ECONOMIC COST ANALYSIS OF REMEDIATION ALTERNATIVES TO TREAT IMPACTED SOILS BENEATH ABOVE GROUND STORAGE TANKS

DFSP NORWALK FACILITY
15306 NORWALK BOULEVARD
NORWALK, CALIFORNIA

Prepared for

Defense Energy Support Center
8725 John J. Kingman Road
Fort Belvoir, Virginia 22060-6222

November 20, 2003

Prepared by

PARSONS
100 WEST WALNUT STREET • PASADENA • CALIFORNIA 91124

ECONOMIC COST ANALYSIS OF REMEDIATION ALTERNATIVES TO TREAT IMPACTED SOILS BENEATH ABOVE GROUND STORAGE TANKS

DFSP NORWALK FACILITY
15306 NORWALK BOULEVARD
NORWALK, CALIFORNIA

Prepared for

Defense Energy Support Center
8725 John J. Kingman Road
Fort Belvoir, Virginia 22060-6222

November 20, 2003

Approved by: [signature] 12/18/03

Cannon Silver, PE
Senior Project Engineer
Date

Submitted by: Lynette Stancy for Redwan Hassan 12/18/03

Redwan Hassan
Project Manager
Date

TABLE OF CONTENTS

APPENDICES

ABBREVIATIONS AND ACRONYMS

1,2-DCA	1,2-dichloroethane
AST	aboveground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
COC	chemical of concern
CPT	cone penetrometer
cy	cubic yard
DESC	Defense Energy Support Center
DFSP	Defense Fuel Support Point
ft	feet
HASP	health and safety plan
HW	horizontal well
IDW	investigation derived waste
JP	jet propellant
KMEP	Kinder Morgan Energy Partner
LARWQCB	Regional Water Quality Control Board, Los Angles Region
LBP	lead-based paint
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTBE	methyl tertiary-butyl ether
O&M	operation and maintenance
ppmv	parts per million by volume
PID	photo-ionization detector
ROST	rapid optical screening tool
SVE	soil vapor extraction
TF	total fluids
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

Parsons was retained by the Defense Energy Support Center (DESC) to perform an economic cost analysis of remediation alternatives to treat impacted soils below the aboveground storage tanks (ASTs) at the Defense Fuel Supply Point (DFSP) Norwalk facility located at 15306 Norwalk Boulevard, Norwalk, CA (Figure 1). The cost analysis focuses on eight tanks under which contamination was identified during previous investigations, as illustrated on Figure 2.

1.1 Site Description and Background

The DFSP Norwalk site (Site) encompasses approximately 50 acres, consisting of twelve 80,000 and 55,000-barrel AST that were used to store and distribute jet propellant (JP) numbers 5 and 8 (JP-5 and JP-8). Aviation gasoline (Avgas) and JP-4 were also reportedly stored, for a period, at the Site. Currently, the AST tanks have been emptied of fuel, cleaned, and marine chemist certified. The facility underwent decommissioning by the DESC, and at this time the facility is no longer expected to store or distribute fuel from the tanks. Jet fuel was transferred to and from the facility primarily via underground pipelines from the DFSP San Pedro facility and area refineries. Known releases of jet fuels have occurred in the bulk fuel tank area of the site. In addition, known releases of jet fuels have been documented in the truck fill stand area of the site and in an approximate 2-acre area leased by Kinder Morgan Energy Partner (KMEP), which are being addressed separately (GTI, 2002).

Since 1986, environmental assessments have been performed at the DFSP Norwalk facility (both on-site and off-site) by several consultants. These investigations evaluated and defined the extent of the liquid-phase, adsorbed-phase, and dissolved-phase hydrocarbons in soil and groundwater beneath the facility and off-site properties. The principal chemical constituents of concern (COCs) were determined to be total petroleum hydrocarbons (TPH) as gasoline, diesel, and JP-4, and JP-5; benzene, toluene, ethylbenzene, and total xylenes (BTEX); 1,2-dichloroethane (1,2-DCA); and methyl tertiary-butyl ether (MTBE) (GTI, 2001). Several of these constituents emanate from groundwater plumes from other portions of the site.

Remediation of the north-central plume is currently underway. The north-central plume remediation system consists of four soil vapor extraction (SVE) horizontal wells (HWs), 21 total fluids (TF) extraction wells, and 36 biosparging wells (GTI, 2002).

The 60-ft radius bulk fuel ASTs have been drained, cleaned, and certified by a marine chemist (GTI, 2002). The tanks are composed of painted high-grade steel with floating roofs. Currently, the floating roof rests approximately five feet above the floor. Tanks 80006, 80007, 80013, 55003, 55004, and 80017 have floors constructed with ¼-inch steel plate over 12- to 16-inches of concrete over ¼-inch steel. Tanks 80001, 80002, 80004, 80005, and 80009 are reported to have a single 1/8-inch steel plate bottom (GTI, 2002). According to site personnel, floor drains from the center of the tanks with piping to the outside were removed or plugged during the 1960s.

1.2 Site Setting

1.2.1 Regional Geology

DFSP Norwalk is located between the Montebello Forebay and the Downey Plain in the Central Basin pressure area. Approximately 50 to 60 feet (ft) of alluvium (primarily sand, gravel, silt, and clay) cover the underlying Lakewood Formation in this area. Alluvial sediments exposed in the area of the site include sand, gravel, silt, and clay. The Lakewood Formation is composed of marine and continental gravel, sand, silt, and clay deposits. The San Pedro Formation underlies the area, approximately 300 ft below grade, and consists of marine and continental gravel, sandy silt, silt, and clay deposits (California Department of Water Resources, 1961).

Lithologic logs of borings drilled during previous investigations indicate that sediments beneath the site consist of clayey silt, sandy silt, silty sand, medium to coarse-grained sand, and deeper coarse-grained sand with granitic cobbles. The top of a clay layer (preliminarily identified as the uppermost sediment layer of the Bellflower aquitard) was encountered at a depth of approximately 55 to 65 ft during previous investigations (IT, 2001).

1.2.2 Hydrogeology

A shallow, semi-perched aquifer, consisting of silts, fine to medium sands, and coarse sands, exists in the alluvial sediments underlying the site. Groundwater from this semi-perched aquifer has ranged between 22 and 31 ft below ground surface (bgs), with groundwater most recently measured between 27 and 28 ft bgs. The shallow aquifer is approximately 30 to 35 ft thick, based on the inferred presence of the clay layer at approximately 55 to 65 ft bgs. Local groundwater flow within the semi-perched aquifer is to the northwest (IT, 2001).

1.3 Economic Cost Analysis Scope

The existing horizontal SVE well system has removed an estimated 85,000 gallons of hydrocarbons at the site during approximately eight years of operation. Additional soil and soil gas sampling is needed to identify where residual soil contamination remains underneath the tanks that is not reached by the existing HWs. Identifying and removing this remaining residual soil contamination is needed prior to requesting soil closure from the LARWQCB for the bulk fuel tank farm area. As such, an economic cost estimate was prepared to identify how best to proceed with characterization and remediation of contaminated soil beneath the ASTs. Three alternatives were evaluated:

1) Tank removal, shallow soil excavation, and deep soil venting;
2) Tank access doors and soil venting; and
3) Soil venting with the tanks in place.

This report documents the economic cost analysis of these three alternatives for eight bulk fuel ASTs.

2.0 PREVIOUS INVESTIGATIONS

This section documents previous soil investigations related to the bulk fuel storage tanks.

2.1 Fuel Releases

An unknown quantity of petroleum product was released in 1968 from the slop tank adjacent to Tank 55003. In 1969, an unknown quantity of JP-4 fuel was released from Tank 55004 when fuel overflowed the weir surrounding the tank. According to site personnel, a buried pipeline located in the southeast corner of the facility ruptured in the late 1970s or early 1980s. The type and volume of released fuel has not been confirmed; however, the fuel is believed to have been gasoline (GTI, 2001).

An aerial photograph taken in 1958 showed discolored soil near Tank 80004 and in the western portion of the Tank 80008 location. Ponded liquid was present in the southwest corner of the berm surrounding Tank 80002. An aerial photograph taken in 1959 showed two areas of discolored soil in the bermed areas surrounding tanks 80002 and 80008 (Geomatrix, 1990). Aerial photographs also indicate the possible presence of a settling pond in the northeastern portion of the facility (GTI, 2001).

Based on the finding of previous investigations at the site, Tanks 80006, 80007, and 80008 are suspected to have leaked in the past and contributed to the majority of the fuel observed in the subsurface soils and groundwater associated with the north-central plume (GTI, 2002).

2.2 1999 Tank Farm Subsurface Investigation

In May 1999, GTI conducted an investigation in the tank farm area of DFSP Norwalk using a direct-push rig and a cone penetrometer (CPT) equipped with a Rapid Optical Screening Tool (ROST). Direct-push results indicated hydrocarbons above 1,000 milligrams per kilogram (mg/kg) southwest of Tank 80006, northeast of Tank 80008, and both southeast and north of Tank 55004. Measured porosity ranged from 33.2 to 49.6 percent of bulk volume. Effective permeabilities to air were measured at 160 and 2,957 millidarcies. The ROST data indicated that jet-fuel hydrocarbons were present in saturated soil below the water table (GTI, 2000).

2.3 2001 Bulk Fuel Tank Area Investigation

In February and March 2002, additional soil investigation was conducted from inside the bulk fuel tanks. Prior to sampling, DFSP Norwalk personnel marked the proposed boring locations and performed a survey for buried utilities. Manways were opened to ventilate on each tank prior to the start of work. Tanks floor coring occurred from February 13 to 15, 2002. From February 11 through March 5, 2002, hand auger sampling was conducted. Borings were advanced using 3¼-inch auger with 3 to 4 ft extensions to depth (GTI, 2002).

Soils below the AST's consisted of alternating layers of poorly graded to well-graded sands and silts from the ground surface to depth. Groundwater was encountered at depths ranging from 27.5 to 28.8 ft bgs (GTI, 2002).

Shallow soil samples from beneath the floor in tanks 80001, 80009, and 80013 showed evidence of TPH contamination being stained, emitting odors, or photo-ionization detector (PID) readings greater than 100 parts per million by volume (ppmv). Mid-depth soil samples (5 to 20 ft bgs) from tanks 80001, 80007, 80008, and 80009 showed evidence of TPH contamination. Deep soil samples (25 to 29 ft bgs) from below tanks 80001, 80008, 80013, 55003, and 55004 also showed evidence of TPH contamination. Free product was observed in a boring from Tank 80008 (AST-08-0l) at a depth of 28.6 ft bgs, and a product sheen was observed on water in a boring below AST-80013 (GTI, 2002).

3.0 GENERAL TECHNICAL APPROACH

This economic cost analysis compares the costs for three technically viable soil cleanup approaches to evaluate whether removal of the targeted tanks would be cost-effective.

The three alternatives evaluated are as follows.

1) Demolish eight tanks and their foundations, excavate/remove shallow contaminated soil, and conduct venting of deeper contaminated soil.
2) Shear cut access doors in the side of each of eight tanks, demolish the floating roof (leaving the walls and bottom intact), and install vertical soil borings and venting wells from inside the tanks.
3) Conduct soil characterization and SVE remediation from outside the tanks using angled and horizontal directional drilling techniques to reach areas under the tanks. Supplement as needed with hand-augered vertical borings installed from inside the tanks.

3.1 Remedial Action Goals

Site cleanup goals were discussed in a recent October 2, 2003, meeting with the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) (Appendix A). They consist of the following:

1) Removal of free product;
2) Dissolved-phase BTEX below maximum cleanup levels (MCLs);
3) Demonstration of stable or decreasing TPH concentrations in the dissolved plume; and
4) Meet RWQCB soil screening levels for TPH (C23-C32) of 1,000 mg/kg (LARWQCB, 1996).

The objective of this phase of work is to remediate soil sufficiently to remove the source of pollution to the groundwater. This will be achieved by meeting the RWQCB soil screening levels for TPH (C23-C32).

3.2 Strengths of the Cost Analysis

Costs are based on a realistic, achievable approach to site remediation. Where possible, direct quotes from subcontractors were obtained and used in the cost estimate. Each of the proposed alternatives use proven soil remediation technologies recommended by the United States Environmental Protection Agency (USEPA), including soil excavation, SVE, and bioventing (USEPA, 1995).

Each of the proposed alternatives also incorporates standard site investigation techniques, including soil gas sampling. Soil gas sampling is recommended in conjunction with soil matrix sampling because soil gas data are more representative in coarse-grained soil formations (DTSC & LARWQCB, 2003). Soil gas data also identifies residual volatile contamination that can be removed through soil venting.

3.3 Limitations of the Cost Analysis

This economic cost analysis provides a clear basis on which to compare the technologies. However, there are limitations on this approach.

1) This cost analysis is not a traditional feasibility study that evaluates all possible remedial alternatives, screens out those that are not feasible, and then systematically evaluates those technologies retained on the basis of technical effectiveness, implementability, and cost.

2) The cost analysis compares costs only and does not rank the options in terms of technical effectiveness and timeframe. However, a qualitative discussion is presented in Section 6.

3) The cost analysis is an estimate only based on assumptions of the scope and site findings. This cost analysis is not a proposal. A separate cost proposal will be submitted once the specific scope of work is confirmed.

4) The cost analysis includes the cost for soil characterization, remediation, and confirmation sampling at the eight tanks were soil contamination was identified. It does not evaluate whether additional soil characterization or remediation will be required at the other bulk fuel ASTs prior to receiving site closure.

5) The cost analysis focuses on the remediation tasks required for site closure, and does not include removal of berms, grading, or paving.

3.4 Cost Analysis General Assumptions

The cost analysis makes several general assumptions, including the following:

1) Soil venting is a proven remedial approach that consists of bioventing or soil vapor extraction. Bioventing can be more effective in removing heavier end petroleum contamination (e.g. diesel, motor oil) (USEPA, 1995).

2) Soil venting is generally most effective when the site surface is "capped" with a non-permeable surface. The existing tank floors act as such a non-permeable surface, preventing "short-circuiting" of soil vapor through the ground surface. Hence, alternatives that leave the tank floors in place benefit from greater efficiency by allowing venting wells and hence vapor sampling points to be placed farther apart. Based on past site studies and observations, soil venting is estimated to have a radius of influence of 30 to 50 feet.

3) The north-central plume treatment system currently provides excess SVE capacity. Also, the blower could potentially be converted into a bioventing blower. None of the alternatives includes the cost to install a new blower or to modifying the existing treatment equipment.

4) Operation and maintenance (O&M) and monitoring for any of the selected alternatives will require a similar timeframe and level of effort. To a large extent these costs may be included within current system remedial cost projections. Hence, annual O&M costs are not included in the cost comparison.

4.0 DESCRIPTION OF EACH REMEDIAL ALTERNATIVE

This section discusses each of the three remedial alternatives.

4.1 Alternative 1: Tank Removal, Soil Excavation, and Soil Venting

Remedial alternative 1 involves demolition of eight of the existing aboveground storage tanks and excavation/removal of the contaminated soil. Because of probable use of lead paint, a lead-based paint (LBP) survey will be performed first and the LBP will be scrapped, drummed, and transported for disposal. Next, the tanks will be dismantled, including the floating roofs and concrete and wood foundations. The demolition contractor will sell metal as scrap. It is assumed that the structures contain no asbestos or contamination other than LBP. Sampling will determine the actual amount of shallow soil requiring removal and deeper soil requiring remediation.

The following sampling and remediation assumptions were made:

- Obtain permission from Air Force to dismantle up to eight tanks.
- Conduct LBP assessment, reporting, and abatement.
- Demolish tanks. Conduct dust control and air monitoring. Remove concrete foundation (estimated 2 ft by 2 ft) around the tank perimeters and concrete flooring (estimated 12-inch thick). Assume half is crushed and reused on site for backfill, and the other half is transported offsite for crushing and reuse.
- Conduct soil gas survey on a 20-foot grid under each tank, with samples collected at 5 ft bgs. This accounts for approximately 30 borings under each tank. In areas where contamination is detected, install deeper borings and sample at 15 and 25 ft bgs.
- Screen soil gas from each of the vapor monitoring points using a PID meter. Vapor monitoring points with elevated PID readings will be purged and sampled for analysis by a certified mobile laboratory. It is assumed that approximately 12 samples beneath each former tank will be analyzed using a mobile laboratory.

- Analyze soil samples corresponding to elevated soil vapor for TPH using USEPA Method 8015 Modified and for volatile organic compounds (VOCs) using USEPA Method 8260B. It is assumed that 8 soil samples will be analyzed per tank.
- Excavate shallow soil with TPH concentrations exceeding 1,000 mg/kg and transport for disposal. It is assumed that approximately 25 percent of soil under each tank will require excavation to a depth of 4 ft. Actual soil removal may be deeper in certain areas and less in others. This equates to 418 cubic yards (cy) per tank, or 3,350 cy for eight tanks.
- Clean soil will be brought in as backfill and compacted.
- Install vertical SVE or bioventing wells to address deeper contamination. It is assumed that one vertical soil venting well will be installed within the footprint of each former tank, and that new piping will be required to connect the new vertical wells to the existing blower.
- Perform confirmation soil sampling after soil excavation and remedial activities are completed. Assume four borings per tank, with samples collected at 5 and 15 feet bgs.

The estimated costs for each of the above Alternative 1 tasks are listed in Table 1.

4.2 Alternative 2: Tank Access Doors and Soil Venting

Remedial alternative 2 involves cutting access doors on the side of each of eight tanks, demolishing the floating roof, and installing vertical soil borings and SVE wells within the tank walls.

The site characterization and remediation assumes the following.

- Obtain permission from Air Force to cut access doors in up to eight tanks.
- Conduct LBP assessment, reporting, and abatement.
- Shear cut access doors on each tank, approximately 12 ft wide by 20 ft high.

- Remove entire floating roof, shear cutting steel into manageable pieces and transporting to offsite high-temperature recycling facility. Conduct dust control and air monitoring.
- Core through the steel and concrete tank bottoms.
- Conduct a soil gas survey on a 30-foot grid under each tank, with samples collected at 5, 15, and 25 ft bgs. This accounts for approximately 16 borings under each tank. This grid is larger than the sampling grid for Alternative 1 because the site is capped and the radius of influence of the subsequent soil venting will be larger.
- Screen soil gas from each of the vapor monitoring points using a PID meter. Vapor monitoring points with elevated PID readings will be purged and sampled for analysis by a certified mobile laboratory. It is assumed that approximately 12 samples from each tank will be analyzed using a mobile laboratory.
- Analyze soil samples corresponding to elevated soil vapor for TPH using USEPA Method 8015 Modified and for VOCs using USEPA Method 8260B. It is assumed that 8 soil samples will be analyzed per tank.
- Measure pressure and oxygen, first with the existing remedial systems off and then with the existing HWs turned on, to confirm that contaminated vapor monitoring points are not within the reach of existing HWs.
- Install vertical soil vapor extraction or bioventing wells in areas outside the influence of the current remedial systems where soil TPH exceeds 1,000 mg/kg. It is assumed that two vertical venting wells will be installed within the footprint of each former tank, and that new piping will be required to connect the new vertical wells to the existing blower.
- Install new piping to connect the new venting wells to the existing blower located at the existing north-central plume SVE treatment system. It is assumed that the new piping may be placed on top of the tank foundations, and that trenching through the tank bottoms will not be required. It is assumed that new piping located outside the tank footprint will be buried approximately 18-inches bgs.

- Perform confirmation soil sampling after remedial activities are completed. Assume four borings per tank, with samples collected at 5 and 15 ft bgs.

The estimated costs for the above Alternative 2 tasks are listed in Table 2.

4.3 Alternative 3: Soil Venting with Tanks in Place

Remedial alternative 3 involves the installation of angled soil boring/vapor monitoring probes and horizontal venting wells from outside the existing tank structures, as well as a limited quantity of soil borings hand-drilled from inside the tanks. The need for a limited number of vertical soil borings collected from inside each AST is due to the following factors.

1) Soil sampling is technically difficult and generally not cost effective using angled or horizontal borings.
2) Angled borings can be installed at a 45 degree angle, which will only reach below the outer edges of the 60-ft radius ASTs.
3) Regulators will likely require vertical borings below the ASTs prior to granting soil closure.

The ASTs are accessible through manways. However, the size of the manways and the height of the floating roof prevents drilling rigs from entering the tank. Hence, environmental workers will need to enter the tanks under a confined-space entry permit and hand-auger the vertical soil borings. Collection of these additional shallow soil samples under the bulk fuel ASTs will likely be needed to adequately characterize the soil beneath the tanks.

Site remediation will commence with the installation of soil gas monitoring probes around each of the eight tanks with identified contamination, followed by selected hand-drilled borings from inside the tanks, as follows.

- Install up to eight vertical borings around each tank with soil samples collected and soil vapor monitoring points installed at 5, 15, and 25 ft bgs.
- Install up to eight angled borings installed at a 45 degree angle under the tanks to a depth of 20 ft bgs, thus sloping under the tank and identifying contamination beneath

the tank at a point 20 ft within from the edge of the tank. While the sharp angle makes it difficult to collect split-spoon soil samples, a single soil gas probe may be installed in each slanted boring.

- Perform additional soil sampling from within the tanks using coring and hand-augering techniques, similarly to what was done in the 2002 investigation (GTI, 2002). This sampling will allow soil characterization below portions of the tanks not sampled during the 2001 investigation. Prepare a confined entry permit to enter the ASTs. Core through the concrete/steel floor and install approximately four hand-augered samples within each tank at 5 and 15 ft bgs.
- Screen soil gas from each of the vapor monitoring points (both the vertical and angled borings) using a PID meter. Vapor monitoring points with elevated PID readings will be purged and sampled for analysis by a certified mobile laboratory. It is assumed that approximately 12 samples from each tank will be analyzed using a mobile laboratory.
- Analyze soil samples corresponding to elevated soil vapor for TPH using USEPA Method 8015 Modified and for VOCs using USEPA Method 8260B. It is assumed that 8 soil samples will be analyzed per tank.
- Measure pressure and oxygen, first with the existing remedial systems off and then with the existing HWs turned on, to confirm that contaminated vapor monitoring points are not within the reach of existing HWs.
- Install soil vapor extraction or bioventing wells in areas outside the influence of the current remedial systems where soil TPH exceeds 1,000 mg/kg. Both horizontal and slanted venting wells will be considered. If contamination appears to extend beneath the tanks, then horizontal wells will be selected. For purposes of the cost estimate, it is assumed that one 130-foot long horizontal extraction well will be placed under each tank.
- Install new piping to connect the new venting wells to the existing blower located at the existing north-central plume SVE treatment system. It is assumed that this new piping will be buried approximately 18-inches bgs.

- Perform confirmation soil sampling after remedial activities are completed. Confirmation soil sampling will be performed from within the tanks using coring and hand-augering techniques, similarly to what was done in the 2002 investigation (GTI, 2002). Assume four borings per tank, with samples collected at 5 and 15 feet bgs.

The estimated cost for the above Alternative 3 tasks are listed in Table 3.

5.0 COST ANALYSIS

This section summarizes the result of the cost analysis for the three alternatives evaluated in this document.

The estimated costs for each alternative are listed in Tables 1 through 3. The costs were based on standard prices and subcontractor quotes. The costs for each alterative include anticipated soil characterization, remediation, and confirmation needed to reach soil closure.

Table 4 compares the cost for each alternative. Alterative 2, tank access doors and soil venting, has the lowest cost of $355,000. This is just slightly lower than Alternative 3, soil venting with tanks in place, which was estimated at $366,000. Alternative 3, complete removal of the tanks, was estimated at $768,000, which is more than double the cost of the other alternatives.

6.0 OTHER CONSIDERATIONS

This section discusses other considerations not included in the capital cost comparison, but ones that can have a significant economic impact.

6.1 Timeframe

Timeframe is one consideration not included in the capital cost comparison, but one that can have a significant economic impact.

All three alternatives involve similar timeframes for soil vapor extraction or bioventing, which often require one to three years. However, there are differences in the timeframes for implementation:

- Alternative 1 requires the most extensive upfront time. Obtaining permission from the Air Force for Tank Removal and conducting the tank removal with the associated lead paint testing and abatement is time intensive. These activities would likely require 6 to 12 additional months before commencing soil remediation.
- Alternative 2 requires approximately 3 to 6 additional months upfront to conduct lead paint analysis and abatement and floating roof demolition prior to commencing the soil remediation.
- Alternative 3 does not require additional upfront time for implementation. Remedial activities could commence immediately after obtaining regulatory approval and funding. However, confined-space permitting, hand-augering, and mobilization for the horizontal well installation will add approximately 2 to 3 months to the project length during the course of the project.

In terms of remedial timeframes, either Alternative 2 or Alternative 3 is recommended as the means to most quickly proceed with cleanup of contaminated soil beneath the tanks.

6.2 Risks

Each of the remedial alternatives evaluated intends to clean up the site to meet regulatory cleanup guidelines and hence adequately protect the public and future land uses. Also, each alternative relies on proven remedial technologies. However, the alternatives present varying risks during remediation activities. This section discusses the relative risks of each of the alternatives, considering potential contaminant exposure and health and safety.

Both Alternatives 1 and 2 involve potential LBP abatement. The magnitude of the abatement, and hence the magnitude of the risk, is much smaller with Alternative 2, in which paint from only a small portion of each tank will be stripped and removed. Dust control and air monitoring will be performed during the LBP abatement activities to minimize this risk. Paint chips will be containerized for offsite disposal.

There are also risks associated with demolition of the floating roofs and tanks, including physical and chemical. Again, the risks are greater with Alternative 1, because the entire walls will be removed. Experienced contractors will be used to minimize the risk associated with the demolition, and health and safety procedures will be carefully followed.

Alternative 3 involves confined-space tank entry and working under a low ceiling. The tanks are reported to be clean of contaminants. Nonetheless, to minimize potential risks, a confined-space entry permit will be obtained, air monitoring will be performed, and personnel will be carefully monitored for heat exhaustion.

The above risks will be addressed in the site-specific health and safety plan (HASP), and specific precautions and monitoring will be taken in the field to minimize these risks.

7.0 RECOMMENDATIONS

Alternative 2, tank access and soil venting, is recommended as the approach to remediation beneath the existing bulk fuel storage tanks. This is based on the following considerations:

1) Lowest cost
2) Reasonable timeframe
3) Manageable risk to workers
4) Effective soil characterization and remediation

Alternative 2 also has another benefit. While not completely removing the AST, the removal of the floating roofs will facilitate the eventual removal of the entire tank.

Alternative 3, soil venting with the tanks in place, was only slightly more costly than Alternative 2. As with Alternative 2, Alternative 3 presents a reasonable timeframe and relatively low risks. However, the need for confined-space entry and coring in order to adequately characterize the soil beneath the ASTs make Alternative 3 less cost-effective overall.

Complete removal of the tanks, as presented in Alternative 1, is not required for soil remediation, and only adds to the cost and timeframe of the soil remediation. Shallow soil excavation would not be sufficient to clean up the deeper VOC contamination within the subsurface soils, and hence soil venting is required. Soil venting is most effective when the ground surface is not permeable, as is the case when the tank bottoms are left in place.

While Alternatives 2 is overall the most cost-effective alternative, a combination of Alternatives 2 and 3 may be the best solution, depending on the specific location of the contamination around and beneath each tank. The remedial action plan will address the selected approach for each former bulk fuel AST.

After submittal of this economic cost analysis, Parsons will proceed with the request to implement the site remediation using a combination of Alternatives 2 and 3. The work plan will be prepared, identifying specific sampling techniques and locations. The remedial action plan will propose the locations for soil venting wells and piping. After the soil remediation system is installed, the performance of the soil venting will be monitored and reported. Once the soil cleanup goals have been confirmed, soil closure will be requested.

8.0 REFERENCES

California Department of Water Resources, 1961. *Planned Utilization of the Groundwater Basins in the Los Angeles Coastal Plain: Bulletin 104.*

California Regional Water Quality Control Board—Los Angeles Region (LARWQCB), 1996. *Interim Site Assessment & Cleanup Guidebook.* May.

Department of Toxic Substances Control (DTSC) and LARWQCB, 2003. "Advisory—Active Soil Gas Investigations." January 28.

Geomatrix, 1990. *Phase II Soil and Groundwater Investigation Report of the Norwalk Pump Station,*, Norwalk, California. December 10.

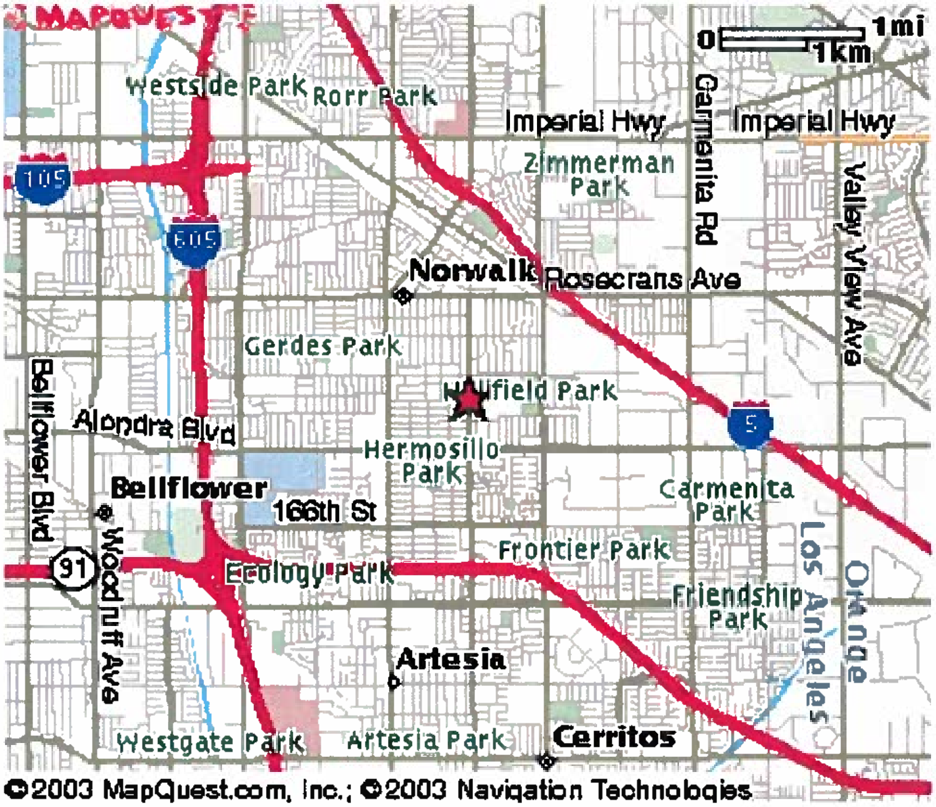
Groundwater Technology, Inc. (GTI), 2000. *Tank Farm Subsurface Investigation and Water Tank Release Area Assessment, Defense Fuel Support Point Norwalk, Norwalk, California.* May 11.

GTI, 2001. *Groundwater Sampling and Monitoring Investigation, Second Semiannual 2000 Report, Defense Fuel Support Point Norwalk.* January 12.

GTI, 2002. Si*te Assessment Report, Bulk Fuel Tank Area, February 20001, Norwalk DFSP, Norwalk, California.* April 30.

IT Corporation, 2001. *Request for "No Further Action", DFSP Norwalk, California, Oily Waste Area of Concern.* December 4.

United States Environmental Protection Agency (USEPA), 1995. *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers.* EPA 510-B-95-007. May.



k:\depts\dept48\desc\norwalk\aca-0010 norwalk proposal tank farm remediation\figures\Figure 1 Site Map.dwg

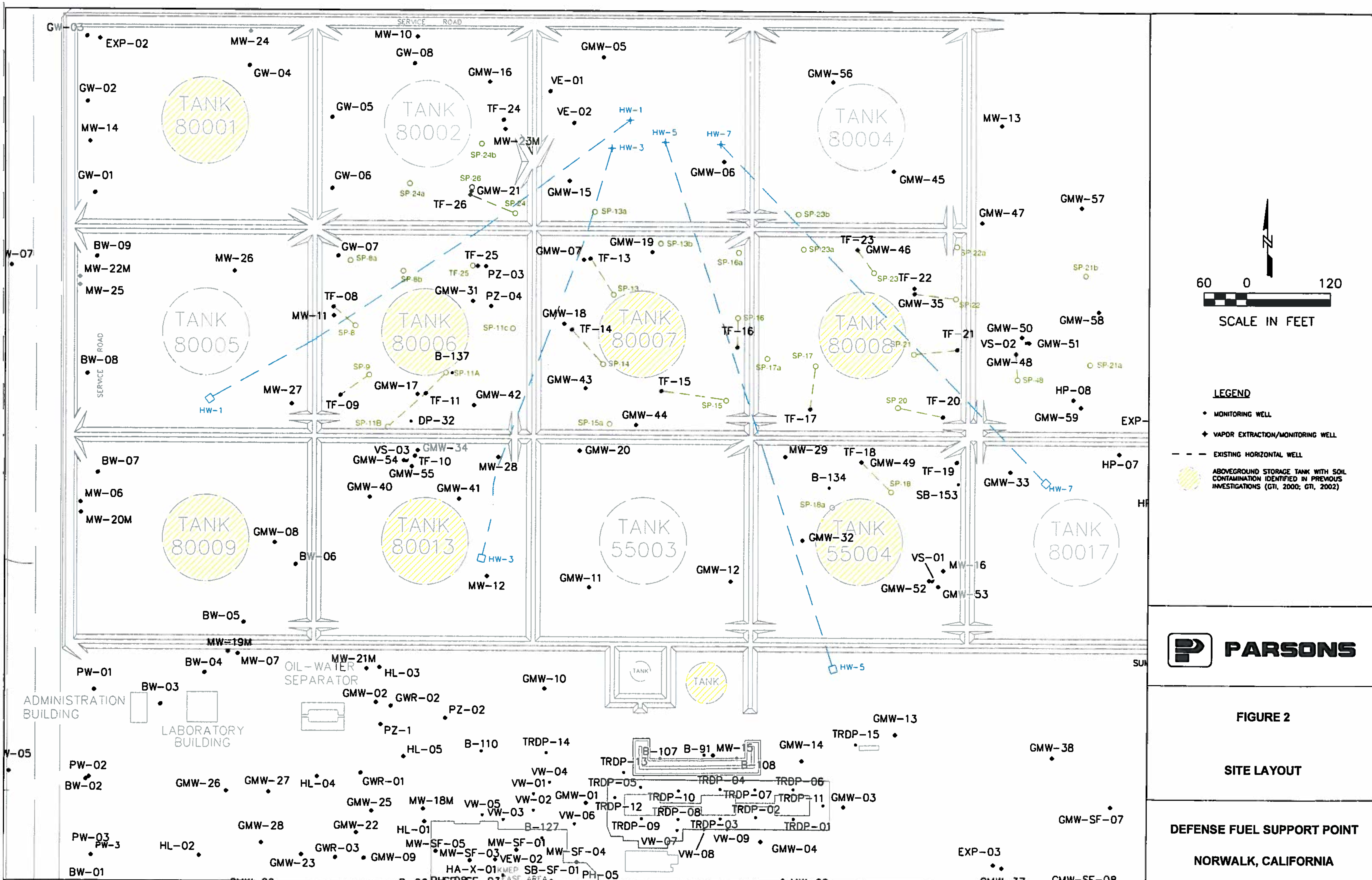
PARSONS

FIGURE 1

SITE LOCATION

DEFENSE FUEL SUPPORT POINT

NORWALK, CALIFORNIA



PARSONS

FIGURE 2

SITE LAYOUT

DEFENSE FUEL SUPPORT POINT

NORWALK, CALIFORNIA

Table 1
Cost Estimate for Alternative 1
Tank Removal, Soil Excavation, and Soil Venting
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Capital Cost				
Work Plan (LBP, sampling, HASP)[1]	lump sum			15,000
Tank Access				
Lead-based paint (LBP) sampling	lump sum			3,000
Mob/Demob	lump sum			2,500
Tank Demolition[2]	lump sum			179,000
Concrete removal/recycling	CY	1900	60	114,000
Excavation, loading	CY	3350	5.4	18,090
Soil transportation/recycling, nonhaz	tons	4700	37.1	174,370
Backfill/compaction--concrete (incl.)	tons	2350	0	0
Backfill/compaction--clean fill	tons	2350	8.35	19,623
Labor (engineer)	hour	240	48	11,520
Soil gas survey				
Subsurface Clearance	lump sum			4,196
Soil/Gas Survey Mobilization	lump sum			1,597
Soil/Gas Survey--5 ft	per 10	240	846	20,300
Soil/Gas Survey--15 ft	per 10	32	857	2,700
Soil/Gas Survey--25 ft	per 10	32	860	2,800
Analytical, mobile soil gas	day	8	1800	14,400
Analytical, soil--8015 & 8260[3]	number	64	171	10,944
O2/Explosimeter	day	8	40	320
Sampling pump	day	8	16	128
Tedlar bags	per 12	8	155	1,240
Misc.	day	8	100	800
Remedial Action Plan	lump sum			10,000
Venting Well Installation--Vertical wells	8			
Mob/Demob	lump sum			1,619
2" well to 15'	feet	240	71	17,000
Decon	day	8	150	1,200
Drums	each	12	45	540
IDW Disposal	drum	12	65	780
Misc.	day	8	100	800
Venting Pipe Installation				
Mob/Demob	lump sum			2,000
Footage--excavate, trench & backfill[4]	feet	0	8	0
Footage, HDPE	feet	1000	4.5	4,500
Pipe installation subcontractor labor	day	5	650	3,250
Pipe installation subcontractor equipmen	day	5	410	2,050
Misc. fittings, valves	lump sum	1	2250	2,250
Labor (engineer)	hour	100	48	4,800
Venting System Startup				
Labor (engineer)	hour	80	48	3,840
O2/Explosimeter	day	5	40	200
Sampling pump	day	5	16	80

Table 1
Cost Estimate for Alternative 1
Tank Removal, Soil Excavation, and Soil Venting
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Tedlar bags	per 12	5	155	775
Misc. supplies	day	5	100	500
Analytical--VOCs TO-3 & -14	number	24	150	3,600
Startup Report	lump sum			10,000
Confirmation Soil Sampling				
Soil Boring Mobilization	lump sum			1,494
Borings @ 5 ft	each	32	773	2,500
Borings @ 15 ft	feet	480	50	2,400
Decon	day	26	150	3,900
Drums	each	24	45	1,080
IDW Disposal	drum	24	65	1,560
Misc.	day	8	100	800
Analytical, soil--8015 & 8260[3]	number	48	171	8,208
Soil Closure Report	lump sum			10,000
Project Management at 10%				69,825
			Total Capital Cost	**768,000**

Assumptions:

1. Assumes lead based paint (LBP) survey will be required.
2. Includes mobilization; floating roof removal and tank wall demolition for 8 tanks; steel recycling; transport & nonhaz. disposal of debris; dust control; air monitoring; and paint chip removal/disposal
3. Analyze based on PID readings; assume EnCore sampling not required.
4. Assumes no add'l trenching/backfill is necessary

Table 2
Cost Estimate for Alternative 2
Tank Access Doors and Soil Venting
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Capital Cost				
Work Plan (LBP, sampling, HASP)[1]	lump sum			15,000
Tank Access				
Lead-based paint (LBP) sampling	lump sum			3,000
Tank Access and Roof Demolition[2]	lump sum			82,650
Labor (engineer)	hour	120	48	5,760
Soil gas survey				
Subsurface Clearance	lump sum			4,196
Core through concrete/steel floor	each	128	150	19,200
Soil/Gas Survey Mobilization	lump sum			1,597
Soil/Gas Survey--5 ft	per 10	128	846	10,800
Soil/Gas Survey--15 ft	per 10	128	857	11,000
Soil/Gas Survey--25 ft	per 10	128	860	11,000
Analytical, mobile soil gas	day	8	1800	14,400
Analytical, soil--8015 & 8260[3]	number	64	171	10,944
O2/Explosimeter	day	8	40	320
Sampling pump	day	8	16	128
Tedlar bags	per 12	8	155	1,240
Misc.	day	8	100	800
Add'l Monitoring Labor (geologist)	hour	64	34	2,176
Remedial Action Plan	lump sum			10,000
Venting Well Installation--Vertical wells	8			
Mob/Demob	lump sum			1,619
2" well to 20'	feet	320	71	23,000
Decon	day	8	150	1,200
Drums	each	16	45	720
IDW Disposal	drum	16	65	1,040
Misc.	day	8	100	800
Venting Pipe Installation				
Mob/Demob	lump sum			2,000
Footage--excavate, trench & backfill[4]	feet	1600	7.5	12,000
Footage, HDPE	feet	1600	4.5	7,000
Pipe installation subcontractor labor	day	5	650	3,250
Pipe installation subcontractor equipmen	day	5	410	2,050
Misc. fittings, valves	lump sum	1	3500	3,500
Labor (engineer)	hour	100	48	4,800
Venting System Startup				
Labor (engineer)	hour	80	48	3,840
O2/Explosimeter	day	5	40	200
Sampling pump	day	5	16	80
Tedlar bags	per 12	5	155	775
Misc. supplies	day	5	100	500
Analytical--VOCs TO-3 & -14	number	24	150	3,600
Startup Report	lump sum			10,000

Table 2
Cost Estimate for Alternative 2
Tank Access Doors and Soil Venting
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Confirmation Soil Sampling				
Core through concrete/steel floor	each	32	150	4,800
Soil Boring Mobilization	lump sum			1,494
Borings @ 5 ft	each	32	773	2,500
Borings @ 15 ft	feet	480	50	2,400
Decon	day	26	150	3,900
Drums	each	24	45	1,080
IDW Disposal	drum	24	65	1,560
Misc.	day	8	100	800
Analytical, soil--8015 & 8260[3]	number	48	171	8,208
Soil Closure Report	lump sum			10,000
Project Management at 10%				32,293
			Total Capital Cost	**355,000**

Assumptions:

1. Assumes lead based paint (LBP) survey will be required.
2. Includes mobilization; shear cutting access doors; demolition, transport & nonhazardous disposal of 8 floating roofs; dust control; air monitoring; and limited paint chip removal and disposal
3. Analyze based on PID readings; assume EnCore sampling not required.
4. Assumes can use excavated soil as backfill.

Table 3
Cost Estimate for Alternative 3
Soil Venting with Tanks in Place
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Capital Cost				
Work Plan (sampling, HSP)	lump sum			10,000
Soil gas survey, 0 and 45 degrees				
Subsurface Clearance	lump sum			4,196
Soil/Gas Survey Mobilization	lump sum			1,597
Soil/Gas Survey--5 ft	per 10	64	846	5,400
Soil/Gas Survey--15 ft	per 10	64	857	5,500
Soil/Gas Survey--25 ft	per 10	128	1100	14,100
Soil borings from inside tanks				
Confined space permit training	hour	16	48	768
Core through concrete/steel floor	each	32	150	4,800
Soil Boring Mobilization	lump sum			1,494
Borings @ 5 ft	each	32	773	2,500
Borings @ 15 ft	feet	480	50	2,400
Decon	day	8	incl.	--
Drums	each	4	45	180
IDW Disposal	drum	4	120	480
Analytical, mobile soil gas	day	8	1800	14,400
Analytical, soil--8015 & 8260[1]	number	64	171	10,944
O2/Explosimeter	day	8	40	320
Sampling pump	day	8	16	128
Tedlar bags	per 12	8	155	1,240
Misc.	day	8	100	800
Add'l Monitoring Labor (geologist)	hour	72	34	2,448
Remedial Action Plan	lump sum			10,000
Venting Well Installation--Horizontal	8			
Mob/Demob	lump sum			9,000
Installation subcontractor	well	8	16750	134,000
Decon	day		incl.	--
Bin rental	month	2	300	600
Bin transportation	lump sum	1	400	400
IDW Disposal	cy	15	112	1,680
Misc.	day	12	100	1,200
Labor (geologist)	hour	100	48	4,800
Venting Pipe Installation				
Mob/Demob	lump sum			2,000
Footage--excavate, trench & backfill[2]	feet	1600	7.5	12,000
Footage, HDPE	feet	1600	4.5	7,000
Pipe installation subcontractor labor	day	5	650	3,250
Pipe installation subcontractor equipmen	day	5	410	2,050
Misc. fittings, valves	lump sum	1	3500	3,500
Labor (engineer)	hour	100	48	4,800

Table 3
Cost Estimate for Alternative 3
Soil Venting with Tanks in Place
DFSP Norwalk Tank Farm

Task	Unit	Quantity	Unit Price ($)	Cost ($)
Venting System Startup				
Labor (engineer)	hour	80	48	3,840
O2/Explosimeter	day	5	40	200
Sampling pump	day	5	16	80
Tedlar bags	per 12	5	155	775
Misc. supplies	day	5	100	500
Analytical--VOCs TO-3 & -14	number	24	150	3,600
Startup Report	lump sum			10,000
Confirmation Soil Sampling				
Core through concrete/steel floor	each	32	150	4,800
Soil Boring Mobilization	lump sum			1,494
Borings @ 5 ft	each	32	773	2,500
Borings @ 15 ft	feet	480	50	2,400
Decon	day	26	150	3,900
Drums	each	24	45	1,080
IDW Disposal	drum	24	65	1,560
Misc.	day	8	100	800
Analytical, soil--8015 & 8260[1]	number	32	171	5,472
Soil Closure Report	lump sum			10,000
Project Management at 10%				33,298
			Total Capital Cost	**366,000**

Assumptions:

1. Analyze based on PID readings; assume EnCore sampling not required.
2. Assumes can use excavated soil as backfill.

Table 4
Summary of Alternatives Cost Analysis
DFSP Norwalk Tank Farm

Alternative	Description	Capital Cost ($)
1	Tank Removal, Soil Excavation, and Soil Venting	768,000
2	Tank Access and Soil Venting	355,000
3	Soil Venting with Tanks in Place	366,000

APPENDIX A

NOTES FROM MEETING WITH RWQCB, DFSP NORWALK, OCTOBER 2, 2003

PARSONS

Infrastructure & Technology Group, Inc.

Meeting Notes

Subject:	**Notes from meeting with RWQCB, DFSP Norwalk**		
Location:	DFSP Norwalk		
Date:	10/2/2003	Time:	10:00 AM
Project:	DFSP Norwalk Regulatory Mtgs	Facilitator:	R. Hassan, Parsons
Project No.:	743491.01000	Recorded By:	C. Silver, Parsons

Attendees Name/Company

Rebecca Chou	RWQCB LA	Joseph Trani	DESC San Pedro
Ana Townsend	RWQCB LA	Redwan Hassan	Parsons
Kola Olowu	DESC Fort Belvoir, VA	Cannon Silver	Parsons

Item	Meeting Notes	Action
1.	Redwan provided an overview of site and remedial progress in removing free product. He discussed the long-term plan of 1) immediately raising product recovery pumps to skim product in conjunction with biosparging and SVE; 2) later moving to biosparging alone; and 3) finishing with monitored natural attenuation (MNA). He also discussed the option to treat SVE vapors using vapor-phase granulated activated carbon (VGAC) rather than the thermal oxidizer.	
2.	Discussed the tank farm cost estimate. Parsons indicated that a draft report will be prepared and presented at the October RAB meeting. Ana commented that the city wants the site and prefers the tanks to be removed prior to taking ownership; Joe clarified that DESC is not funded to take down tanks. Parsons is comparing remedial effectiveness and the cost of leaving tanks in place versus removing them. Joe suggested a 3rd option be considered of cutting a hole in the side of the tanks to obtain access. Ana suggested that the sooner that soil remediation commences under the tanks and truck rack, the happier the community will be.	Complete draft cost proposal by RAB meeting, looking at 3 options. DESC and Parsons to proceed with soil remediation as soon as possible.
3.	Discussed the truck fill station and the proposal currently being prepared to remediate the soil. SVE will likely be treated using the existing system, assuming it is the most economical. Discussed recent Kinder Morgan valve leak and potential impact on truck fill station.	DESC and Parsons to proceed with proposal and soil remediation of truck fill station.
4.	Discussed the oily waste area. Ana explained that she could not recommend closure of this area because there was insufficient BTEX data. She suggested two possible approaches: 1) more soil characterization, or 2) remediation. She explained that additional soil characterization could	Ana to fax earlier oily waste data to Parsons. DESC and Parsons to conduct additional soil characterization of the oily waste area.

Item	Meeting Notes	Action
	consist of a continuous boring down to groundwater at the known center of the contaminated area, sampling for volatiles, as well as collecting a shallow metals sample. Remediation through excavation would unlikely be cost effective with contamination at 13' bgs, and hence a cap could make sense. The oil-water separator was likely installed on top of the contaminated area. Parsons explained that they do not have access to the earlier volatile data—Ana explained that she had previously received a fax from Scott (Shaw) containing this information, and would be happy to forward it to Parsons.	
5.	Redwan asked regarding cleanup goals. Rebecca responded that, typical of UST sites, 1) free product should be removed, 2) BTEX should be below MCLs, and 3) TPH concentrations should be shown to be decreasing and the TPH plume stable. She explained after receiving soil closure, and property could be developed while awaiting groundwater closure. The first goal is to remove the contaminant sources to groundwater. Equivalent TPH cleanup goals, as provided in the RWQCB LA Guidebook, are typically approximately 1,000 mg/kg.	Continue to focus current and planned remedial activities on the site cleanup goals discussed.
6.	Ana explained that 5 potential sources, including a sump, were identified in a previous report. Parsons does not have a copy of this report (2001?).	Parsons to obtain copy of potential source report and to confirm that all potential source areas have been/will be addressed.
7.	Ana expressed concern regarding the potential spreading of contamination beyond the tank farm eastern site boundary. She requested installation of two groundwater monitoring wells at the boundary.	DESC/Parsons to install two wells at the eastern site boundary, and monitor groundwater concentrations and potential offsite migration.
The meeting was concluded at approximately noon		
cc:	All participants File	