteria				
Meets Threshold:	**No**	**Yes**	**Yes**	**Yes**
1. Protection of Human Health and the Environment	Some owners of existing water wells within the plume have not opted to connect to the waterline for potable water. Possible plume migration may move contaminants to wells (private and PWS) that are currently unaffected and outside the existing groundwater restrictions zone. The BLRA determined that contaminants at the study area do not pose any danger to the environment relative to ecological considerations.	Institutional Controls prevent or restrict exposure to contaminated source area soil. In Situ Treatment protects human health by destroying contaminants in the source area groundwater. In Situ Treatment protects human health by destroying contaminants in the deep groundwater plume and applying Institutional Controls to prevent use of contaminated groundwater. In the source area, soil and groundwater would be treated using ISCO, and in the deep drinking water aquifers, hot spots and groundwater would be treated using bioaugmentation. The BLRA determined that contaminants at the study area do not pose any danger to the environment relative to ecological considerations. LTM would be used to track treatment effectiveness.	Institutional Controls prevent or restrict exposure to contaminated source area soil. Hydraulic Containment / Pump and Treat would adequately protect human health primarily by preventing the migration of contaminants, with a secondary benefit of removing contaminants from extracted groundwater, in both the source area and deep drinking water aquifers. The BLRA determined that contaminants at the study area do not pose any danger to the environment relative to ecological considerations. LTM would be used to track treatment effectiveness.	Institutional Controls prevent or restrict exposure to contaminated source area soil. In Situ Enhancements to Pump and Treat would adequately protect human health by destroying contaminants in situ and removing and treating contaminants in the soil and groundwater. In the source area, soil and groundwater would be treated using ISCO, and in the deep drinking water aquifers, hot spots and groundwater would be treated using bioaugmentation. The BLRA determined that contaminants at the study area do not pose any danger to the environment relative to ecological considerations. LTM would be used to track treatment effectiveness.
2. Compliance with ARARs and Other Criteria, Advisories, and Guidance	Groundwater contaminants exceed the MCLs in some water wells that are still in use.	It is expected that this alternative would comply with ARARs. In Situ Treatment would provide treatment of contaminated soil and groundwater, and provide a record of treatment effectiveness and progress toward reduction of contaminants to levels below the MCLs in wells within the plume.	It is expected that this alternative would comply with ARARs. Hydraulic Containment / Pump and Treat prevents the migration of and reduces groundwater contaminant concentrations over time.	It is expected that this alternative would comply with ARARs. In Situ Enhancements to Pump and Treat destroys contaminants immediately and reduces groundwater contaminant concentrations over time.

Table 5
Comparative Analysis of Remedial Alternatives
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Evaluation Criteria	**Alternative 1** - No Further Action	**Alternative 2** - In Situ Treatment	**Alternative 3** - Hydraulic Containment / Pump and Treat	**Alternative 4** - In Situ Enhancements to Pump and Treat
Balancing Criteria				
3. Long term Effectiveness and Permanence (Long term risks and adequacy of reliable controls)	Groundwater contamination would not be tracked or remediated.	In Situ Treatment achieves long term effectiveness and permanence by destroying contaminants in situ. Monitoring to evaluate potential rebound of residual contaminants would be needed.	Hydraulic Containment / Pump and Treat achieves long term effectiveness and permanence through control and treatment. Monitoring of hydraulic containment and of groundwater concentrations for rebound of PCE concentrations would be necessary. Treatment plant operations pose some risk of spills of untreated groundwater due to spills or breakdown.	In Situ Enhancements to Pump and Treat achieves long term effectiveness and permanence through control and treatment. Monitoring of hydraulic containment and of groundwater concentrations for rebound of PCE concentrations would be necessary. Treatment plant operations pose some risk of spills of untreated groundwater due to spills or breakdown.
4. Reduction of TMV through Treatment (including contribution to site remediation)	Toxicity would not be reduced. Mobility would not be reduced. Volume would not be reduced. Cessation of periodic monitoring would prevent knowledge of changed conditions.	In Situ Treatment reduces Toxicity and Volume through treatment. Mobility is not affected. The dissolved phase ground water plume Volume and Toxicity would be reduced by the in situ treatment application. The in situ treatments applied (such as ISCO and bioaugmentation) are irreversible.	Hydraulic Containment / Pump and Treat would reduce Toxicity, Mobility and Volume through treatment. The ex situ treatment applied (air stripping) is irreversible.	In Situ Enhancements to Pump and Treat would reduce Toxicity, Mobility and Volume through in situ and ex situ treatment of groundwater. The ex situ treatment applied (air stripping) is irreversible. The dissolved phase ground water plume Volume and Toxicity would be reduced by the in situ treatment application. The in situ treatments applied (such as ISCO and bioaugmentation) are irreversible.
5. Short term Effectiveness (including risks during construction and timeliness to meet RAOs)	Groundwater contamination would not be tracked or remediated.	In Situ Treatment effectiveness in the short term is through destroying contaminants with treatment. Additional risks associated with applying the treatments should be manageable. Short term risks to local residents related to remedial implementation are expected to be minimal. Short term risks to workers are expected to be minimal to low. Standard health and safety safeguards can protect workers from exposure to in situ chemicals, fugitive dust, contaminants and odors during implementation of this alternative. Ground water monitoring would use standard techniques and engineering controls to ensure minimal exposure to the contaminants.	Hydraulic Containment / Pump and Treat would control groundwater flow and begin removing groundwater contaminants immediately. With proper O&M, risks from running the treatment plants would be minimal. Short term risks to local residents related to remedial implementation are expected to be minimal. Short term risks to workers are expected to be low. Ground water monitoring would use standard techniques and engineering controls to ensure minimal exposure to the contaminants. Standard health and safety safeguards can protect workers from exposure to fugitive dust, contaminants, and odors during implementation of this alternative.	In Situ Enhancements to Pump and Treat would begin removing groundwater contaminants immediately. With proper O&M, risks from running the in situ treatment and ex situ treatment plants would be minimal. In situ enhancements would likely speed reductions of contaminant concentrations. Short term risks to local residents related to remedial implementation are expected to be minimal. Short term risks to workers are expected to be low. Groundwater monitoring would use standard techniques and engineering controls to ensure minimal exposure to the contaminants. Standard health and safety safeguards can protect workers from exposure to fugitive dust, contaminants, and odors during implementation of this alternative.

Table 5
Comparative Analysis of Remedial Alternatives
Jones Road Groundwater Plume Federal Superfund Site (SUP075)
Harris County, Texas
Shaw Project Number 137226

Evaluation Criteria	**Alternative 1** - No Further Action	**Alternative 2** - In Situ Treatment	**Alternative 3** - Hydraulic Containment / Pump and Treat	**Alternative 4** - In Situ Enhancements to Pump and Treat
6. Implementability, Technical Feasibility (including construction and O&M considerations, site access, availability of services and materials)	No Further Action is technically feasible. No construction, O&M, access, or availability concerns would apply.	In Situ Treatment is technically feasible. ISCO and bioaugmentation are commercially available technologies that have been used at numerous contaminated soil and groundwater sites and the known site characteristics present no unique obstacles. Effective delivery of in situ treatments depends on an accurate understanding of the depth and extent of contaminated groundwater. LTM would be required to monitor the implemented remedy. LTM must be sufficient to identify rebounding contaminant concentrations which commonly occur after initial treatment application.	Hydraulic Containment / Pump and Treat is technically feasible. Groundwater extraction and air stripping are well developed technologies and commercially available. Installation of extraction and injection wells is relatively easy using existing drilling techniques. Long term system O&M and ground water monitoring would be required to maintain the implemented remedy. Reinjection of treated groundwater depends on identifying an appropriate location for reinjection and adequate maintenance of the injection wells.	In Situ Enhancements to Pump and Treat is technically feasible. In situ treatment, groundwater extraction, and air stripping are well developed technologies and commercially available. Installation of extraction and injection wells is relatively easy using existing drilling techniques. Effective delivery of in situ treatments depends on an accurate understanding of the depth and extent of contaminated groundwater. LTM must be sufficient to identify rebounding contaminant concentrations which commonly occur after initial treatment application. Reinjection of treated groundwater depends on identifying an appropriate location for reinjection and adequate maintenance of the injection wells.
6. Implementability, Administrative Feasibility (permits, waivers, statutory limits)	No Further Action is administratively feasible. No permits, waivers, or statutory limits would apply.	In Situ Treatment is administratively feasible. No apparent permits or waivers would be required.	Hydraulic Containment / Pump and Treat is administratively feasible. Approval of construction, appropriate groundwater extraction, and treatment plant water and air discharges may be needed. Approval of a disposal method for treated groundwater is critical to the success of this alternative.	In Situ Enhancements to Pump and Treat is administratively feasible. Approval of construction, appropriate groundwater extraction, and treatment plant water and air discharges may be needed. Approval of a disposal method for treated groundwater is critical to the success of this alternative.
7. Cost in 2009 dollars				
Total Capital Cost	$0	$635,680	$2,818,060	$2,998,540
Total O&M Cost	$0	$1,589,430	$3,343,230	$3,343,230
Total Periodic Cost	$0	$1,224,480	$144,480	$1,224,480
Total Cost	$0	$3,450,000	$6,306,000	$7,566,000
Net Present Value	$0	$2,710,000	$4,668,000	$5,849,000
Lower Range (-30%)	$0	$1,897,000	$3,268,000	$4,094,000
Upper Range (+50%)	$0	$4,065,000	$7,002,000	$8,774,000
Acceptance Criteria				
8. Federal, State, and Local Agency Acceptance	No Further Action would not be acceptable to Federal, State, or Local agencies. It does not provide adequate plume management.	In Situ Treatment would reduce the mass of contaminants in the plume and monitoring would document the effectiveness of the treatment. Agency acceptance is likely.	Hydraulic Containment / Pump and Treat would be acceptable to federal and State agencies. A very high groundwater extraction rate may be opposed by the Harris Galveston Subsidence District, though the rules specifically exempt monitor and treatment wells.	In Situ Enhancements to Pump and Treat would be acceptable to federal and State agencies. A very high groundwater extraction rate may be opposed by the Harris Galveston Subsidence District, though the rules specifically exempt monitor and treatment wells.
9. Community Acceptance	Wait for Public Comments.	Wait for Public Comments.	Wait for Public Comments.	Wait for Public Comments.

Notes:
ARAR - applicable or relevant and appropriate requirement
O&M - operations and maintenance
LTM - long term monitoring
RAOs - remedial action objectives
TMV - toxicity, mobility, or volume