REMEDIAL ACTION ALTERNATIVES ANALYSES

Time Oil Co. Facility No. 01-056
500 George Washington Way
Richland, Washington

May 19, 2006

Prepared for:

Time Oil Co.
2737 West Commodore Way
Seattle, Washington

Prepared by:

Sound Environmental Strategies Corporation
2400 Airport Way South, Suite 200
Seattle, Washington 98134-2020

Prepared by:	*Reviewed by:*	*Reviewed by:*
James (Jim) Burgess, LG	Timothy Murphy	Ryan K. Bixby, LG #1691
Principal Geologist	Engineering Manager	Geoscience Project Manager

SOUND ENVIRONMENTAL STRATEGIES
www.soundenvironmental.com

State of Washington
1691
Licensed Geologist
Ryan K. Bixby

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EXECUTIVE SUMMARY

Sound Environmental Strategies Corporation prepared a Remedial Action Alternatives Analysis for the Time Oil Co. Facility 01-056, located at 500 George Washington Way in Richland, Washington. The purpose of this report is to present the results of an analysis of remediation technologies to address elevated concentrations of gasoline-range petroleum hydrocarbons and benzene toluene, ethylbenzene and total xylenes that persist at the site in soil and groundwater despite the implementation of the existing remediation technologies. The elevated contaminant concentrations in soil and groundwater resulted from a release at a former fueling facility that operated at the site. The highest contaminant concentrations are encountered within a submerged smear zone that is situated on and off the property.

The following technologies were evaluated and considered as possible full-scale remedial alternatives:

- Monitored Natural Attenuation;
- Dual Phase Extraction and Treatment;
- In Situ Chemical Oxidation;
- Soil Vapor Extraction with Air Sparging;
- Enhanced Bioremediation Techniques; and
- Bio-Venting.

Upon comparison with other technologies, the combination of soil vapor extraction with air sparging alternative was determined to be superior to others in effectiveness, implementability, and cost. This option has the additional advantage of having been pilot-tested and implemented on site. The existing remediation layout and compound may also be useable and may save some of the expense of future remediation.

The following report also includes suggestions intended to improve the efficiency of the current remediation system and address portions of the source area contamination as a possible interim action.

1.0 INTRODUCTION

This report documents the evaluation of remedial alternatives that address an area at the site that has not responded adequately to existing remedial efforts to date. Time Oil Co. owns the property, which is currently operating as a Jackpot Store and retail gasoline service station. The property is located at 500 George Washington Way in Richland, Washington (Figure 1). Soil and groundwater exhibits contaminant levels exceeding Model Toxics Control Act (MTCA) Method A Cleanup Levels (Cleanup Levels) both on and off property (the site).

1.1 SITE HISTORY AND DESCRIPTION

According to the Time Oil Co. Request for Proposal and records available to Sound Environmental Strategies Corporation (SES), the property was operated as a bus depot and gasoline service station prior to being purchased by Time Oil Co. in 1959. The bus depot was demolished and a Jackpot Food Mart convenience store was constructed in the central portion of the site.

Four carbon steel underground storage tanks, (USTs) were previously located beneath the southwestern portion of the site, in the vicinity of monitoring well MW-01 (Figure 2). Three of these tanks and their associated product piping and dispenser islands were removed in 1990 and replaced with the current tank system. There are no closure records for the fourth steel tank; however, this tank was believed to have been located immediately adjacent to the three that were removed. The fourth tank was searched for and not encountered during removal of the other tanks. The new dispenser complex was constructed in the same location as the original complex, and the new underground tanks are located slightly northeast of the dispenser islands. Reportedly, analytical testing of soil samples recovered during UST removal revealed that gasoline-range petroleum range hydrocarbon (GRPH) concentrations in soil exceeded the Cleanup Level.

In addition to the former vehicle fueling tanks, a 750-gallon heating oil tank is believed to have been located along the western wall of the former bus depot. It is not known whether this tank was removed during demolition of the depot.

An initial site assessment was completed in 1993. Tasks completed during the assessment activities included a soil vapor survey, installation of six groundwater monitoring/vapor extraction wells, and vapor extraction testing. Results of this assessment reportedly indicated that soils impacted by gasoline were present beneath the former UST cavity, that gasoline-impacted soils were likely present beneath the dispenser islands, and that gasoline-impacted groundwater was present beneath both the former UST and dispenser areas. The extent of affected groundwater was not delineated, and groundwater appeared to be flowing off-property to the east. Results of vapor extraction testing reportedly indicated that vapor extraction would be a suitable cleanup technology for impacted soils. Prior remedial actions are presented in detail in Section 1.3.

1.2 SITE CONDITIONS

1.2.1 Topography

The site lies at an elevation of approximately 375 feet above mean sea level. The land surface slopes to the east north-east toward the Columbia River (Lake Wallula). Land use in the immediate vicinity of the site is commercial.

1.2.2 Surface Hydrology

The Columbia River, located adjacent to the east of the site, flows in a southerly direction.

1.2.3 Geology and Groundwater Hydrology

The site is located in the Pasco Basin geologic structure, within the flat-lying sequence of basalt flows of the Miocene Columbia River Group. Several Pleistocene glaciers advanced into the northern part of the Columbia Plateau and melt-water streams from Northern Washington, along with floods caused by sudden breakage of ice-dammed lakes to the northeast of the Columbia Plateau, cut deep channels across the plateau. Geologic conditions beneath the site are characterized by glaciofluvial sediments deposited over basal bedrock of the Columbia River Group. Soil beneath the site consists of coarse gravels with some cobbles in a sandy matrix. Groundwater is encountered at a depth of approximately 11 to 33 feet below ground surface (bgs). Groundwater levels have decreased across the site approximately three feet since the initial site investigation in 1993.

1.2.4 Nature and Extent of Contamination (Site Conceptual Model)

Soil and groundwater contamination beneath the site reportedly resulted from a historical release that occurred in a former tank field in the southwest corner of the Time Oil Co. property.

No documentation of the soil conditions encountered during the UST removal activities were provided to SES. However, contaminant concentrations that exceeded the Cleanup Levels were reportedly encountered in soil samples collected from the UST excavation area. As shown on Figure 3, the results of previous investigations by others indicate that petroleum-contaminated soil (PCS) remains within a submerged smear zone. The PCS within this smear zone appears to be acting as a source of contamination to groundwater, as indicated on Figure 4. Additional PCS is likely present above the groundwater table within the former tank field, and within the downward migration pathway between the former tank field and the underlying smear zone, as illustrated in Figure 3. This combined source area contamination is the target zone for this alternatives analysis.

Significant soil contamination appears to remain in the vicinity of monitoring well MW-02, (located near the former and current pump island area). This assessment is based on the observation that sudden decreases in groundwater contamination levels were observed simultaneous with a reduction in groundwater elevations in the spring of 2003. MW-02 is not within the radius of influence (ROI) for either the existing air sparging or vapor extraction systems, as presented on Figure 4.

Dissolved groundwater contamination once extended from the Time Oil Co. property down gradient approximately 800 feet toward the Columbia River. Operation of remedial systems located on the eastern portion of the site were generally successful in reducing the area of dissolved contamination above the Cleanup Levels to the current feasibility study area. Therefore, additional containment of the contamination is not required.

Contamination in soil and groundwater consists of GRPH with benzene, toluene, ethylbenzene and total xylenes (BTEX) constituents. Dissolved total lead concentrations have also been shown to exceed groundwater Cleanup Levels within the source area.

An analysis of the existing on- and off-property remediation treatment zones indicates that a significant portion of the smear zone is not being addressed by the present remediation systems.

An area within the source area proximal to sparge wells SW-01 and SW-05 and by vapor extraction system (VES) well RW-01 currently has groundwater concentrations below Cleanup Levels. The lack of dissolved hydrocarbon in the samples collected from the sparge wells can be explained by the well screens positioned below the smear zones, approximately 15 feet below the saturated level. However the absence of contamination above Cleanup Levels in groundwater samples collected from RW-01 indicates that the sparging wells may have indeed remediated the smear zone in that area.

1.3 FORMER AND CURRENT REMEDIAL ACTIVITIES

A hydrocarbon assessment was conducted between February and April 1995 in an attempt to define the full extent of the groundwater impact and perform remedial testing for the design of a groundwater remediation system. Six groundwater monitoring wells (MW-06 through MW-11), one groundwater/soil vapor recovery well (RW-01), and one air sparging well (SW-01) were installed and tested during the assessment. Results of the assessment defined the cross-gradient extent of impacted groundwater in the vicinity of monitoring wells MW-06 and MW-08. The upgradient and downgradient extent of impacted groundwater remained undefined as evidenced by groundwater contaminant concentrations exceeding Cleanup Levels in wells MW-10 and MW-11.

The presence of a widespread horizon of hydrocarbon impacted soils located approximately 5 to 10 feet below the current groundwater surface was first documented during the April 1995 assessment. The presence of this submerged horizon of affected soil may indicate that a large release occurred prior to the completion of McNary Dam in 1953 and the subsequent rise in elevation of the Columbia River behind the dam. Remedial testing conducted in the vicinity of wells MW-04, RW-01, and SW-01 in the course of the April 1995 assessment suggested that operation of a combination air sparging/vapor extraction system could result in the recovery of significant amounts of petroleum hydrocarbons from the subsurface. The radii of influence of the vapor extraction and air sparging systems were observed to be approximately 40 and 24 feet, respectively, during remedial testing.

A supplemental site assessment was conducted in November 1995 in an effort to more fully define the full extent of the petroleum hydrocarbon impact at the site. In addition to site assessment activities, the subsurface components of a remediation system were installed as a portion of the November 1995 site assessment project. During the combined project, fourteen groundwater monitoring wells (MW-12 through MW-22), four vapor extraction wells (VE-02 through VE-05), and five sparging wells (SW-02 through SW-06) were installed. All vapor extraction wells and sparging wells were manifolded to a treatment area with subsurface piping.

Two additional groundwater monitoring wells (MW-23 and MW-24) were installed in January 1996 and design details for a vapor extraction and air sparging remediation system were developed and finalized between February and July 1996. The above ground treatment system components were installed in September 1996 and the remediation system commenced full-time operation on October 1, 1996.

The remedial system at the site consists of three subsystems which operate in different areas of the site. The Subject Property Remedial System (SPRS) is located at the eastern boundary of the Time Oil Co. property. The West Park Remedial System (WPRS) is located between the Time Oil Co. property and the western edge of the adjacent community center parking lot. The East Park Remedial System (EPRS-2) is located near the southeastern corner of the newly constructed Richland Community Center.

Each remedial system includes a line of groundwater air sparging wells installed perpendicular to the axis of the groundwater plume. Vapor extraction wells are included in the SPRS system to capture hydrocarbon vapors produced by air sparging activities.

The SPRS commenced operation in October 1996. The SPRS operated as an extended pilot test for the first six months of operation. A programmable controller was used during the extended pilot test to automatically alternate between three combinations of two vapor extraction and two air sparging wells every eight hours. The SPRS was reconfigured at the conclusion of the extended pilot test to operate all vapor extraction and air sparging wells on a continuous basis. Following a decade of remedial operations, groundwater within the source area still contains contamination above groundwater Cleanup Levels.

The results of pilot testing conducted in at least three areas of the site suggested that combined VES and AS is a good remedial technology for the site conditions. The radius of influence for VES ranged to approximately 40 feet; the AS radius of influence was determined to be 20 to 40 feet. A ROI of 24 feet was apparently used for design criteria (27 CFM at 10 PSI).

On March 23, 2006, SES conducted a ROI test for the VES remediation system connected to well VW-05. The test indicated that with the present configuration, the effective ROI was less than 19 feet. When the VES blower vacuum was increased to 20 inches of water, the ROI increased to greater than 34 feet but less than 55 feet, which generally corresponds with the former pilot study results.

1.4 CURRENT AND FUTURE LAND USE

1.4.1 Land Use

The site is currently zoned commercial. No short-term changes to site use are anticipated. Site improvements include a Jackpot Store, an existing remediation system, a new UST tank field, and fuel-dispensing pump islands.

1.4.2 Groundwater Use

Currently, the site and surrounding community are provided water by the City of Richland.

2.0 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) form the basis for evaluating the areas requiring remediation and the appropriate remedial action for these areas. They are also useful in identifying remedial technologies capable of eliminating, reducing, or controlling a particular exposure pathway, and form the basis for evaluating the need for long-term monitoring.

The overall remedial objective is to reduce the concentrations of chemicals of concern (COCs) in soil, vapors and groundwater located beneath the western portion of the site to below the Cleanup Levels. In particular, the remedial efforts will address the submerged smear zone, the unsaturated soil and soil vapors within and beneath the former tank field, and the plume of contaminated groundwater extending down-gradient from the former tank field to the eastern boundary of the Time Oil Co.-owned property.

The Cleanup Levels for COCs in soil and groundwater beneath the site are listed in Table 2-1 below:

Table 2-1
Chemicals of Concern Cleanup Levels

COC	Groundwater Cleanup Level (µg/L)	Soil Cleanup Level (mg/kg)
GRPH	1,000 (800 when benzene is present)	100
DRPH	500	2,000
Benzene	5	0.030
Toluene	1,000	7
Ethylbenzene	700	6
Total Xylenes	1,000	9
Total Lead	15	250

3.0 REMEDIAL TECHNOLOGY SCREENING

3.1 POTENTIALLY APPLICABLE TECHNOLOGIES

The following technologies have been identified as potentially applicable for remediation of petroleum-contaminated vapor, soil, and groundwater at the site:

Monitored Natural Attenuation;
Excavation with Off-Site Treatment / Disposal;
Dual Phase (groundwater and soil vapor) Extraction and Treatment;
In situ Chemical Oxidation;
Soil Vapor Extraction in combination with Air Sparging;
Enhanced Groundwater Bioremediation Technologies;
Bioventing; and,
Dewatering (Pump and Treat).

3.2 TECHNOLOGY DESCRIPTIONS

3.2.1 Monitored Natural Attenuation

Monitored natural attenuation (MNA) depends on intrinsic environmental factors to reduce contaminant concentrations over time, through such processes as biodegradation, adsorption, and dispersion.

Monitored natural attenuation is often the default technology for that portion of a site that cannot be cost-effectively remediated by active means. It is also used as a polishing technology after an active technology has reduced contaminant concentrations but is unable to achieve Cleanup Levels. Monitoring is required to evaluate the effectiveness of natural attenuation and to document the achievement of Cleanup Levels.

3.2.2 Excavation with Off-Site Treatment/Disposal

Excavation and off-property treatment/disposal involves the physical removal of contaminated media beneath the site via excavation of soil along with pumping of groundwater. This method is most commonly used when the contamination is relatively limited in extent and located near the ground surface. It is also utilized when the remediation efforts must be completed within a limited timeframe.

3.2.3 Dual Phase (Soil Vapor and Groundwater) Extraction and Treatment

Dual-phase extraction (DPE), also known as bioslurping, involves recovering both contaminated soil vapor and groundwater for aboveground treatment. This technology is effective by recovering the volatile compounds in both the vapor and aqueous phases and providing oxygen to the subsurface to enhance further *in situ* biological degradation of the compounds that were not recovered by physical removal. High vacuum pressure is applied in a DPE well to recover both vapor and groundwater simultaneously. Both media are recovered and treated separately in aboveground treatment units.

3.2.4 *In situ* Chemical Oxidation

In situ chemical oxidation (ISCO) involves injecting chemicals into the subsurface to oxidize contaminants. The oxidants most commonly used are potassium permanganate, ozone, and hydrogen peroxide. Fenton's Reagent, an aggressive form of chemical oxidant comprised of an aqueous solution of concentrated hydrogen peroxide and ferrous iron could be injected into subsurface soil and groundwater. Source area chemical oxidation can be completed in a relatively short timeframe using Fenton's Reagent. As with other in-situ treatment technologies, however, it is generally unable to achieve 100 percent removal/destruction of contaminant mass. The residual mass of soil contamination frequently requires additional injection events. Hydrogen peroxide injection has been implemented repeatedly at the site source area; however a ferrous catalyst has not been included in the previously injected solutions.

3.2.5 Soil Vapor Extraction with Air Sparging

Soil vapor extraction and air sparging are proven technologies for recovering volatile petroleum hydrocarbons from unsaturated and saturated soils, respectively. These technologies are being used together at the site and have shown limited effectiveness; however, SVE could be expanded by installing vertical or horizontal wells within the zone of contamination. Air sparging could also be expanded to appropriately affect the entire source area smear zone.

3.2.6 Enhanced Bioremediation Technologies

Bioremediation of residual concentrations of petroleum hydrocarbons in the saturated zone is most effective and sustainable under aerobic (i.e., elevated dissolved oxygen) conditions. The rate and effectiveness of intrinsic aerobic bioremediation of COCs are controlled and generally limited by the lack of sufficient dissolved oxygen (DO) available to native microbes.

Increasing the availability and concentration of DO in the impacted groundwater by artificial methods enhances the subsurface conditions to promote natural degradation of COCs. Several proven methods exist to increase the DO concentration in the saturated zone, including injection of chemical reactants that produce elemental oxygen (hydrogen or magnesium peroxide), or sparging oxygen gas or compressed air (via in situ oxygen curtain [ISOC] technology) directly into the water-bearing zone. The increased DO concentration resulting from these enhancements produces an increased and sustained rate of natural degradation of the dissolved COCs.

3.2.7 Bioventing

Bioventing is an *in situ* remediation technology that uses microorganisms to biodegrade organic constituents in soils in the unsaturated zone. The process is similar to SVE but bioventing typically promotes biodegradation and minimizes volatilization utilizing lower flow rates that SVE. Generally, a nutrient tank is connected to an infiltration gallery that wets and delivers nutrients and bio-enhancers across the affected soil area while a vacuum blower is configured to pull air through the treatment zone.

3.2.8 Dewatering (Pump and Treat)

This technology involves removing dissolved contaminants in groundwater by pumping. The recovered groundwater is either treated on property or stored on property for eventual off-property transportation and disposal. Pump and treat is similar to DPE except that contaminated soil vapor is not recovered; therefore it is generally less effective than DPE. This technology is partially effective for the recovery of aqueous (dissolved) phase hydrocarbons, but is prone to result in rebounding concentrations of contaminants in groundwater due to inherent mass transfer limitations from smear zone soil to groundwater.

3.3 TECHNOLOGY SCREENING RESULTS

The results of the remedial technology screening, in terms of overall effectiveness on the site-specific COCs, relative cost, and relative implementability, are summarized on Table 3-1 (Table 3-1 is located at the end of this report). The effectiveness evaluation focuses on the ability of the technology to remove and/or destroy the COCs in the environment. Implementability is a measure of whether the technology is practical at the site based on subsurface conditions, site operations, system construction, and potential regulatory constraints. Cost is ranked as high, medium or low, primarily to allow comparison between technologies with similar effectiveness and implementability. Based on this information, the following technologies were retained for more detailed evaluation as part of the full-scale remedial alternative evaluation:

Monitored Natural Attenuation;

Dual Phase Extraction and Treatment;

In situ Chemical Oxidation;

Soil Vapor Extraction with Air Sparging;

Enhanced Bioremediation Techniques; and

Bioventing.

The Excavation with Off-Site Treatment/Disposal approach was eliminated from consideration due to the relative inaccessibility of the submerged smear zone. In addition to the high cost and logistical difficulties associated with excavating to a depth of more than 30 feet bgs, the highly transmissive gravelly material beneath the site would be extremely difficult to dewater. Furthermore, the dewatering remedial approach commonly results in rebounding concentrations of COCs due to inherent mass transfer limitations from smear zone to groundwater and was deemed impractical for application at the site.

4.0 REMEDIAL ALTERNATIVE SELECTION

The purpose of the alternatives analysis is to identify a technology or combination of technologies that are feasible to implement, effective in achieving the RAOs, and reasonable from a cost perspective. The screening of technologies, documented in Section 3.3 and summarized in Table 3-1, identify the short list of potential remedial action technologies that meet these criteria. This section describes how retained technologies would be implemented alone or in combination with other technologies as remedial action alternatives to achieve the overall RAO and component objectives restated below:

Overall Remedial Objective: Reduction of COC concentrations in soil, vapor, and groundwater beneath the western portion of the site to below Cleanup Levels.

Component Objectives: To achieve the overall objective, the following areas for remediation are identified: 1) the submerged smear zone, 2) the soil within the former tank field and along the pathway below the tankfield to the groundwater below, and 3) the groundwater plume in the vicinity of the smear zone.

4.1 AFFECTED MEDIA ALTERNATIVES

Soil and groundwater contamination require remediation in the source area. *In situ* treatment technologies are the only ones considered feasible. This section presents alternatives to address this contamination.

4.1.1 Monitored Natural Attenuation

MNA is not considered a viable alternative to bring conditions at the site to the RAOs, but may be used as a polishing technology after an active technology has reduced contaminant concentrations to the extent practical. Monitoring is required to evaluate the effectiveness of natural attenuation and to document the achievement of Cleanup Levels. MNA is an important complementary technology for each alternative described below. Following implementation of a remedial action technology, periodic monitoring will be performed to verify that natural attenuation processes are effective at preventing rebounding concentrations and whether Cleanup Levels are permanently achieved. If monitoring indicates that natural attenuation is not effective at maintaining COC concentrations below Cleanup Levels, then additional remedial action would be necessary to achieve the RAOs.

4.1.2 Dual Phase Extraction

DPE of the soil vapors and groundwater in the source area could be implemented by installing dual phase extraction wells screened in the smear zone and applying a vacuum to recover the water and contaminated soil vapor. Treatment effectiveness would be determined by collecting soil samples before and after remediation efforts and comparing concentrations to Cleanup Levels for that medium.

4.1.3 *In situ* Chemical Oxidation

This alternative consists of using direct-push methods to install several well points in a grid pattern in the area of soil contamination. Potable water would be injected in the well points to saturate the treatment area before injecting a hydrogen peroxide or Fenton's Reagent solution to oxidize the contaminants. A minimum of two injection events would be conducted. Treatment effectiveness would be evaluated following the second injection event by collecting soil samples in a grid pattern between the injection points. Alternately, a continuous ozone injection system could be installed.

4.1.4 Air Sparging with Soil Vapor Extraction

SVE with AS has been pilot tested and implemented at the site. The combined technology has been successful in remediating down-gradient portions of the plume and the dissolved COC analytical trends within the source area indicate that there has been limited localized success with source area remediation. A review of the data indicates that the ROI for the AS wells is insufficient for source area remediation using the present configuration.

SVE technology can be expanded by installing vertical or horizontal wells within the zone of contamination. Vacuum pressure can be applied to recover contaminants in the vapor phase for subsequent treatment and disposal. Air sparging can also be expanded to affect the entire source area smear zone.

4.1.5 Enhanced Bioremediation Techniques

As indicated in Section 4.1.4 above, AS has been pilot tested and implemented at the site and review of the data indicates that the ROI for the AS wells is insufficient for source area remediation using the present configuration. AS could also be expanded to cover the source area smear zone and the addition of biological enhancements may prove beneficial in remediating the submerged smear zone within the source area. Used in combination with Bioventing (4.1.6 below) the entire submerged smear zone and vadose-zone adsorbed phase COCs may be remediated to attain site RAOs.

4.1.6 Bioventing

Bioventing has been demonstrated to remediate vadose-zone adsorbed-phase organic COCs, but is generally not used for groundwater or submerged smear zone remediation by itself. Used in conjunction with DPE, SVE with AS, or enhanced groundwater bioremediation, the resulting combined remedial approach could be appropriate for addressing and bringing the site affected media to the RAOs.

4.2 RECOMMENDED ALTERNATIVE

Prior to expanding the present system or implementing a new remediation technology at the site, an interim action could be conducted to enhance the present remediation system and increase its effectiveness. Air sparging through the smear zone is the only remedial technology that has been demonstrated to be effective at remediating portions of the submerged source area. Optimizing the operation of the present remediation system could greatly increase it's capability to effectively remediate portions of the source area, but most of the source area is situated beyond the radius of influence of the present configuration.

Suggested operational changes to the existing remediation system include increasing the air flow to sparge wells SW-01 and SW-05 by turning off the air flow to the other ineffective sparge wells connected to the same sparge air blower or increasing the blower capacity. Monitoring well MW-01 should be re-connected to the SVE system, and existing SVE wells that provide marginal mass recovery be closed for purposes of controlling and directing any VOC emissions from the AS system.

A variety of viable technologies were evaluated and several could potentially achieve the RAOs. The remedial technologies were screened for probable effectiveness with COCs in site media, general implementability, and relative costs (Table3-1) to identify the most appropriate remedial approach.

Following review of the available resources, the SVE with AS combination approach is considered the most likely to achieve the RAOs in soil, soil vapor and groundwater while being highly implementable and relatively inexpensive. The SVE with AS combination technology option has the additional advantage of having been pilot-tested and implemented on site. An existing remediation layout and compound may also be useable and may save some of the expense of future remediation.

To implement the selected technology, SES recommends re-conducting ROI testing for the AS system by testing for DO in offset wells rather than checking for pressure increases at the offset well heads. This will more properly show the distance air travels through the saturated smear zone as opposed to how far it travels through the unsaturated zone. Following ROI testing, install and operate a system of AS wells located on a grid-spacing that addresses the entire submerged smear zone area.

SES also recommends that interim remediation soil and groundwater sampling be conducted in the areas adjacent to MW-01 and MW-02 to evaluate present concentration levels for these media. Borings advanced in these areas should be completed as SVE wells or AS wells.

5.0 LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. SES is not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services and does not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

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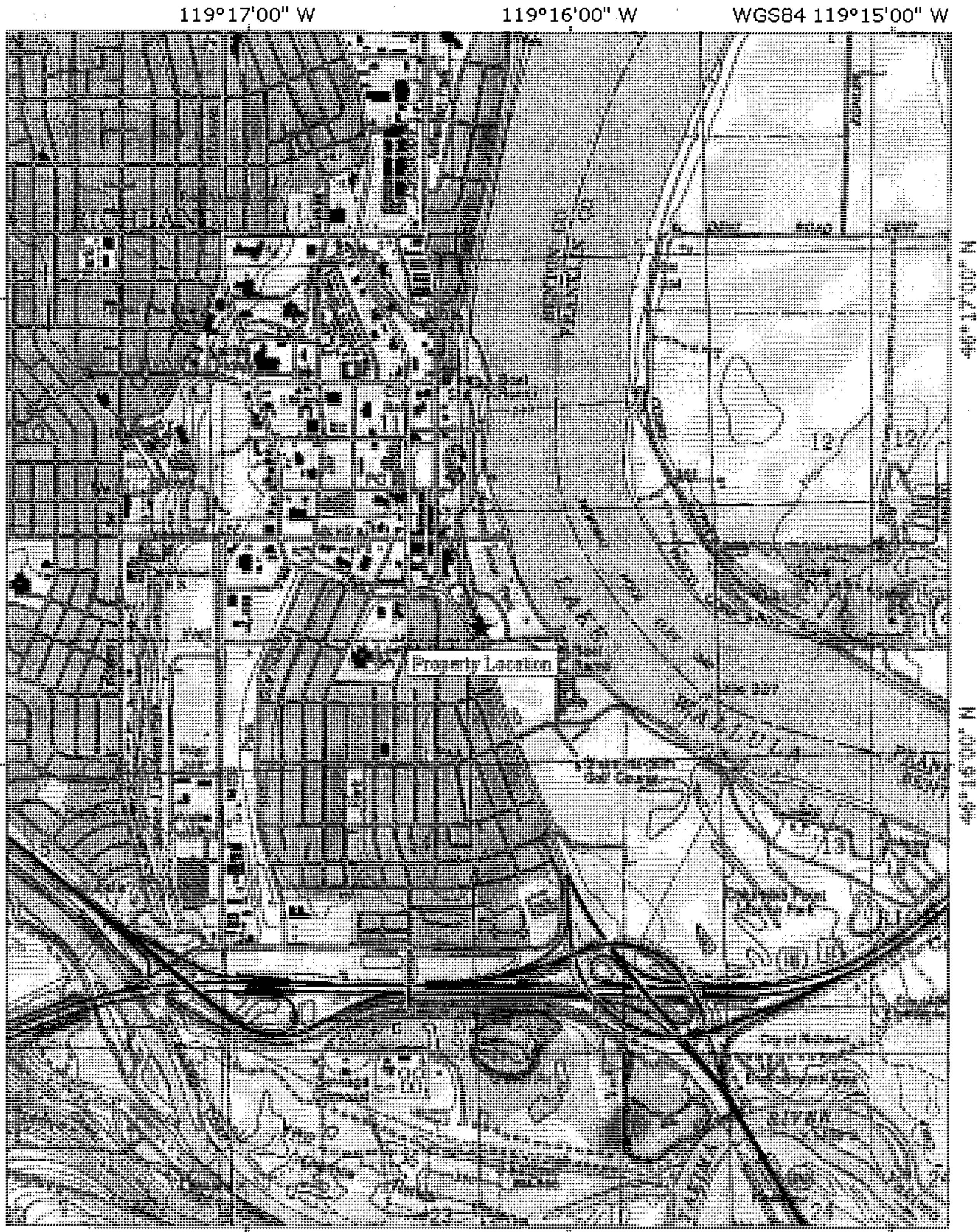

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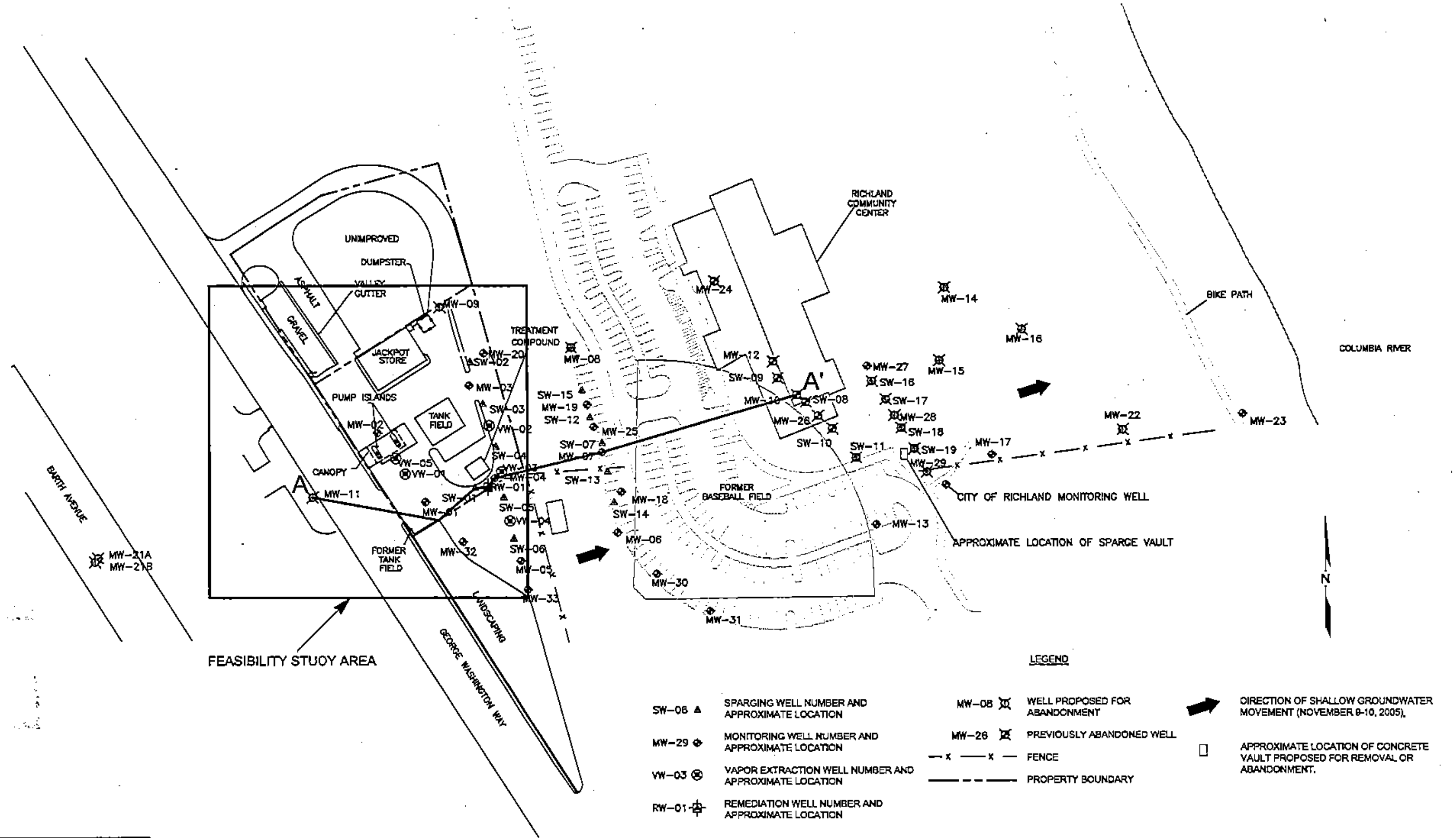
SOUND ENVIRONMENTAL STRATEGIES www.soundenvironmental.com	N	Date: May 9, 2006 Drawn By: D. Richardson Chk By: R. Bixby SES Project No.: 0440-012-01 File ID: 01-056 Fig 1.doc	Time Oil Co. Facility #01-056 500 George Washington Way Richland, Washington	**FIGURE 1** Property Location Map



SOUND ENVIRONMENTAL STRATEGIES
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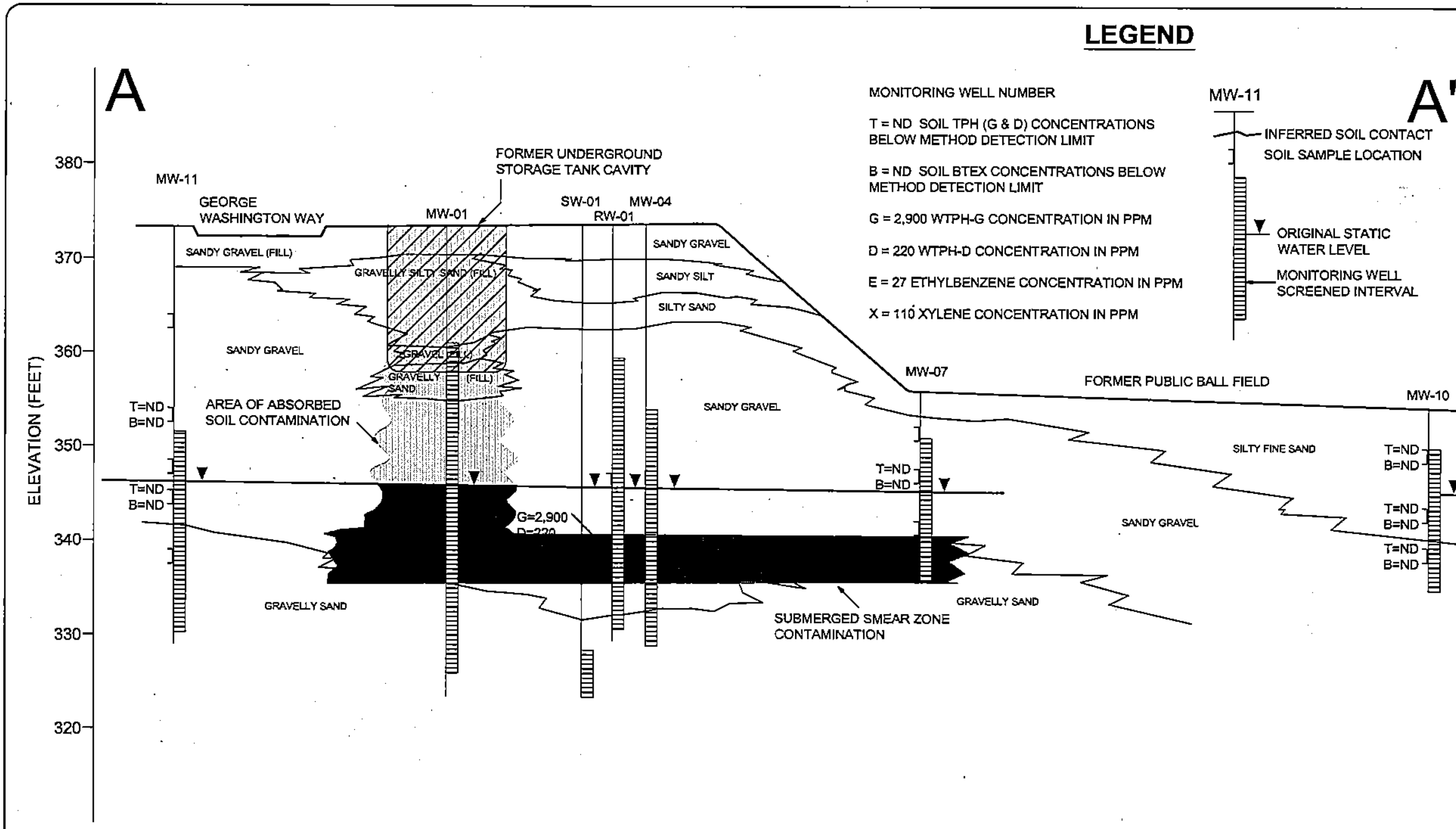
DATE: 04/18/06
DRAWN BY: HCL
CHK BY: JGB
CAD FILE: 01-056 FIG 2 SP

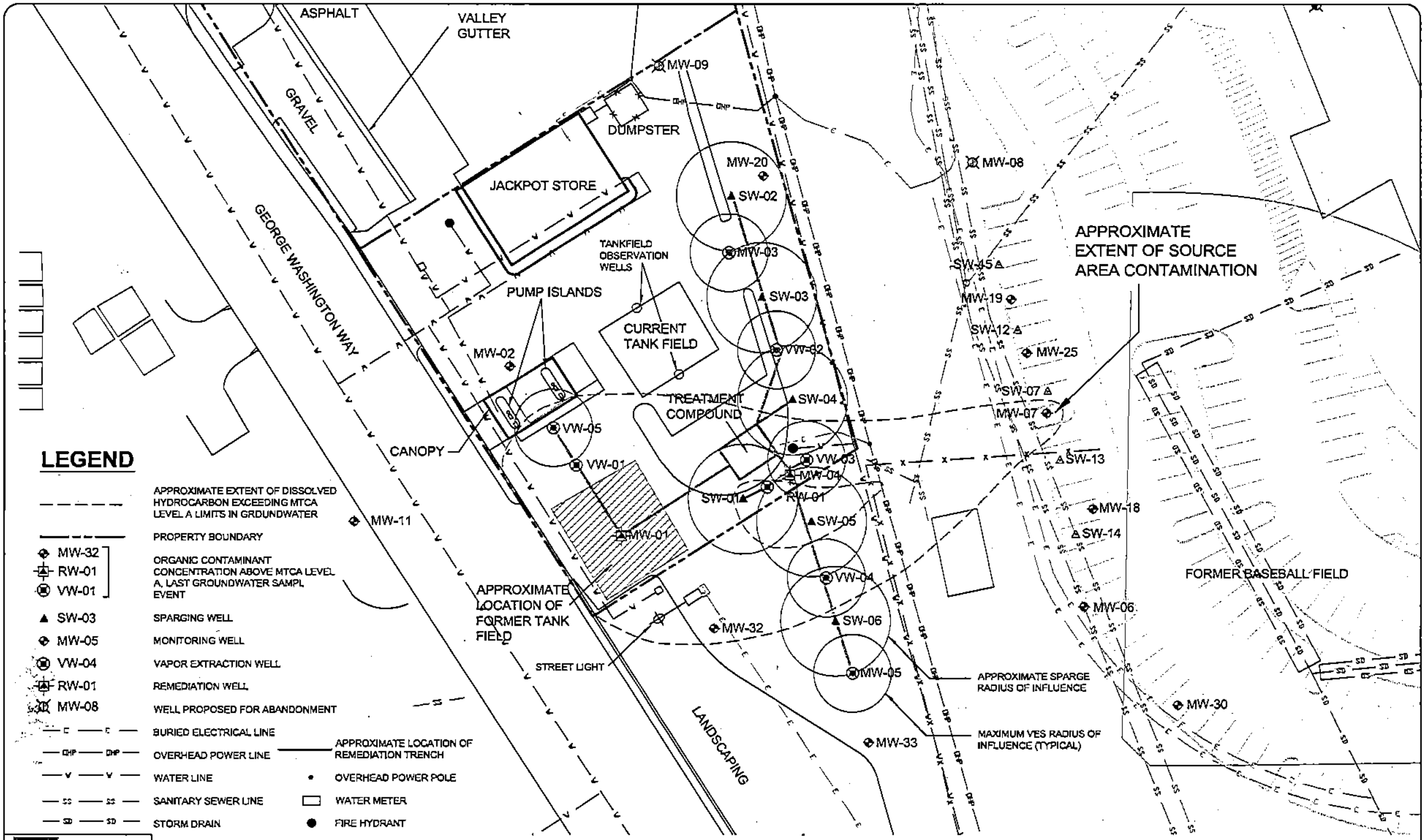
PROJECT NAME: TIME OIL CO. FACILITY #01-056
LOCATION: 500 GEORGE WASHINGTON WAY RICHLAND, WASHINGTON
SES PROJECT NUMBER: 0440-012-02

FIGURE 2
SITE PLAN



REFERENCE: FIGURE 4, AGRA EARTHLAND ENVIRONMENTAL, JUNE 1995

SOUND ENVIRONMENTAL STRATEGIES www.soundenvironmental.com	DATE: 04/18/06 DRAWN BY: HCL CHK BY: JGB CAD FILE: 01-056 FIG 3	PROJECT NAME: LOCATION: SES PROJECT NUMBER:	TIME OIL CO. FACILITY #01-056 500 GEORGE WASHINGTON WAY RICHLAND, WASHINGTON 0440-012-01	40 20 0 40 APPROXIMATE SCALE IN FEET	FIGURE 3 GENERALIZED EAST-WEST GEOLOGIC CROSS-SECTION A-A'



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DATE: 04/18/06
DRAWN BY: HCL
CHK BY: JGB
CAD FILE: 01-056 FIG 4 PR

PROJECT NAME: TIME OIL CO. FACILITY #01-056
LOCATION: 500 GEORGE WASHINGTON WAY, RICHLAND, WASHINGTON
SES PROJECT NUMBER: 0440-012-02

40 20 0 40
SCALE IN FEET

FIGURE 4
REMEDIAL SYSTEM CONFIGURATION AND SOURCE AREA MAP

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Table 3-1
Remedial Technology Screening Summary
Time Oil Co. Facility No. 01-056
500 George Washington Way, Richland, Washington
SES Project No. 0440-012-02

Remedial Technology	Effectiveness for Soil Vapor	Soil	Groundwater	Implementability	Cost	Screening Result
Monitored Natural Attenuation [1]	Medium	Medium	Medium	High	Low	Retained as a secondary or tertiary technology.
Excavation with Off-Site Treatment/Disposal	High	High	Low[2]	Low	High	Not retained based on implementability and cost.
Dual Phase Extraction and Treatment	High	Medium	High	High	Medium	Retained as an onsite source and onsite and offsite affected media control technology.
In Situ Chemical Oxidation	Medium	Medium	High	Medium	Medium	Retained as soil and groundwater treatment technology.
Soil Vapor Extraction with Air Sparging	High	High	High	High	Medium	Retained as soil and groundwater treatment technology.
Enhanced Groundwater Bioremediation Technologies [3]	Low	Low	High	High	Medium	Retained as groundwater treatment technology.
Bioventing	High	High	Low	High	Medium	Retained as soil treatment technology.
Dewatering (Pump and Treat)	Low	Low	Medium	High	Medium	Not retained; DPE more effective.

Notes:

[1]Monitored natural attenuation is a slow process, but can be effective over time if groundwater concentrations are reduced to low levels and unacceptable exposures are prevented (e.g. through institutional and engineered controls).

[2]Excavation is generally not applicable to groundwater remediation; and complete source removal/control is necessary to effectively initiate and expedite groundwater treatment.

[3]Bioremediation techniques are effective at relatively lower soil/groundwater concentrations; rate of treatment increases with increased treatment costs (i.e., increased enhancement by oxygenation and nutrient addition).