LOCKHEED MARTIN

Lockheed Martin Information Systems & Global Services
Environmental Services SERAS
2890 Woodbridge Avenue, Building 209 Annex
Edison, NJ 08837-3679
Telephone 732-321-4200 Facsimile 732-494-4021

RECEIVED
MAY 24 2010
REMEDIAL BUREAU E

DATE: May 12, 2010

TO: Terrence Johnson, U.S. EPA/ERT Work Assignment Manager

THROUGH: Richard Leuser, SERAS Deputy Program Manager

FROM: Dan Patel, SERAS Task Leader/Project Engineer

SUBJECT: REMEDIAL ALTERNATIVES ASSESSMENT, FOR RESIDUAL SOURCE CONTAMINATION TREATMENT AT THE CIRCUITRON SITE, EAST FARMINGDALE, NEW YORK, WA#0-022, TECHNICAL MEMORANDUM

1.0 INTRODUCTION

This technical memorandum has been prepared by personnel from the Scientific, Engineering, Response and Analytical Services (SERAS) contract and presents an assessment of remedial alternatives and its findings for addressing the residual source of chlorinated volatile organic compounds (CVOC) contamination at the Circuitron Site (Site), East Farmingdale, Long Island, New York (NY).

The Remedial Alternatives Assessment (RAA) was completed under the previous Response Engineering and Analytical Contract (REAC) for the Environmental Protection Agency (EPA) Environmental Response Team (ERT).

2.0 PURPOSE

As per the Record of Decision (ROD) issued by EPA on March 29, 1991 for the Circuitron Site, a source control remedy referred to as Operable Unit 1 (OU-1) was required to be implemented to prevent further impact to the groundwater as a result of residual CVOCs in subsurface soils and sediments in the southwest corner of the Site. In line with the objectives and requirements of the OU-1 ROD, remedial alternatives such as excavation, in situ chemical oxidation (ISCO), and in situ source removal using air sparging and soil vapor extraction (AS/SVE) were explored to determine the technical and/or economic viability of these options.

3.0 BACKGROUND

The Circuitron site (Site) is located at 82 Milbar Boulevard in East Farmingdale, Long Island, New York. The site is the location of a former circuit board manufacturer. From 1961 to 1986, when the facility was in operation, thousands of gallons of plating waste solvents containing CVOCs were discharged both to a licensed underground leaching pool and to an unauthorized leaching pool located beneath the floor of the Site building. The primary contaminants-of-concern (COCs) that contaminated soil and groundwater are 1,1,1-trichloroethane (TCA) and tetrachloroethene (PCE). A groundwater pump-and-treat (P&T) system operated at the Site from 2000 to 2007 to treat dissolved TCA and PCE. However, TCA concentrations in water samples from shallow monitor well (MW-4S) on the Circuitron property remained elevated, suggesting that the TCA concentrations in the shallow saturated soil were above the soil cleanup criteria at the Site.

A detailed history of the Site is documented in:

- EPA Superfund Record of Decision (ROD): Circuitron Corporation, EPA ID:NYD981184229 Operable Unit 1 (OU1), East Farmingdale, New York (NY) 3/29/91
- EPA Superfund Record of Decision (ROD): Circuitron Corporation, EPA ID:NYD981184229 Operable Unit 2 (OU2), East Farmingdale, New York (NY) 9/30/94

4.0 METHODOLOGY

In October 2006, based on the information and data available at the time (REAC 2006a, REAC 2006b), the residual source contamination was believed to be in two distinct pockets; the major one underneath the storm drain SD3 in the southwest corner of the property, and a smaller one underneath the storm drain SD2 located about 30 feet north of SD3 (Figure 1).

The two storm drains were in dry wells, each 10 feet in diameter, with a 24-inch diameter cast iron grate at the surface to allow storm water to drain into the dry wells. These dry wells were built using 10-inch thick slotted concrete cylinders 4-feet tall, stacked three on top of each other, with the bottom being open to the native sandy soil. The top of the cylindrical wall of each dry well came up to approximately two feet below ground surface (bgs). Each dry well was capped with a 10-inch thick reinforced concrete cap (about 12 feet in diameter), backfilled with soil to ground surface, while leaving the cast iron grate and its 24-inch connection to the dry well open. The dry well bottoms were approximately 12 feet bgs for SD2 and 15 feet bgs for SD3.

During the period when the Circuitron facility was in operation, it is believed that spent solvents consisting primarily of TCA and PCE were released to the dry wells. The waste solvents were released to the dry wells via 8-inch diameter buried (about 2 feet bgs) drain pipes leading from the facility building to the dry wells. The groundwater table at the Site fluctuates between 25 to 35 feet bgs.

Soil sampling data available in October 2006 (REAC 2006a and 2006b) suggested that the vertical extent of the contamination underneath SD3 was restricted to a depth of 40 feet bgs. This information was used to define the source zone for the purpose of completing this Remedial Alternatives Assessment (RAA) of three OU-1 ROD prescribed options; excavation, ISCO and AS/SVE. Based on the data and information available in October 2006, the source zones under both SD3 and SD2 were conceptualized to be cylindrical in shape. The assessment of each option is summarized below.

Excavation

Excavation would require transportation and off-site disposal of significant quantities of contaminated soils from around the SD2 and SD3.

Around SD2, TCA/PCE contamination exceeding the OU-1 ROD specified cleanup goals (for TCA and PCE) was found between the depths of 12 to 16 feet bgs over an area roughly 30 feet in diameter. This amounted to approximately 100 cubic yards (cy) of soil to be excavated and disposed of. However, in order to reach this pocket of contaminated soil approximately 300 cy of overburden soil would have to be excavated, stockpiled and tested before it could be reused as backfill.

Around SD3, high levels of TCA contamination prevailed between the depths of 15 to 40 feet bgs over an area roughly 40 feet in diameter. This amounted to approximately 1,200 cy of soil to be excavated and disposed of. In this area, approximately 600 cy of overburden soil would need to be excavated, stockpiled and tested before it is reused. The water table at this Site is located 25 to 30 feet bgs. This means that excavation around SD3 could require dewatering or involve wet excavation. There is also the issue of contaminated groundwater that could recontaminate clean fill.

The interval from the surface to a depth of 80 feet consists primarily of coarse sand and gravel (the Upper Glacial Formation). Therefore, excavation of contaminated soil to depths described above would require shoring protection to prevent caving of adjoining soils, to safeguard worker safety and to limit the excavation to only targeted contaminated pockets of soil. In addition, given the relatively high concentrations of VOCs in the soils, fugitive emissions and exposure to workers and the public downwind of the Site would need to be addressed prior to undertaking excavation of the TCA/PCE contaminated soil.

The following is the projected cost for excavation at the Site:

- Disposal cost of $390,000, for approximately 1,300 cy of TCA contaminated soil at $300/cy. If excavation was considered only around SD2, this would be $30,000 (i.e., for 100 cy).
- Trucking cost of $87,600, for the 1,300 cy of soil (at $1,200 per 18-cy load x 73 loads). For SD2 area only, this cost would be $7,200.
- Imported backfill material cost of $39,000 (750 cy at $30/cy). For SD2 area only, this cost would be $3,000.
- Excavation, stockpiling and backfilling costs (including benching and shoring protection) of $154,000 (total of 2,200 cy of excavation including the overburden soil at an average $70 per cy). For SD2 area only, this cost would be $32,000 (total of 400 cy at an average of $80 per cy.)

In summary (Table 1), the estimated base cost for excavating both SD2 and SD3 areas, not including the design, construction oversight and final compliance monitoring, can be expected to be on the order of $670,000 or more. The estimated base cost for excavating just the impacted soil around SD2 can be expected to be around $73,000. If upon excavation and testing, if the overburden soil is determined to have concentrations of VOCs above the regulatory guideline for reuse, this would increase the cost for off-site disposal and for additional fill material.

In Situ Chemical Oxidation (ISCO)

When the primary contaminants of concern are chlorinated VOCs such as TCE, PCE, DCE and VC in situ chemical oxidation (ISCO) is considered a viable treatment option.

Several chemical blends have been used to effect ISCO at CVOC impacted sites. Among the notable methods are, hydrogen peroxide (standard and modified Fenton's reagent), permanganate (sodium or potassium), ozone, sodium persulfate (heat, alkali or ferrous iron activated) and sodium percarbonate.

With respect to treating TCA, some of these ISCO methods are less effective than others. Per industry literature, TCA (which falls in the chloroethanes family) has proven to be recalcitrant to reduction by ISCO methods such as hydgrogen peroxide, permanganate, ozone and Fe activated persulfate. However, industry literature indicates that, ISCO methods such as alkali or heat activated persulfate, ozone/peroxide combination and sodium percarbonate based ISCO technologies have shown to be quite effective.

Typically, the applicability and selection of a specific ISCO technology depends on site specific characteristics such as physical and chemical properties of the targeted soil. For example, the amount of oxidant required and the method and frequency of application would depend primarily on the total oxidizable content of the targeted volume of soil to be treated, including native organic content, certain inorganic and metals content, and the concentration of the targeted organic contaminants. As per the findings of the USEPA's "Streamlined Remediation System Evaluation (RSE-Lite) of Circuitron Corporation Superfund Site" of August 12, 2004, precipitation of iron (i.e., ferrous iron converting to ferric) was a significant issue for the pump-and-treat system. The RSE-Lite and the USEPA "Five-Year Review Report for Circuitron Corporation Superfund Site" of August 2005 have reported that at this site the levels of total chromium in soils remain elevated, though the levels of hexavalent chromium (the soluble form of chromium) in groundwater are non-detectable. These findings suggest that the presence of high levels of ferrous iron in the site soil have managed to keep the otherwise elevated levels of total chromium in the trivalent (the more stable and sparingly soluble) form.

At this site, the native organic content of the coarse sandy soil is low. The only other constituent with significant oxygen demand would be the ferrous iron. Other important factors to consider for the purpose of selecting the remedial alternative are the hydraulic conductivities (HC) of the vadose and the saturated zones and the stratification of the subsurface. The HC is high at the Site and the subsurface is relatively homogeneous. Thus, the low soil organic content coupled with high vadose zone permeability and high hydraulic conductivity apparently make ISCO a candidate for the treatment of the high level TCA source areas.

Based on information obtained from a vendor who has recently implemented an alkali-activated persulfate treatment at a comparable site (also on Long Island, with quite similar geology and hydrology) for the treatment of 1,2,3-trichloropropane (a chloroethane) the cost of implementing a similar ISCO application at the Site is estimated to be in the order of $260,000 for both the SD2 and SD3 areas, at approximately $200 per cy and a total of 1,300 cy (Table 1). The estimated cost for implementing an ISCO application in the SD3 area only is $240,000 (i.e., for treating 1,200 cy). These estimates are based on an assumption that at least three applications of the selected ISCO treatment would be required to attain the desired cleanup levels.

Air Sparging/Soil Vapor Extraction (AS/SVE)

At this site, the larger area of concern (one around SD3) has TCA occurring in the vadose zone (between 15 and 25 feet bgs) and the upper saturated zone (between 25 and 40 feet bgs). In this area an SVE system could be used to treat the vadose zone. In the saturated zone, most of the contamination appears to be between 25 and 40 feet bgs. To treat the saturated zone an air-sparging (AS) network (between 30 and 60 feet bgs) could be used. An SVE/AS system for this area (i.e., around SD3) would be expected to have a radius-of-influence (ROI) of at least 25 feet around SD3.

The smaller area of concern (around SD2) has TCA only in the vadose zone (between 12 and 16 feet bgs). A single SVE point would be required, with an ROI of 15feet around SD2. Furthermore, the exhaust vapors from the SVE system may need to be treated above-ground through a vapor-phase GAC unit.

Based on input obtained from a local AS/SVE system vendor, the estimated cost for the purchase and installation of the AS/SVE system, to remediate both SD2 and SD3 areas, including installation of the remediation points, trenching, subsurface piping, purchase of air treatment equipment (VGACs), start-up and shakedown is around $150,000. This estimate includes the cost of applying a liquid boot over the areas of concern to prevent short-circuiting of air. However, this does not include the cost for possible disposal associated with the well installation and trenching. The estimated annual system O&M and reporting costs are estimated to be in the order of $100,000, depending on carbon consumption and utility (electric) charges (Table 1). The cleanup time for an AS/SVE system to remediate the TCA levels from hundreds of ppm down to a low ppm level in the vadose and saturated zone soil and down to low ppb level in the groundwater is estimated to be at least 3 years.

The geology and hydrology at the Site appear to be conducive to AS/SVE. Furthermore, both TCA and PCE have physical properties (vapor pressures and Henry's constants) that are quite amenable to AS/SVE.

5.0 SUMMARY OF FINDINGS

Three remedial alternatives; excavation, ISCO and AS/SVE, were investigated as potential source treatment options for in the southwestern portion of the Circuitron Site.

Excavation, though labor intensive, would take the least time to accomplish the clean-up objectives. On the other hand, AS/SVE would take up to three years (and possibly more). ISCO would take on the order of months to a year to reach the target clean-up levels.

Excavation is the most expensive option as well as the most labor intensive, and estimated to cost in the order of $670,000, not including the cost of design, construction oversight and final compliance monitoring, which could be as much as $100,000. If the overburden soil (between the depths of 0 to 12 feet bgs) is determined to require off-site disposal, then the total excavation cost may be higher. Given the high levels of VOCs in the soils, controlling fugitive emissions and exposure to workers and the public downwind of the Site would be a challenge.

On the other hand, the cost of implementing an ISCO treatment is estimated to be in the order of $260,000. This estimate is based on an assumption that at least three applications (spanned two months apart) of the selected ISCO method would be required to achieve the desired clean-up levels. This estimate does not include the post-treatment sampling and monitoring program costs, which could be as much as $60,000. However, the factors that would determine the actual applicability of ISCO at this site would be its impact on the state of chromium in the soil, the performance of the selected ISCO treatment and the number of applications that would be required to attain the desired clean-up levels. Both of these issues; mobilization of chromium, and treatment performance, can be investigated and addressed through a bench-scale laboratory treatability study.

Alternatively, the cost of implementing an AS/SVE system at this site is estimated to be around $150,000 in up-front cost for installation and start-up and up to $100,000 annually for three years in O&M costs.

6.0 RECOMMENDATIONS

Given the high cost of excavation and the depth of the contaminated zone between 12 feet and 40 feet bgs and, the coarse sand underlying the Site which would make deep excavation difficult, excavation does not appear to be a practical remedy for this site.

Both ISCO and AS/SVE appear to be viable and practical for this site. The estimated total costs for both alternatives are comparable. If there is an urgency to clean-up the Site then ISCO may be a better choice. However, if ISCO were to be considered, then it is recommended that a bench-scale laboratory treatability study using the TCA contaminated site soil and groundwater be conducted to determine the effectiveness of two or more ISCO treatment methods, as well as to evaluate the effect of the ISCO treatment on the conversion of chromium from the stable trivalent form to the mobile hexavalent form.

If the treatability study deems ISCO as technically limiting, then a traditional AS/SVE system with multiple AS and SVE points may be deployed to treat the residual contamination in place. Alternatively, in lieu of the traditional AS/SVE system, a pilot-scale single groundwater circulation well (GCW) with in-well vapor stripping (IVS) and soil vapor extraction (SVE) may be implemented.

REFERENCES

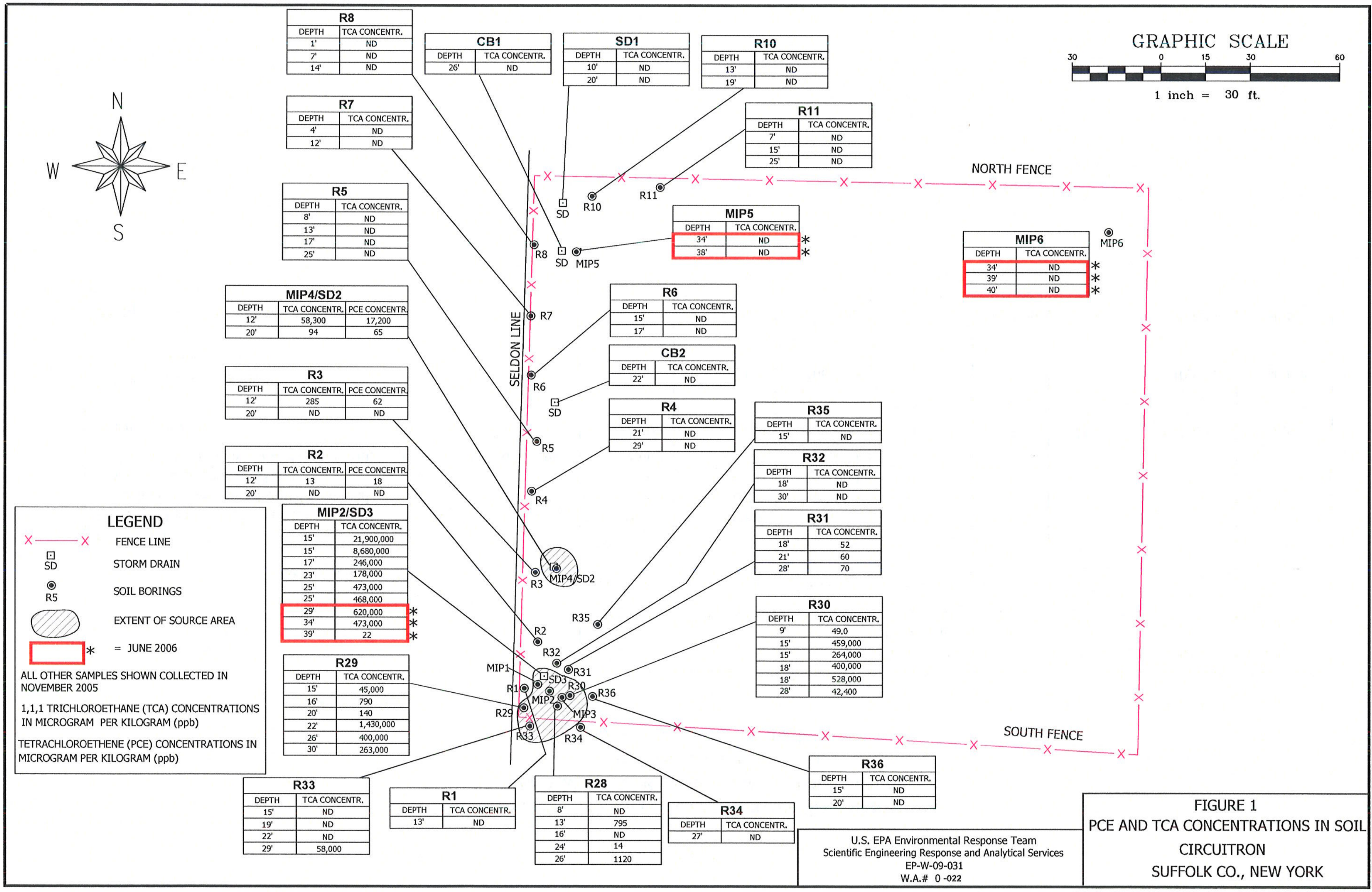
Lockheed Martin/REAC (REAC). 2006a. Investigation of a chlorinated source at the Circuitron Site, East Farmingdale, New York. Work Assignment 0-132: Trip Report. April 2006.

Lockheed Martin/REAC (REAC). 2006b. Assessment of a chlorinated hydrocarbon source and remedy evaluation of the Circuitron Site, East Farmingdale, New York. Work Assignment 0.132: Technical Memorandum. October 2006.

Table 1.

Summary of Estimated Costs of Remedial Alternatives For Addressing Residual Source Contamination In the Southwest Corner At Circuitron Site, East Farmingdale, NY

Treatment Alternative	Initial Upfront Implementation Cost ($)			Estimated Duration to Complete/ Implement	O & M Cost per year	Estimated Total Cost of Treatment Implementation		
	SD2 Only (100 cy)	SD3 Only (1,200 cy)	SD2+SD3 (1,300 cy)	# of years	$	SD2 Only $	SD3 Only $	SD2+SD3 $
Excavation								
Off-site Disposal of Contaminated Soil, @ $300/cy	30,000	360,000	390,000					
Trucking of soil, @ $1,200/18-cy load	7,200	80,400	87,600					
Backfill Material, @ $30/cy	3,000	36,000	39,000					
Labor & Equipment, @$70/cy for both areas; $80/cy for SD2 only	32,000	135,000	154,000					
Excavation Total	72,200	611,400	670,600	0.5	0	72,200	611,400	670,600
In Situ Chemical Oxidation (three applications)		240,000	260,000	1	0	-	240,000	260,000
Air Sparging + Soil Vapor Extraction		145,000	150,000	3	100,000	-	445,000	450,000



R8

DEPTH	TCA CONCENTR.
1'	ND
7'	ND
14'	ND

CB1

DEPTH	TCA CONCENTR.
26'	ND

SD1

DEPTH	TCA CONCENTR.
10'	ND
20'	ND

R10

DEPTH	TCA CONCENTR.
13'	ND
19'	ND

R11

DEPTH	TCA CONCENTR.
7'	ND
15'	ND
25'	ND

R7

DEPTH	TCA CONCENTR.
4'	ND
12'	ND

R5

DEPTH	TCA CONCENTR.
8'	ND
13'	ND
17'	ND
25'	ND

MIP5

DEPTH	TCA CONCENTR.	
34'	ND	*
38'	ND	*

MIP6

DEPTH	TCA CONCENTR.	
34'	ND	*
39'	ND	*
40'	ND	*

MIP4/SD2

DEPTH	TCA CONCENTR.	PCE CONCENTR.
12'	58,300	17,200
20'	94	65

R6

DEPTH	TCA CONCENTR.
15'	ND
17'	ND

CB2

DEPTH	TCA CONCENTR.
22'	ND

R3

DEPTH	TCA CONCENTR.	PCE CONCENTR.
12'	285	62
20'	ND	ND

R4

DEPTH	TCA CONCENTR.
21'	ND
29'	ND

R35

DEPTH	TCA CONCENTR.
15'	ND

R2

DEPTH	TCA CONCENTR.	PCE CONCENTR.
12'	13	18
20'	ND	ND

R32

DEPTH	TCA CONCENTR.
18'	ND
30'	ND

MIP2/SD3

DEPTH	TCA CONCENTR.	
15'	21,900,000	
15'	8,680,000	
17'	246,000	
23'	178,000	
25'	473,000	
25'	468,000	
29'	620,000	*
34'	473,000	*
39'	22	*

R31

DEPTH	TCA CONCENTR.
18'	52
21'	60
28'	70

R30

DEPTH	TCA CONCENTR.
9'	49.0
15'	459,000
15'	264,000
18'	400,000
18'	528,000
28'	42,400

R29

DEPTH	TCA CONCENTR.
15'	45,000
16'	790
20'	140
22'	1,430,000
26'	400,000
30'	263,000

R33

DEPTH	TCA CONCENTR.
15'	ND
19'	ND
22'	ND
29'	58,000

R1

DEPTH	TCA CONCENTR.
13'	ND

R28

DEPTH	TCA CONCENTR.
8'	ND
13'	795
16'	ND
24'	14
26'	1120

R34

DEPTH	TCA CONCENTR.
27'	ND

R36

DEPTH	TCA CONCENTR.
15'	ND
20'	ND

LEGEND

X——X FENCE LINE

⊡ SD STORM DRAIN

◉ R5 SOIL BORINGS

▨ EXTENT OF SOURCE AREA

🟥* = JUNE 2006

ALL OTHER SAMPLES SHOWN COLLECTED IN NOVEMBER 2005

1,1,1 TRICHLOROETHANE (TCA) CONCENTRATIONS IN MICROGRAM PER KILOGRAM (ppb)

TETRACHLOROETHENE (PCE) CONCENTRATIONS IN MICROGRAM PER KILOGRAM (ppb)

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0 -022

FIGURE 1
PCE AND TCA CONCENTRATIONS IN SOIL
CIRCUITRON
SUFFOLK CO., NEW YORK

SERAS01/00-022/022_TCA_SOIL.DWG
01/06/10