REMEDIAL ALTERNATIVES REPORT

115 FRONT STREET PROPERTY
VILLAGE OF GREENPORT,
NEW YORK

PREPARED IN CONJUNCTION WITH THE INCORPORATED
VILLAGE OF GREENPORT AND THE
NYSDEC ENVIRONMENTAL RESTORATION PROJECTS
(BROWNSFIELD PROGRAM)

PROJECT NO. GRPT98-01

JANUARY 2000

REMEDIAL ALTERNATIVES REPORT
for
115 FRONT STREET
GREENPORT, NEW YORK

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

FIGURES

TABLES

Appendices

Remedial Alternatives Report

for

115 Front Street Property

Village of Greenport, New York

January 2000

1.0 INTRODUCTION

Holzmacher, McLendon & Murrell, P.C. (H2M) was contracted by the Incorporated Village of Greenport (the Village) to prepare a Remedial Alternatives (RA) report for the property located at 115 Front Street (Mitchell's Property) in Greenport, New York. The RA report was prepared based on the findings from the Site Investigation (SI) also performed by H2M (July 1999). The work was conducted under the New York State Department of Environmental Conservation (NYSDEC) 1996 Clean Water/Clean Air Act's Environmental Restoration Projects Brownfields Program (Technical and Administrative Guidance Memorandum Number 4058).

1.1 Purpose and Organization of Report

The objective of the RA report is to develop, screen and evaluate appropriate actions which will achieve the remedial objectives established for the site. Based on the nature and extent of contamination at the 115 Front Street site (Mitchell's Property), remedial action objectives determined to be appropriate for the site are: to minimize the potential for direct contact exposure, to remediate the source area to the extent practical, and to implement strategies for groundwater protection. The RA will evaluate methods to prevent, minimize, or eliminate the release of hazardous substances from the site and to minimize the risk to human health and the environment. This RA process is consistent with NYSDEC's Brownfield Guidance Memo (TAGM 4058 - Environmental Restoration Projects (Brownfields)).

1.2 Background information

1.2.1 Site Description

The subject property, also known as Mitchell's property is located at 115 Front Street in Greenport, New York (see Figure 1.1). The property's tax map number is 1001-005-00-04-00-040-001, and encompasses approximately 3.19 acres (139,168 square feet). Currently, the majority of the site is being utilized by the Village as a public park. The southeast corner of the site is utilized for parking. As shown in Figure 1.2, the site has little topographic relief. The northern property line abuts onto Front Street while the southern property line is characterized by bulkheading and piers constructed into Greenport Harbor.

1.2.2 Site History

The 115 Front Street property was acquired by the Village on September 5, 1996. Prior to this date, the property was known as Mohring's Marina and was also the location of Kokomos Restaurant. Reportedly, there were three to five underground storage tanks (USTs) which were used to store gasoline fuel for the boats utilizing the adjoining marina facilities. This portion of the site is herein designated as the South UST Area. The prior owners of the site were the Mitchell family.

During a hurricane in August 1991, one 3,000-gallon UST was apparently flooded by the rain water and it's contents, reported as oil, flowed out onto the surface of the blue-stone parking lot of the Kokomo's restaurant parking lot. The incident was assigned NYSDEC Spill No. 91-05515. The 3,000-gallon steel UST was removed under NYSDEC oversight. Minor soil contamination was reportedly noted in the area of the fill pipe but none was observed under the UST. Records indicate that the surface spill was cleaned up to Suffolk County Department of Health Services and NYSDEC satisfaction and the spill case was subsequently closed by the NYSDEC. The records also indicate the presence of five additional USTs at the site but no action was taken at the time with respect to the remaining USTs.

According to local citizens, there were five additional areas of concern on the site (see Figure 1.2) including:

1. Texaco Alley where above-grade and below-grade petroleum storage tanks were located.
2. Oily residues were reported encountered in the vicinity of two light poles during on-site excavation activities.
3. Oily residues were reported in the vicinity of a subsurface water line during on-site excavation activities.
4. An area where oyster boats were reportedly brought ashore and their bottoms scraped of anti-fouling paint several decades ago.
5. An area where dredge spoils were reportedly placed.

Based on boring logs and tank excavations on the subject site (as summarized in the SI report) the entire site apparently consists of fill from off-site sources. The results of the SI investigation indicate that this fill material is between 9.5 to 12 feet in depth. A top soil layer of fill, ranging from 2-inches to approximately 12-inches thick, constitutes a small portion of the entire fill material on the subject site.

1.2.3 Nature and Extent of Contamination

Based upon the results of analytical testing summarized in the SI, several contaminants were detected in on-site surface soils, subsurface soils, and groundwater at levels exceeding NYSDEC concentrations of concern. Arsenic was found to be present in the surface soil. This was determined based on surface soil sampling conducted during the SI from 0 to 3 inches below grade. Quantified levels of arsenic in surface soil ranged from 1.9 mg/kg to 67.8 mg/kg, compared to the NYSDEC Recommended Soil Cleanup Objective (RSCO) for arsenic of 7.5 mg/kg and a site background concentration of 8.7 mg/kg.

Non-halogenated hydrocarbons associated with petroleum contamination were detected in on-site unsaturated subsurface soils, and groundwater in the areas of concern where previous underground petroleum storage tanks were located. Specifically, at the Texaco Alley Area where above-grade petroleum storage tanks had been present and more recently, three nested below grade petroleum storage tanks were removed, volatile and semi-volatile organic compounds were detected above their respective soil criteria. Compounds of concern include benzene, xylenes, isopropylbenzene, n-propylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, napthalene, acenapthalene, fluorene, phenanthrene and dibenzo(a,h) anthracene down to a depth of approximately 7 feet below ground surface (bgs), which is below the groundwater interface of 3 feet bgs (as measured during high tide).

Semi-volatile organic compounds (SVOCs) are present between 0 and 1.5 feet bgs at the Light Pole Area where oily residues had reportedly been encountered. SVOCs that were quantified above one or more of the soil criteria include fluoranthene, phenanthrene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, Ideno(1,2,3-cd)perylene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

No further is warranted for the North Tank Area and the South Tank Area. At both locations, petroleum impacted soils were excavated for off-site disposal at the time that the underground storage tanks were removed. From the North Tank Area, the excavation extended to approximately 10 to 12 feet bgs and a total of approximately 62 tons of petroleum impacted soil was removed. Post closure soil samples collected from the North Tank Area excavation indicate that the source area has been adequately addressed. From the South Tank Area, the excavation extended to approximately 9 feet bgs, which is also at least 2 feet below the groundwater table. Approximately 135 cubic yards of soil was removed. Test pits constructed around the perimeter of the South Tank Area excavation did not reveal any signs of petroleum impact.

Low levels of polyaromatic hydrocarbons, and elevated concentrations of copper, lead, mercury, and zinc are present at several areas of the site (i.e., the Dredge Spoil, the Water Line, and/or the Boat Bottom Scraping Areas). Based on contaminant concentrations and low frequency of detection, none of these contaminants are considered as source areas. Consequently, remedial actions are not necessary for these areas, with the exception of a deed restriction that will be put in place as part of a site-wide remedial strategy to minimize the potential for direct contact exposure.

Shallow groundwater beneath the site has been impacted primarily with petroleum-related VOCs. Constituents of concern that are above the NYS Class GA Groundwater Quality Standards include benzene, ethylbenzene, toluene, xylene, isopropylbenzene isomers, trimethylbenzene isomers, and butylbenzene isomers. The highest concentrations of total volatile organic compounds (TVOCs) in groundwater were detected at MW-4 in the South UST Area, and at MW-8 in the Texaco Alley Area.

1.2.4 Contaminant Fate and Transport

This section provides a summary of the fate and transport mechanisms for the migration of various contaminants present on the subject site in air, unsaturated soil and groundwater.

The potential routes of migration for site contaminants include:

- Migration of SVOCs associated with petroleum hydrocarbons from surface and subsurface soils to the air in the form of vapors.
- Migration of VOCs and SVOCs associated with petroleum hydrocarbons from unsaturated zone soils to groundwater.
- Migration of dissolved VOCs and SVOCs in groundwater.

Migration of SVOCs in Air

The volatilization of SVOCs from soil to air is not a completed migration pathway. The tendency for a compound to volatilize from a liquid state into the atmosphere is a function of its vapor pressure. Readings recorded using a photoionization detector (PID) during the soil sampling program did not indicate significant volatilized organic readings at most of the subsurface sampling points. This indicates that petroleum contamination detected in the soils is relatively non-volatile and only low amounts will change phase from a liquid to a vapor state at standard temperature and pressure.

Migration of Petroleum Hydrocarbons in Unsaturated Soils

With its relatively low vapor pressure, SVOCs will tend to remain in a liquid phase versus changing to a vapor phase. In the unsaturated zone, free-phase liquid SVOCs will tend to migrate downward due to the influence of gravity and leaching of rain water. As rainwater flows downward through the unsaturated zone in response to gravity, it will dissolve a portion of any petroleum contaminant that is present in the soil which will result in a downward contaminant migration pathway through the unsaturated zone, eventually reaching groundwater. The general migration of liquids through the soil column will be predominantly downward with relatively modest dispersion in the sands and gravels.

Migration of VOCs in Groundwater

The transport of hydrocarbons in groundwater is based on the USGS standard hydraulic conductivity (K) of 270 feet per day for the Upper Glacial aquifer and a maximum un-retarded groundwater flow velocity of 1.8 feet per day. Based on these hydraulic characteristics, the maximum distance that groundwater is expected to travel over a 10-year period is 6,570 feet. The actual rate of migration for these VOCs will be at a rate slower than groundwater movement due to the physical/chemical properties of the contaminants and the aquifer system. Factors that affect the migration rate of the contaminants include retardation (due to carbon in the soils), and natural attenuation due to biodegradation, dilution, dispersion and diffusion.

1.2.5 Human Exposure Assessment

A human health exposure assessment was performed in the SI to qualitatively evaluate the chemicals of concern and the affected media with respect to potential exposure pathways and receptors for human health. For the Mitchell Park site, the following pathways were evaluated:

- Ingestion of contaminated soil.
- Inhalation of vapors and/or dust.
- Direct contact with potentially contaminated surface runoff.
- Ingestion of contaminated groundwater.
- Dermal contact to contaminated soils
- Dermal contact to contaminated groundwater.

Since the area is highly developed, there is little wildlife in the area that could be impacted by chemical contamination related to the subject site. Marine life living in the waters adjacent to the site are not likely to be impacted due to the relatively low concentration levels found in on-site groundwater, in comparison to contaminant levels from bulkheading materials, and marine commercial and recreational uses.

The human health assessment identified the four potentially completable functional exposure pathways with respect to human health including:

- Ingestion of contaminated soil.
- Inhalation of vapors or dust during remedial activities.
- Dermal adsorption of contaminants via direct contact with contaminated soil.
- Dermal adsorption of contaminants via direct contact with contaminated groundwater.

A summary of potentially completable functional exposure pathways for each group of human receptors is as follows:

Workers on the Site

The potential for site workers to be exposed to site-related contaminants (pre-remediation) includes:

- Ingestion of on-site contaminated soils - This pathway is potentially completable for on-site workers due to the presence of impacted unsaturated-zone soils at the site. There are currently no indications of contaminated off-site soils; therefore, off-site workers can not be exposed.
- Inhalation of vapors - On-site workers may be exposed to VOC vapors emanating from impacted soil piles during future excavation activities.
- Dermal adsorption of contaminants via direct contact with contaminated soil - Workers may be exposed to contaminated unsaturated soils during on-site excavation activities.

- Dermal adsorption of contaminants via direct contact with contaminated groundwater - There are no on-site water supply wells; therefore, there is little potential for on-site worker exposure to contaminated groundwater.

Trespassers Who Transit the Site

Site security consists of wire mesh fencing with gates that are locked when no on-site activity is underway. This fencing, however, maybe scaled by individuals. Additionally, there is evidence that trespassers occasionally transit the site and could potentially be at risk due to the presence of on-site contaminants. The potential for trespassers to be exposed to site-related contaminants includes:

- Ingestion of on-site contaminated soils - This pathway is potentially completable due to the presence of impacted unsaturated-zone soils at the site.
- Inhalation of vapors and potentially contaminated dust - Trespassers may be exposed to VOC vapors emanating from impacted soil piles during future excavation activities.
- Dermal adsorption of contaminants via direct contact with contaminated soil - Trespassers may be exposed to contaminated unsaturated soils if soil stockpiles generated during on-site excavation activities are left uncovered.
- Dermal adsorption of contaminants via direct contact with contaminated groundwater - There are no on-site water wells; therefore, there is little potential for on-site worker exposure to contaminated groundwater.

Residents Who Live in the Area

Potentially completable functional pathways in which residents who live in the area of the site to become exposed to site-related contaminants include:

- Ingestion of contaminated soil by residents - There are no indications of off-site contaminated unsaturated soils. Any potential for exposure to site-related contaminants would be at the site, which was already addressed under the tresspasser scenario.
- Inhalation of vapors for residents – There are no indications of off-site contaminated unsaturated soils.

- Inhalation of potentially contaminated dust during remedial activities for residents – Fugitive airborne dust from near-surface soils from the site would only be likely during remediation activities that entail subsurface excavation activities. Such activities incorporate mitigation measures that reduce or eliminate fugitive dust. In addition, during any such activity a community monitoring program would be initiated that would greatly reduce the likelihood of dust exposure to area residents.
- Dermal adsorption of contaminants via direct contact with contaminated soil – Residents are not likely to be in direct contact with impacted soil from the site.
- Dermal adsorption of contaminants via direct contact with contaminated groundwater – Residents are not likely to be in direct contact with impacted groundwater from the subject site.

Remedial Construction Workers

Remedial construction workers who will install potential remedial systems could potentially be exposed for short periods of time to contaminants of concern during the installation/implementation, testing and operation of any remediation system. However, as all of the workers will be working under a NYSDEC-approved Health and Safety Plan; knowledgeable of site conditions; and utilize appropriate personal protective equipment, the exposure/uptake route is considered incomplete.

The human health assessment identified several functional pathways and exposure/uptake routes consisting of ingestion of contaminated soil, inhalation or vapors and dermal absorption of contaminated soil that can potentially be completed. Although the potential exists for exposure, the qualitative risk for these receptors to come into contact with contaminated runoff, to ingest site-related contaminated groundwater or come into dermal contact with groundwater is actually low.

2.0 IDENTIFICATION AND DEVELOPMENT OF ALTERNATIVES

2.1 Introduction

The remedial actions selected for this site should strive to attain New York State Standards Criteria and Guidance (SCGs) or other applicable Federal and state environmental standards. Potentially applicable SCGs fall within three categories: Chemical-Specific, Action-Specific, and Location-Specific.

The SCGs for site soil are the NYSDEC STARS TCLP Alternative Guidance Values (AGVs) as presented in the NYSDEC STARS Manual dated August 1992, and the Recommended Soil Cleanup Objective (RSCOs) as presented in the NYSDEC TAGM HWR-94-4046 dated January 24, 1994 and revised April 1994. The SCGs for groundwater are the NYS Groundwater Quality Standards for Class GA Groundwater and the NYS drinking water standards. The groundwater standards are taken from the NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1): Ambient Water Quality and Guidance, dated March 1998, and the drinking water standards are identified in the State Sanitary Code, Chapter I, Subpart 5-1, Public Water Systems. Chemical-specific SCGs for this site are listed in Appendix A, Table A.1 and A.2 "Chemical-Specific SCGs for Soil" and "Chemical-Specific SCGs for Groundwater."

2.2 Remedial Action Objectives

The site-specific remedial action objectives (RAOs) help define media-specific cleanup goals that are protective of human health and the environment. Protection of human health may be achieved by minimizing exposure as well as by reducing contaminant levels. Remedial action objectives that are protective of the environment typically seek to preserve or restore groundwater or soil to target cleanup levels.

The remedial action goals and general response actions for this site will be established based on concentration-based SCGs and acceptable exposure levels for human health. Contaminant levels that exist within each environmental media are compared to these cleanup levels to determine whether remedial actions are warranted.

Cleanup objectives for the soil media will strive to attain cleanup criteria based on the NYSDEC STARS TCLP Alternative Guidance Values (AGVs), or the Recommended Soil Cleanup Objective (RSCOs). Contaminants of interest in soil, based on the findings of the SI include arsenic in surface soils across the site, SVOCs in surface soils at the Light Pole Area, and VOCs and SVOCs in subsurface soils at the Texaco Alley Area. The area of arsenic-impacted surface soil totals approximately 139,168 square feet, which encompasses the entire 3.19-acre site. Only the top 1-foot warrants remedial action because of the risk for direct contact exposure associated with the surface soil. The total volume of arsenic-impacted soil is approximately 5,155 cubic yards. The area of impact at the Light Pole Area is estimated to be 45 feet by 34 feet and extends to about 2 feet deep. This soil volume totals approximately 100 cubic yards. Lastly, the area of soil impact at Texaco Alley is approximately 13,775 square feet and extends to approximately 7 feet below grade, totaling approximately 3,570 cubic yards of soil. Of this volume, approximately 380 cubic yards was previous excavated and replaced with clean fill when the tanks were removed. The resulting volume of VOC-impacted soil at Texaco Alley is approximately 3,190 cubic yards.

For groundwater, the SCGs are based on NYS Groundwater Quality Standard for Class GA Groundwater and the NYS drinking water standards. The highest TVOC concentrations are centered at MW-4 (South UST Area) and MW-8 (Texaco Alley), the locations of former underground storage tanks. VOC concentrations in groundwater decrease to the south and southwest, moving further away from these former tank locations.

2.3 General Response Actions

In the previous section, remedial action objectives were identified to reduce the potential for direct contact exposure and/or reduce toxicity, volume and mobility of constituents of concern. To achieve these objectives, it is necessary to identify general response actions (GRAs) that may applicable for implementation. The GRAs are broad categories for which specific technologies and processes are then selected that, when implemented, will achieve the RAOs.

Two media at the site was shown to be affected by contaminants, namely soil and groundwater. General response actions for soil might include containment, excavation with off-site disposal, in-situ or ex-situ treatment, and institutional controls and no action. General response actions for groundwater might include containment, in-situ treatment, collection, treatment, and discharge actions, and no action.

2.3.1 Identification of Remedial Technologies

This section of the RA identifies and evaluates potentially feasible remedial technologies that can be implemented to remediate both soil and groundwater. The evaluation of technologies takes into account the nature and extent of contamination, the ability of the technology to meet the regulatory standards and/or ability to provide overall protection of human health and the environment within a reasonable time frame. Remedial technologies which will not be effective in meeting remedial action objectives, which will prove difficult to implement based on site conditions, which rely on an unproven technology, or are prohibitively expensive will be eliminated from further consideration. A discussion of potentially applicable GRAs for soil and groundwater is provided below. Remedial technologies that are deemed suitable for site conditions and contaminants will be developed into remedial action alternatives for further evaluation in Section 3.0 of this RA report.

2.3.1.1 Soil Remedial Technologies

General response actions for soil are summarized in Table 2.1 and include the following:

Excavation and Disposal

This would require excavation of contaminated surface soils for off-site disposal at a permitted landfill or recycling facility. The disposal option will be dependent on the contaminants in the soil and whether the soil exhibits any of the characteristics of hazardous waste. Soil from the Texaco Alley Area could be recycled since the source of the contamination is from virgin gasoline or diesel fuel. This remediation option is feasible and can be readily implemented given that excavation will not extend more than 7 feet bgs.

Chemical Treatment

Chemical treatment refers to three broad categories where chemicals are employed to reduce organic or inorganic contaminants: mobilization, immobilization, or detoxification. Chemical treatment can be applied in-situ or to excavated soils.

- Mobilization is the flushing of the contaminated soil using flushing agents (surfactants, dilute acids, bases, and water) to extract the contaminants. In this process an aqueous solution is injected, contaminants are mobilized into solution, and the resulting liquid is captured and pumped out for treatment. The inorganic contaminants within the soil (arsenic) may not be easily transformed into a mobile state. Furthermore, because there are several different types of contaminants in soil (arsenic, SVOCs and VOCs), more than one flushing agent would be needed in order for this technology to be effective. This further complicates treatment of the flushing solution and impedes the overall effectiveness of this treatment process. This treatment technology will not be retained for further analysis.
- Immobilization includes the process of precipitation (for dissolved metals), chelation (for metals), and polymerization (for organics) to modify the chemical contaminant into a less mobile form. Immobilization is still relatively unproven as a viable treatment alternative and is therefore eliminated from further consideration.
- Detoxification attempts to alter the contaminants into a less toxic form through the process of oxidation, reduction, neutralization and hydrolysis. This method is also relatively unproven as a viable treatment alternative and is eliminated from further consideration.
- Stabilization/Solidification processes chemically or physically "lock" the contaminants into a solid matrix, which minimizes or eliminates the potential for contaminant leaching and chemical interaction. Stabilization/solidification processes commonly used include silicate, organic polymer, thermoplastics, cement, or molten glass as fixation agents to create a stiffened concrete-like product. While this technology may be effective for the kinds of contaminants at the site, it is not suitable for site application. The majority of the impacted soil that warrants remedial action is located at or near the surface. Because the site is being developed as a public park, the solidified soil mix would not be suitable

for use within the top feet of soil column. This treatment technology will not be retained for further evaluation.

In-Situ Treatment with Soil Vapor Extraction (SVE)

The performance of a Soil Vapor Extraction (SVE) system depends on properties of both the contaminants and the geology. SVE is generally effective on VOCs, is not effective on inorganic compounds, and has limited effectiveness on SVOCs because of the relatively low vapor pressure of these compounds. Therefore, this treatment technology will only be considered for use for the Texaco Alley Area where contaminants in soil are primarily VOCs. In addition to being effective on contaminants with a high vapor pressure, an SVE system is effective at sites with a relatively permeable geologic media. Although pneumatic conductivities have not been confirmed for site soils, boring logs indicate that the unsaturated soils are mostly fill, consisting of interbedded sand, gravel, silty sand and sandy silt. The permeability of this type of material is generally suitable for an SVE system. The SVE system may be supplemented with air sparge points to also treat VOCs in shallow groundwater. Based on site contaminants and the soil permeability, this technology can be effective and therefore is retained for further consideration.

Institutional Controls

A deed restriction is an institutional control to minimize potential threats to public health and the environment by restricting the use of a property in a manner that prevents exposure. A deed restriction is a covenant incorporated into a property deed that limits the way the property can be used. The deed restriction for this property will also help to alleviate direct contact exposure concerns associated with residual levels of site contaminants. The deed restriction will be recorded on the property deed to prohibit a change in site use without NYSDEC approval.

No further Action

Under the no action alternative, no additional soil cleanup actions would be undertaken at the site. Some soil remedial actions have already been implemented with the removal of the leaking underground tanks and impacted soils from beneath the tanks. The no action alternative poses a potential risk to the public because contaminated soil is present within the top foot of soil column and potentially accessible for contact. Additionally, VOC-contaminated soils exists in the Texaco Alley Area which could be acting as a source of on-going groundwater contamination. Although the no further action alternative does not meet the remedial action objectives for this site, it will be further evaluated as a procedural requirement as it provides a basis for comparison with other alternatives.

2.3.1.2 Groundwater Remedial Technologies

General response actions for groundwater are summarized in Table 2.1 and include the following:

Containment

Containment of impacted groundwater entails either the construction of impermeable slurry walls or sheet piling to surround the entire plume. Use of slurry walls would require the installation of a network of trenches, which would then be backfilled with low permeable slurry (for example, a bentonite-cement grout mixture) in order to prevent further migration of the plume. Sheet Piling would necessitate surrounding the entire VOC plume with impermeable steel sheeting. Because of the areal extent of the VOC plume, use of a slurry wall and sheet piling was deemed unfeasible, and thus was eliminated from further consideration.

In-situ Treatment

In-situ treatment is the process by which contaminants are remediated at their present location. In-situ technologies for groundwater remediation include biological, chemical, and physical treatment.

- Biological treatment requires the development of aerobic or anaerobic microorganisms capable of decomposing specific organic contaminants. This process requires the addition of oxygen for aerobic microorganisms (in the form of oxygen reducing compounds), or hydrogen for the enhanced growth of anaerobic microorganisms. Biological treatment is most effective in the remediation of groundwater containing moderate to high levels of organic compounds, especially when used in conjunction with other remediation technologies. Because groundwater at the site is brackish to saline, indigenous microorganisms may or may not be present at sufficient levels to promote aerobic degradation. Full scale treatability testing would be needed to assess the viability of this treatment technology. Because this technology is unproven in saline waters, this technology was eliminated.

- In-situ chemical treatment of groundwater would require the introduction of chemicals into the aquifer to degrade, immobilize or flush out the contaminants. Limiting factors include the necessary use of hazardous chemicals to perform the process. Because introducing hazardous substances into a federally designated sole source aquifer is prohibited, this method will not be considered.
- In-well stripping is an in-situ remedial technology that uses air stripping principles to remove VOCs. This is accomplished by passing air through groundwater that is circulated in the well bore. The in-well stripping system creates an elliptical groundwater circulation cell by drawing groundwater from the aquifer through the lower section of a double-screened well and discharging it through the upper screen. Since groundwater in the well bore discharges through the top well screen (which is set at the groundwater surface) mounding, as much as 5 feet, will occur. Because the groundwater table at this site is very shallow (3 feet bgs during high tide), the unsaturated soil column is not thick enough to accommodate an in-well stripping system. This treatment technology will not be considered further.
- Air Sparging is a process where air is introduced under pressure below the water table to increase the rate of volatilization of VOCs in the saturated zone. Air sparging must be used in conjunction with SVE technology to capture VOCs volatilized from the saturated and unsaturated soils. As groundwater beneath the site is shallow, and contaminants of concern in groundwater are petroleum-related VOCs, this technology is suitable for site use. Therefore, air sparging combined with an SVE system will be retained for further consideration.

<u>Physical Treatment</u>

Physical treatment techniques include sedimentation, filtration, and ion exchange.

- Sedimentation is the removal of particulate matter by gravity. This process can be enhanced through the addition of chemical coagulants to settle out the suspended solids. Sedimentation is effective in the removal of suspended matter, but not effective in the treatment for VOCs. For this reason, sedimentation was eliminated from further consideration.
- Filtration is the process by which suspended matter is removed from water. It is accomplished by passing a water stream through a porous media of appropriate size. Filtration is utilized in pretreatment systems for a variety of treatment alternatives, but is not effective in the removal of VOCs. Therefore, filtration was eliminated.
- Ion exchange is the process by which a substitution of ions occurs between the waste stream and an ion exchange resin. Resins are generally "charged" with H^+ or OH^- ions and can be divided into four groups. Cation exchange resins containing strong acids are generally used in the treatment of heavy metals; cation exchange resins containing weak acids are generally used in the treatment of simple and complex organic bases. Strong base anion resins are utilized in the removal of weak mineral acids; strong mineral acids are best removed with weak base anion resins. The process is reversed during regeneration of the resin, with discharge of the wasted ions and replenishment of original ions transferred from a regeneration solution to the resin. The waste regeneration solution requires disposal. Ion exchange technology is not selective in the contaminants being removed, and therefore removes all ions in solution. As a result, large ion exchange columns are typically required to achieve the desired removal. Use of this treatment technology is not feasible due to space considerations and the amount of waste materials (i.e., regeneration wastes) requiring management after treatment. This treatment technology is also not applicable to treatment of VOCs and thus eliminated from further consideration.

<u>Chemical Treatment</u>

Chemical treatment processes include oxidation reactions and chemical precipitation.

- Chemical precipitation is primarily used in the treatment of solutions containing metals. Chemicals, known as coagulants, are added to the water stream to react with dissolved contaminants to form a precipitate, which is then settled out of the liquid. Common reagents to promote settling include lime, sulfide and calcium or sodium carbonate. Because VOCs would not be effectively treated using this process, chemical precipitation was eliminated from further consideration.

- Chemical oxidation-reduction reactions are effective in reducing the toxicity or solubility of a contaminant. The oxidation process is useful in the treatment of dilute organic solutions via the addition of a powerful oxidizing chemical (ozone, hydrogen peroxide, potassium permanganate, etc.). Limiting factors include the necessary use of hazardous chemicals to perform the oxidation process and the possibility of toxic by-products if the oxidation reaction is not brought to completion. Because of these limiting factors, this process option was eliminated from further consideration.

Collection and Treatment (Pump and Treat Systems)

This option would require the construction of recovery wells of sufficient size and number to create a hydraulic boundary to intercept the groundwater contaminant plume in the form of a pump and treat system. The geology beneath the site is comprised of fill consisting of interbedded sand, gravel, silty sand and sandy silt to a depth between 9.5 and 12 feet bgs. A clay-rich bog layer underlies the fill. Extraction wells would screen the groundwater interface and extend to the surface of this clay layer. This pumping zone represents less than 10 feet of saturated thickness. Typical groundwater treatment technologies for pump and treat systems may include carbon adsorption, air stripping, and UV oxidation. These treatment technologies are discussed below.

- Carbon adsorption treatment is accomplished by passing affected groundwater through a vessel containing granular activated carbon. The carbon used in this process is available in two forms, granular activated carbon (GAC) and powdered activated carbon (PAC). The adsorption of organic materials to the carbon particles is a three-stage process. The first stage is the movement of organic material through the water to the solid-liquid interface. The second stage is the movement of the organic material within the carbon system to adsorption sites located on the carbon particles. The actual chemical adsorption between the carbon particle and organic material is minimal. The third stage, physical attraction, completes the adsorption process. Breakthrough of contaminants occurs when the carbon adsorption sites are at full capacity, and the carbon must be sent off-site for regeneration. This technology has been proven effective in many groundwater remediation projects, and was therefore retained for further consideration

- Air stripping involves the intimate contact between the contaminated groundwater and air, resulting in a transfer of VOCs within the groundwater from the liquid phase to the air phase. This process would require the construction of a tower filled with an inert plastic media designed to maximize the volume of liquid in contact with air. Additional air treatment may be required at the point of air discharge. This treatment technology is effective in removing VOCs from groundwater. However, because of high dissolved iron in the groundwater, once the water is oxygenated via the air stripping process, iron scale can form to cause fouling of the packing material and creating maintenance problems. This may require frequent shutdown of the treatment system to clean the tower. Therefore, air stripping technology is eliminated.

- UV oxidation is a chemical oxidation process that utilizes ultraviolet (UV) light as a catalyst for the reaction of dissolved VOCs to produce carbon dioxide and water. Non-hydrocarbon dissolved contaminants, including naturally occurring metals and minerals, will also be subject to the oxidation reaction. Common sources of oxygen utilized include hydrogen peroxide, air, chlorine, ozone and permanganate. The effectiveness of UV oxidation is dependent upon organic and inorganic contaminant loading, pH and the ability of the groundwater to transmit light. Because of the high concentration of iron and total dissolved solids in the groundwater, iron scale and inorganic salt deposits will form which will increase the level of maintenance required for operation. The formation of iron scale and salt deposits also hinders the effectiveness of the UV oxidation process. This treatment technology is not suited for use at this site and therefore, will not be retained for further evaluation.

No further Action

There is no risk to public health posed by the contaminants in the groundwater since all area residents are connected to public water. Groundwater flow is into Greenport Harbor. There are no supply wells located downgradient of the site. The no further action alternative is evaluated as a procedural requirement and provides a basis for comparison with other alternatives.

3.0 DETAILED ANALYSIS OF ALTERNATIVES

3.1 Introduction

This section of the RA presents the detailed analysis of a range of site management options for soil and groundwater taking into consideration the factors identified in 6NYCRR375-1.10(c)(1-7) and listed below to determine the most cost effective, protective remedy.

1. Overall Protection of Human Health and the Environment - This assessment draws on the results the overall evaluations to describe whether, and how, each alternative provides protection of human health and the environment.

2. Compliance with New York State Standards, Criteria, and Guidelines (SCGs) - This criterion describes how the remedial action alternative complies with the New York State SCGs.

3. Short-Term Effectiveness - The effectiveness of alternatives in protecting human health and the environment during implementation, construction and operation is evaluated using this criterion. Short-term effectiveness is assessed by protection of the community, protection of workers, environmental impacts, and the time frame until protection is achieved.

4. Long-term Effectiveness and Permanence - This criterion evaluates the long-term protection of human health and the environment, the potential risk remaining after completing the remedial action, and the permanence of the remedial alternative. It is measured by the magnitude of risk remaining from untreated waste or treatment residuals, by the adequacy of the controls in achieving clean-up criteria and by the reliability of the controls against possible failure.

5. Reduction of Toxicity, Mobility, and Volume of Contaminants - This criterion evaluates the anticipated performance of treatment alternatives. Specific factors include (1) the volume of hazardous materials that will be destroyed or treated; (2) the degree of expected reduction in toxicity, mobility or volume; and (3) the degree to which the treatment will be irreversible.

6. Feasibility - This criterion evaluates the technical and administrative feasibility, the availability of services and materials, ease of implementing the remedial alternative, and consideration of cost-effectiveness.

7. Cost - Order of magnitude cost estimates (-30% to +50%) inclusive of capital and operation and maintenance (O&M) costs are developed to help evaluate the overall cost-effectiveness of the remedial action alternatives. Capital costs include equipment, construction/installation, engineering and associated administrative costs. O&M costs are post construction costs incurred to ensure effective operation (e.g., utilities, chemical stock, waste disposal, operation labor, etc.), and also include the monitoring costs

associated with implementing the remedial action. All costs are developed (using 1999 dollars) to the same level of detail in order to provide for an even basis for comparison. Present worth calculations are used to compare the cost-effectiveness of these alternatives. Present worth values were calculated based on the estimated life span for each remedial action, using a five percent (5%) interest rate.

These evaluation criteria are consistent with those outlined in the National Contingency Plan, and presented in the USEPA Superfund guidance documents.

3.2 Summary of Areas of Concern

There are four (4) AOCs that remain for this site, for which remedial alternatives are evaluated in this RA:

- Surface soils across the site that have been impacted with arsenic,
- Surface soils at the Light Pole Area that have been impacted with SVOCs,
- Subsurface Soils at the Texaco Alley Area that have been impacted by VOCs and SVOCs, and
- Groundwater

General response actions and treatment options that have been retained from the initial screening were assembled together based on their ability to prevent direct contact exposure, achieve source area remediation for soil, and provide for groundwater protection into remedial action alternatives to address the above AOCs. These alternatives were then evaluated as to their ability to achieve the remedial action objectives for this site. The evaluation process for each of the remedial alternatives is described in the subsections below.

3.3 Individual Analysis of Alternatives

3.3.1 Alternative 1

3.3.1.1 Description

Under the no further action alternative, no additional soil and no groundwater remedial activities would be undertaken at the site. As detailed in the SI report, a total of nine underground storage tanks were found at the site. These storage tanks were removed as part of the site investigation to determine whether they had leaked petroleum into the subsurface.

During tank removal subsurface soils impacted by petroleum were excavated in the areas of concern. Any additional site cleanup that would occur would be through natural degradation and attenuation processes. Concentrations of contaminants in soil would remain relatively unchanged in the relative short-term period. VOCs in groundwater would also remain above standards in the relative short-term period.

Although titled the no further action alternative, State regulations would require periodic sampling and laboratory analysis of groundwater from all of the existing on-site monitoring wells. The monitoring program would include quarterly monitoring to check for the presence of any floating product (visual inspection) at any of the areas where USTs were removed. Semi-annual groundwater sampling would also be performed for VOCs and SVOCs from all existing site wells to determine if groundwater quality has improved after the tanks were removed. Since a potential source area would still exist, groundwater sampling would be performed for at least 5 years to monitor for changes in groundwater quality.

3.3.1.2 Assessment

- Overall Protection of Human Health and the Environment

Given that the site is to be developed as public park for recreational use, arsenic and potentially SVOCs in surface soils at the Light Pole Area present a risk to the public via the direct contact pathway. Most of the park grounds will remain unpaved and as such, the public including adults, children and also park workers could potentially come into contact with the contaminants in the surface soil. Additionally, VOC-impacted soil at the Texaco Alley Area is likely to be acting as a source of VOCs to groundwater. As long as VOCs exist in the soil matrix at significant enough concentrations, these contaminants can migrate downwards to impact groundwater groundwater.

Therefore, the no further action alternative poses a potential risk to human health because of direct contact exposure concerns (i.e., attributable to arsenic and SVOCs in surface soils). This alternative also poses a potential threat to the environment because VOCs from the Texaco Alley Area could continue to degrade groundwater quality. This remedy is not protective of human health and the environment.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)

  Under the no further action alternative, VOCs in groundwater would likely continue to exceed the New York State Class GA Water Groundwater Quality Standard, and concentrations of contaminants of concern in the soil would remain above the NYSDEC TCLP AGVs and/or RSCOs.

- Short-Term Effectiveness

  Since no remedial actions are being implemented under this alternative, there will be no short-term effects to the community, to workers, or to the environment associated with implementation of an action.

- Long-Term Effectiveness and Permanence

  As this alternative would not involve active remediation, no efforts would be needed to maintain this remedy. Natural attenuation of the existing plume will occur to some extent through biodegradation, dilution and dispersion, however, concentrations would likely remain above standards.

- Reduction of Toxicity, Mobility, and Volume of Contaminants

  Some degradation of organic compounds would occur through passive, natural degradation processes. For inorganic contaminants in soil (i.e., arsenic), there would be no change in concentrations since these compounds do not biodegrade. Additionally, because a source of VOCs still exists in the Texaco Alley Area, contaminants will continue to leach from the soil matrix to groundwater, making the natural degradation process ineffective as a cleanup remedy.

- Feasibility

  The no action alternative is readily implemented since no remedial actions would be undertaken.

Based on the foregoing, the No Action alternative is not an appropriate management option for this site.

3.3.2 Alternative 2

3.3.2.1 Description

This alternative includes the following remedial actions:

1. Excavation with off-site disposal of the top 1 foot of arsenic-impacted soil from the entire site, placement of clean fill, and capping of some of the arsenic-impacted soils beneath the new building structures,
2. Excavation with off-site disposal of SVOC-impacted surface soil from the Light Pole Area,
3. Groundwater monitoring (for at least 5 years), and
4. Deed restriction for the entire site.

No active soil remediation would be undertaken for the Texaco Alley Area under this remedial action alternative.

Specifically, this remedial alternative would entail the removal of the top 1-foot of soil from across the entire site (due to the presence of arsenic), and approximately 2 feet of soil from the Light Pole Area (due to the presence of SVOCs). All areas where soil is removed will be covered with clean fill brought to the site from an off-site source to bring the site back to its original grade. Removal of the top 1-foot layer has already been completed at a portion of the site, in the area where construction is currently underway by the Village for the carousel and the amphitheater buildings. A portion of the soil that has been removed was placed beneath the raised concrete foundation for the carousel and the amphitheater buildings. The foundation is completely sealed and acts as a cap to prevent the public from coming into contact with the soil. The New York State Department of Health (NYSDOH) had given approval for the placement of excavated surface soil beneath these structures. The remainder of the excavated soil, which is currently stockpiled on-site, as well as the remaining top 1 foot of soil from the rest of the site, will be removed for off-site disposal. Approximately 1,850 cubic yards of soil have already been excavated from the construction area, and approximately 3,040 cubic yards of soil remain to be excavated from across the rest of the 3.19-acre site. Of the 1,850 cubic yards of previously excavated soil, approximately one-third (1/3) of this volume (or 650 cubic yards) has already been buried beneath the raised foundation of the carousel and amphitheater buildings, leaving approximately 1,200 cubic yards to be disposed of off-site. In the Light Pole Area, an additional 50 yards of soil would be removed to provide for a 2-foot soil cut at this area of concern. In all, a total of 4,940 cubic yards of soil from the site will be disposed of off-site.

It should be noted that the total quantities of soils to be excavated and removed is highly conservative for the purposes of this report. The approach of removing 1 foot of soil from across the entire site is premised on the results of ten (10) surface soil samples collected during the SI. Arsenic was quantified above the NYSDEC RSCO at eight of these ten surface soil samples. Potentially, the extent of arsenic contaminated surface soil may not encompass the entire site. As a conservative measure for this RA analysis, it was presumed that the surface soil across the entire site is impacted with arsenic. However, before soil removal is performed, it may be prudent to re-examine, using a grid sampling approach, the surface soil quality across the entire site relative to arsenic to confirm specific areas in which soil removal would or would not be warranted (e.g., beneath paved areas). Surface soils that do not exceed the RSCO for arsenic would not pose a human health threat and therefore, soil removal from these areas would not be warranted. This could reduce the overall volume of surface soil that would need to be removed from this site. In addition, the areal extent of contamination surrounding the light pole had not been specifically determined. Before soil removal around the light pole is performed, it may be prudent to re-examine, using a grid sampling approach. The examination of soils in the light pole area may reduce to the affected area significantly.

It was determined from testing conducted on soil samples taken from around the roots of the trees at the site, that the soil around the trees have only slightly elevated levels of arsenic, ranging from 4.6 mg/kg up to 14 mg/kg. Because the soil around the trees cannot be extricated without killing the tree, both NYSDEC and NYSDOH concurred that the soil within the root system of the tree can remain. Thus, excavation would extend to the approximate edge of the individual tree's root system, or generally within 15 to 20 feet from the tree.

A deed restriction is proposed for the site to restrict the future use of the property. The deed restriction would prohibit a change in site use without NYSDEC approval.

This alternative would require periodic sampling and laboratory analysis of groundwater from all of the existing on-site monitoring wells. The monitoring program would include quarterly monitoring to check for the presence of any floating product (visual inspection) at any of the areas where USTs were removed. Semi-annual groundwater sampling would also be performed for VOCs and SVOCs from all existing site wells to determine if groundwater quality has improved after the tanks were removed. Since a source area would still exist in the Texaco Alley Area, groundwater sampling would be performed for at least 5 years to monitor for changes in groundwater quality.

3.3.2.2 Assessment

- Overall Protection of Human Health and the Environment

Excavation and removal of arsenic and SVOC impacted soils from the site will minimize the potential for direct contact exposure. Placement of soil beneath the raised foundation of the carousel and amphitheater buildings is also an effective means of making this soil inaccessible to the public. The structures themselves act as a cap to prevent exposure via the direct contact pathway.

Site groundwater does not pose any human health threats since there are no downgradient human receptors. Groundwater flow beneath the site is to the south and south-southwest, into Greenport Harbor. There are no known users of groundwater downgradient of the site, given the site's location adjacent to the harbor. Additionally, the marine life living in the waters adjacent to the site are not likely to be impacted due to the relatively low concentrations found in on-site groundwater.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)

This remedial alternative complies with the SCGs for soil at the Light Pole Area and for surface soil across the entire site. Potential risks associated with coming into contact with soil containing arsenic are being adequately addressed by removing the top 1-foot of site soil. Since no active soil remediation is being proposed for the Texaco Alley Area, the concentrations in soil at this location will remain above the SCGs. Furthermore, with the continued presence of a source area at the Texaco Alley Area, contaminants in soil at this location will continue to be released to groundwater. Groundwater concentrations will not naturally attenuate to within groundwater quality standards within a reasonable timeframe because of the continued presence of this source area.

- Short-Term Effectiveness

The potential can exist for site workers and residents from the community to be exposed to dust generated from soil excavation activities. However, these risks can be effectively minimized through administrative and engineering controls taken during field activities. During excavation, dust erosion and control measures would be taken to minimize the release of airborne particulate matters to the atmosphere. On-site air monitoring would be conducted within the work zones, and downwind of the work areas to assess potential exposure to the community. A community air monitoring plan, consistent with NYSDOH guidance, would be implemented. Gloves and other personal protective clothing and equipment (e.g., coveralls, boots, hard-hats, safety glasses, etc.) should be worn to minimize any risk from inhalation, ingestion, or direct contact to remediation contractors.

This remedial alternative would typically take approximately three months to complete. Excavation and backfilling/grading activities would be coordinated with on-going construction activities at the park.

- Long-Term Effectiveness and Permanence

Removing the top foot of soil and then backfilling provides for long term protection to the public. Soil excavation and off-site disposal is also a permanent remedy. No further maintenance of the disposed soil would be required.

The deed restriction will serve to provide notice that residual amounts of impacted soils are still present on the property and would need to be addressed in a manner appropriate for the intended future use, if the property were to ever be converted to another use. Arsenic contaminated soils beneath the raised structure of the carousel and the amphitheater buildings are capped in place and would not require any further maintenance.

- Reduction of Toxicity, Mobility, and Volume of Contaminants

Based on the site contaminants, the soils would not likely exhibit any characteristics of a RCRA hazardous waste and therefore, would be managed as non-hazardous waste for off-site disposal. The off-site landfilling disposal option would not involve treatment, therefore, the toxicity, mobility or volume of hazardous materials in the soil would be unaffected.

- Feasibility

Excavation of the top 1 foot of soil cover and backfilling/grading is readily achievable using conventional construction equipment. Some logistical consideration must be given to waste staging so as to not interfere with on going park construction activities.

The order of magnitude cost estimate for soil removal is presented in Table 3.1. The total present worth cost including cost for soil removal and disposal, and assuming 2 years of groundwater monitoring is preliminarily estimated to be approximately $ 643,586.

3.3.3 Alternative 3

3.3.3.1 Description

This remedial alternative includes the following actions:

1. Excavation of the top 1 foot of arsenic-impacted soil from the entire site, placement of clean fill, capping of some of the arsenic-impacted soils beneath the new building structures, backfilling of deeper excavations in the Texaco Alley Area with some of the arsenic-impacted soils, and off-site disposal of remaining arsenic-impact soil.
2. Excavation of SVOC-impacted soil to 2 feet bgs from the Light Pole Area with off-site disposal,

3. Excavation with off-site disposal of VOC and SVOC-impacted soils to 7 feet bgs from the Texaco Alley Area,
4. Periodic groundwater monitoring (for at least two years), and
5. Deed restriction for the entire site.

The primary difference between Alternative 2 and Alternative 3 is that this alternative includes source area remediation at the Texaco Alley area where soils are impacted by VOCs. This soil will be excavated for off-site recycling/disposal. From the SI, it was determined that VOCs extend to approximately 7 feet bgs, which is also about 3 feet below the groundwater table as measured during high tide. During excavation activities any floating product would be removed by skimming and/or using absorbent pads. This would provide an immediate improvement to groundwater quality. In addition, the removal of the highly impacted soils in the smear zone (that 3 foot area below the high-tide groundwater elevation) at the top of the water table would result in improved groundwater quality. The total volume of VOC-impacted soil at this area of concern is estimated to be approximately 784 cubic yards (based on an area of roughly 57 feet wide by 57 feet long by 7 feet deep).

Due to the greater depth of excavation in the Texaco Alley Area in this alternative, the excavation can be partially backfilled with surface arsenic-impacted soils. The excavation in the Texaco Alley Area may be backfilled to within one-foot of the surface grade. Approximately 560 cubic yards of arsenic-impacted soils can be used as backfill in the subject excavation. The remaining backfill would be undertaken with clean soils. The capping and deed restriction would prevent direct contact with any residual contamination.

Groundwater monitoring would include checking for the presence of any floating product (visual inspection) on a quarterly basis, and semi-annual groundwater sampling for VOCs and SVOCs from all existing site wells to ensure that the groundwater quality is improving since the source has been removed. Groundwater monitoring would be performed initially for two years, and then reassessed as to the need for continued monitoring and/or a reduction in frequency of monitoring.

3.3.3.2 Assessment

- Overall Protection of Human Health and the Environment

This remedial approach is protective of public health and the environment. With excavation and off-site disposal of the contaminated soils and creation of a 1-foot thick clean soil cover, the potential for future exposure to site workers, and to the public via the direct contact pathway is mitigated. This remedial action also provides for protection of groundwater and the environment since source area removal in the Texaco Alley Area will prevent additional contaminant mass from being released to groundwater. By eliminating the source of any ongoing contamination to groundwater, aquifer rehabilitation under natural processes can eventually be achieved.

There is no imminent risk to the public via ingestion of impacted groundwater. Groundwater beneath the site flows to the south to southwest and into Greenport Harbor. There are no known users of groundwater downgradient of the site. All supply wells identified from a record search through NYSDEC are located upgradient of the site.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)

This remedial alternative would meet the SCGs for site surface soil, and for the Light Pole Area and the Texaco Alley Area where soil excavation would extend deeper. Residual levels of contaminants will remain on site at the Dredge Spoil Area, the Water Line, the Boat Bottom Scraping Areas, and the South UST Area. However, contaminants in these areas are inaccessible and do not pose a risk to the public. With the contaminant source at the Texaco Alley Area removed, the groundwater plume would eventually achieve remedial objectives relative to SCGs through natural attenuation processes. The groundwater sampling program would document the gradual decreases in contaminant concentrations over time.

- Short-Term Effectiveness

Any potential risks posed to site workers and the community from soil excavation activities can be effectively minimized through administrative and engineering controls taken during field activities. On-site and perimeter air monitoring would be conducted to assess potential exposure to workers and to the community. Gloves and other personal protective clothing and equipment (e.g., coveralls, boots, hard-hats, safety glasses, etc.) would be worn by remediation workers to minimize any risk from inhalation, ingestion, or direct contact. Sheeting and shoring will be utilized to maintain the stability of the excavation.

- <u>Long-Term Effectiveness and Permanence</u>

Excavation for off-site disposal provides for long term protection to public health via the direct contact pathway and to the environment through aquifer protection. Removal of VOC contaminated soils prevents the continued release of contaminants to the groundwater. Soil excavation and off-site disposal is a permanent remedy. With the removal of contaminated soils from the site, the residual risk to public health, and to groundwater and the environment following remediation would be minimal.

- <u>Reduction of Toxicity, Mobility, and Volume of Contaminants</u>

Based on the site contaminants, the excavated soil from this site, except from the Texaco Alley Area, would be managed as a non-hazardous for disposal at a permitted landfill. Since this off-site disposal option would not involve treatment, the toxicity, mobility or volume of hazardous materials in the soil would be unaffected.

The soil from the Texaco Alley Area contains petroleum hydrocarbon related VOCs and SVOCs. The source of these contaminants is former gasoline and/or diesel USTs. Given that the tanks contained virgin product, the soil from this area could be recycled at a permitted recycling facility. The toxicity, mobility and volume of VOC-impacted soil would be reduced through this off-site recycling option.

- <u>Feasibility</u>

The excavation activities proposed for the removal of site soils are readily implementable using conventional construction equipment and methods.

The order of magnitude cost estimate for soil removal is presented in Table 3.3. The total present worth cost including cost for soil removal and disposal, and assuming 2 years of groundwater monitoring is estimated at approximately $689,092.

3.3.4 Alternative 4

3.3.4.1 Description

This remedial alternative is similar to Alternatives 2 and 3 in that soil excavation would be performed on surface soils, but includes in-situ source area remediation at the Texaco Alley Tank Area instead of soil removal. Specific elements of this remedial alternative include:

1. Excavation with off-site disposal of the top 1 foot of arsenic-impacted soil from the entire site, placement of clean fill, and capping of some of the arsenic-impacted soils beneath the new building structures,
2. Excavation of SVOC-impacted soil to 2 feet bgs from the Light Pole Area with off-site disposal,
3. In-situ treatment (using air sparge/vapor extraction) at the Texaco Alley Area,
4. Periodic groundwater monitoring (for at least two years), and
5. Deed restriction for the entire site.

VOCs in soil and groundwater at the Texaco Alley Area would be treated using an in-situ air sparge/soil vapor extraction system (SVE). The SVE system would be utilized to remove the source area in the Texaco Alley Area. Sparging is a term applied to the injection of air below the water table to induce contaminant removal by volatilization. Under this alternative, both soil and groundwater in the area of Texaco Alley would be treated using a series of air sparge points and vapor extraction wells. Air would be introduced under pressure below the water table to increase the rate of volatilization of VOCs in the saturated zone, and soil vapor extraction (SVE) wells under vacuum would be utilized to remove VOCs from the soil. Air sparging also acts as a delivery mechanism to introduce oxygen to the subsurface environment to promote aerobic degradation of contaminants in both soil and groundwater. The air sparge/SVE system would have limited effect on SVOCs. However, the deed restriction would prevent direct contact with any residual contamination.

Based on the area of soil impacted by VOCs and the configuration of the VOC plume beneath the Texaco Alley Area, it is preliminarily estimated that 12 air sparge points and 16 horizontal extraction legs would be utilized. Horizontal extraction legs are proposed instead of vertical extraction wells because the groundwater table beneath the site is shallow (about 3 feet bgs during high tide conditions). The air sparge wells would be installed to a depth of approximately 15 feet below grade and each horizontal leg would consist of two (2) 10 feet screens installed at a depth of 2 feet below grade. Major equipment would include a vacuum blower and air compressor, both housed inside an enclosure. Off-gas from the air sparge/SVE system would be treated using vapor phase carbon prior to discharge to the atmosphere. The need for off-gas treatment would be confirmed during pilot testing/remedial design. A schematic depicting a preliminary layout of the air sparge/SVE system is shown in Figure 3.1. The exact configuration, and number of air sparge points and extraction legs would be confirmed during remedial design.

Periodic groundwater monitoring for 2 years. The same as that described for Alternative 3 would be conducted to monitor treatment system performance and effectiveness.

3.3.4.2 Assessment

- Overall Protection of Human Health and the Environment

This remedial approach is protective of public health. Surface soil removal and maintenance of a 1-foot thick clean soil cover will adequately prevent direct contact exposure. This remedial action also provides for protection of the environment with active source area and localized groundwater treatment. The air sparge/SVE system will be effective in reducing VOC levels in soil as well as in groundwater at and downgradient of the Texaco Alley Area.

There is no imminent risk to public health via ingestion of impacted groundwater as there are no known users of groundwater downgradient of the site.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)

This remedial alternative complies with the SCGs for soil at the Light Pole Area, the Texaco Alley Area, and for the top 1-foot soil column. Residual levels of levels of contaminants will remain on site at the Dredge Spoil Area, the Water Line, the Boat Bottom Scraping Areas, and the South UST Area.

This remedy will also achieve SCGs for groundwater. This alternative includes aquifer restoration through source area remediation and in-situ treatment of localized groundwater at the area of concern using air sparging/SVE. For the portion of the on-site plume outside the influence of the air sparge/SVE treatment system, groundwater quality would eventually achieve SCGs through natural attenuation processes (degradation, dilution and dispersion). Source area remediation and aquifer rehabilitation are consistent with federal and NYS groundwater protection strategies.

- Short-Term Effectiveness

Although the potential may exist for remediation workers and/or the public to become exposed during soil excavation activities, these risks can be effectively minimized. Control measures would be taken during field activities to control dust erosion, to minimize the release of airborne particulate matters to the atmosphere, and to control runoff releases. This coupled with use of personal protective equipment by remediation workers (e.g., gloves, coveralls, boots, hard-hats, safety glasses, etc.) can further help to minimize inhalation, ingestion, or direct contact risks. Additionally, air monitoring would be conducted to assess potential exposure to site workers and to the community.

Implementing the air sparge/SVE treatment would pose no short-term risk to the public or environment. The air sparging/SVE can be operated safely. Operation of the air sparging/SVE system will generate a vapor phase emission to the atmosphere. Granular activated carbon would be employed to treat the off-gas prior to it being discharged to the atmosphere. There would not be any impact to air quality in the surrounding community.

Soil removal activities would take approximately three months to complete. Installation of the air sparge/SVE system at the Texaco Alley Area would take about one month. This work can be done concurrent with soil removal activities.

- Long-Term Effectiveness and Permanence

The risk to the public via direct contact would be minimal once the surface soil is removed and a 1-foot thick clean soil cover is created. The deed restriction placed on this property would restrict an alternate use of the site without NYSDEC approval.

Source area remediation with localized groundwater treatment for the Texaco Alley Area offers long-range protection to the environment by preventing impacted groundwater from migrating off-site. This remedial action also promotes aquifer rehabilitation. Treatment using in-situ air sparge/SVE is long-term and permanent solution since contaminants would be removed from the soil and groundwater media.

- Reduction of Toxicity, Mobility, and Volume of Contaminants

With the removal of contaminated surface soils from the site, potential threats posed to the public through the direct contact exposure pathway are minimized. The excavated soils would be disposed of off-site at a permitted landfill as a non-hazardous waste. Further, by implementing active source area treatment and aquifer rehabilitation via an air sparge/SVE, contaminant concentrations in soil and groundwater at the Texaco Alley Area will decrease. The air sparge/SVE treatment system does not generate significant residual waste that requires treatment or off-site disposal, with the exception of spent carbon that will be used in treatment of the air discharge from the air sparge/SVE system. Spent carbon would be transported off-site for regeneration. This remedial alternative is considered a permanent solution, provides for long-term protection to the public and the environment through aquifer rehabilitation, and is consistent with the remedial action objectives for the site.

- Feasibility

Soil excavation as proposed is readily achievable. The deed restriction for the site would be recorded with the county. Installation of the air sparge points and extraction legs would utilize conventional well drilling and trench construction methods. All equipment needed for its construction is readily available and can be easily installed.

Operation and maintenance of the air sparge/SVE system is also relatively simple in terms of the level of maintenance requirements. The mechanical equipment associated with this system is limited to blowers and compressors. This equipment would be installed in a small treatment building to allow for easy inspection, maintenance and repairs.

An order of magnitude cost estimate for the air sparge/SVE system is presented in Table 3.4. The total present worth (assuming 2 years of operation, at 5%) for the air sparge/SVE system is estimated to be approximately $842,587. This cost includes capital and annual costs to operate, maintain and monitor the treatment system for 2 years. Annual operation and maintenance (O&M) costs include maintenance and upkeep of the treatment system, vapor phase carbon replacement, utilities, operating labor, and groundwater monitoring, which reflects quarterly groundwater monitoring for the presence of floating product, and semi-annual sampling, analysis and reporting for dissolved VOCs.

3.3.5 Alternative 5

3.3.5.1 Description

This alternative includes the following remedial actions:

1. Excavation with off-site disposal of all impacted soils from the site, and placement of clean fill.
2. Groundwater treatment until groundwater quality standards are met, and
3. Periodic groundwater monitoring.

This alternative would require removal of all impacted soils to within the NYSDEC RSCOs or TCLP AGVs, and treatment of groundwater until groundwater meets groundwater quality standards. The intent of this remedial alternative is to assess the feasibility of bringing the site back to pre-release conditions.

Under this soil remedial alternative, all soils from the site that have been quantified above the NYSDEC RSCOs or TCLP AGVs would be excavated for off-site disposal. Specifically, soil excavation would encompass the removal of 1 foot of surface soil from across the entire 3.19 acre site (for arsenic), removal down to 2 feet bgs in the Light Pole Area, and removal down to approximately 7 feet bgs in the Texaco Alley Area. Soil impacted with arsenic that has already been placed beneath the carousel and amphitheater building structures would also have to be removed. The soil volumes associated with these three areas of concern are as follows: 5,150 cubic yards of arsenic-impacted surface soil, an additional 50 cubic yards from the Light Pole Area, and an additional 3,190 cubic yards from the Texaco Alley Area.

In additional, soil would be removed from the other miscellaneous areas investigated during the SI in which low to moderate levels of residual contaminants including petroleum related SVOCs and/or copper, lead, mercury, and/or zinc were detected. These areas include the Dredge Spoil Area (20 feet x 20 feet x 2 feet deep), the Water Line (70 feet x 30 feet x 5 feet deep), the Boat Bottom Scraping Areas (40 feet x 60 feet x 5.5 feet deep), and the South UST Area (three areas, each 20 feet x 20 feet and averaging approximately 4.5 feet deep). The soil volume associated with each area of concern is shown in Table 3.5. A deed restriction would not be necessary under this excavation scenario since soil removal would be performed until NYSDEC TCLP AGVs and/or RSCOs are met at all areas of the site.

This alternative also provides for aquifer restoration through active groundwater treatment. Contaminated groundwater from the site would be collected via extraction wells and treated using liquid phase granular activated carbon to remove VOCs to levels compliant with NYSDEC surface water discharge standards. The treated water would be discharged to the Greenport Harbor.

Because there are multiple locations from which releases of petroleum-related VOCs had occurred including the Texaco Alley Area, the South UST Area and the North UST Area, multiple pumping wells would be required to capture the majority of the on-site plume. Well locations and pumping rates were estimated using the Theis non-equilibrium well function equation. Application of the Theis equation is a conservative approach by which the theoretical response of the aquifer to pumping (i.e., drawdown) can be estimated. A hydraulic conductivity of 270 feet per day and a saturated thickness of 10 feet were used to estimate aquifer transmissivity. Based on aquifer characteristics, it was estimated that a total of five (5) extraction wells, at three locations, would be required.

The extraction wells would be located near the former tank excavations where the highest TVOC concentrations have been observed in groundwater. Two (2) extraction wells (each pumping at 12.5 gallons per minute, gpm) would be placed at and immediately downgradient of the Texaco Alley excavation; two (2) extraction wells (each pumping at 5 gpm) would be located at the downgradient side of the South UST excavation, and one (1) extraction well (pumping at 5 gpm) would be located at the North UST excavation. The total flow rate to the treatment system is approximately 40 gpm. The estimated radius of capture for these wells is between 25 to 30 feet. Aquifer pump tests would be performed during the remedial design phase to confirm site-specific aquifer characteristics, optimum extraction well locations, and optimum pumping rates. Given the proximity of the site to Greenport Harbor, treated groundwater would be discharged to the neighboring surface water body. A preliminary layout of the proposed groundwater pump and treat system is shown in Figure 3.2.

Groundwater treatment would be provided by a series of granular activated carbon (GAC) adsorption units, with a design flow rate of 40 gpm. The influent concentrations, assumed to be 75% of the maximum detected concentrations in groundwater, are as follows:

Compound	Design Influent Concentration [ug/L]	Design Effluent Concentration [ug/L]
Benzene	59	0.7
Ethylbenzene	297	5
Toluene	108	5
Xylenes (total)	1,101	5
Isopropylbenzene	34	5
p-Isopropyltoluene	7	5
1,2,4-Trimethylbenzene	653	5
1,3,5-Trimethylbenzene	81	5
n-Butylbenzene	89	5
sec-Butylbenzene	16	5
Total VOCs	2,445	

Based upon the estimated pumping rates and projected VOC loading, two 2,000 pound carbon filters would be required, operating in lead-lag fashion. When breakthrough occurs in the lead unit, the carbon will be replaced. At that time, the second unit will be switched into the lead position and the unit with the fresh carbon will be placed in the lag position, until the next change-out occurs when the lag unit will be rotated back into the lead position. This technology has proven very effective in the removal of VOCs from groundwater, and is capable of meeting groundwater discharge standards. Removal efficiencies of 95% and greater are typical.

In addition to groundwater treatment, periodic monitoring of groundwater would be conducted at the existing monitoring wells to observe groundwater cleanup progress. Additional sampling of influent and effluent groundwater would also be conducted to monitor treatment performance and effluent compliance.

3.3.5.2 Assessment

- Overall Protection of Human Health and the Environment

This remedial alternative, which includes both soil removal and active groundwater treatment, is protective of human health and the environment. This alternative also includes removal of soils from the Dredge Spoil Area, the Water Line Area, the Boat Bottom Scraping Area, the South UST Area, and from beneath the carousel and amphitheater buildings. Removal of soil from these additional areas do not provide for any significant incremental degree of protection to human health or the environment when compared to the level of protection that would be achievable with Alternatives 3 or 4.

This alternative also provides for aquifer rehabilitation. However, there are no downgradient receptors or routes of potential exposure for contaminated groundwater. Existing concentrations in groundwater are not expected to pose any threats to the environment since the area is highly developed and there is little wildlife in the area. Furthermore, marine life living in the waters adjacent to the site are not likely to be impacted due to the relatively low concentration levels found in on-site groundwater, in comparison to contaminant levels from bulkheading materials, and marine commercial and recreational uses. Therefore, by implementing an active groundwater remediation, the residual level of risk would only be decreased beyond what is already considered to be acceptable.

This remedial alternative is more comprehensive in terms of restoring sitewide soil and groundwater quality, however, it does not provide additional level of protection beyond what would also be protective using less costly and exhaustive remedies.

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)

The soil removal actions under this alternative would comply with the SCGs, and collection and treatment of the on-site groundwater plume will achieve SCGs for groundwater. Residual areas of the on-site plume not captured by the pump and treat system would eventually achieve SCGs via further dilution and natural attenuation. Granular activated carbon is capable of reducing VOC concentrations to meet surface water discharge standards. Aquifer rehabilitation is consistent with federal and NYS groundwater protection strategies.

To discharge the treated groundwater to Greenport Harbor, a State Pollutant Discharge Elimination System (SPDES) permit must be obtained. Discharge limits under the SPDES permit will be established based on the surface water effluent standards stipulated in 6 NYCRR Parts 700 to 705. At a minimum, monthly monitoring and reporting will be required for the discharge of treated effluent to surface water.

- Short-Term Effectiveness

The potential can exist for exposure to site workers and to the community from soil excavation activities. However, these risks can be effectively minimized through administrative and engineering controls taken during field activities to reduce the potential for release of particulate matters to the atmosphere or as runoff. Air monitoring would be conducted within the work zones and downwind areas to assess potential exposure to the community. Additionally, gloves and other personal protective clothing and equipment (i.e., coveralls, boots, hard-hats, safety glasses, etc.) should be worn by remediation workers to minimize any risk from inhalation, ingestion, or direct contact.

Implementing groundwater collection and treatment would pose no short-term risk to the public or environment, and would be effective in establishing control of plume migration. The treatment option (liquid phase GAC) can be operated safely.

- Long-Term Effectiveness and Permanence

Excavation for off-site disposal and active groundwater treatment provides for long term protection to public health via the direct contact pathway and to the environment through aquifer protection. Soil excavation and off-site disposal is a permanent remedy. With the removal of contaminated soils from the site, the residual risk to public health, and to groundwater and the environment following remediation would be minimal.

Groundwater collection and treatment offers long range protection by preventing contaminated groundwater from migrating off-site and by seeking to restore groundwater to target cleanup levels. Groundwater would be treated to levels that are below the surface water effluent standard for each VOC compound and discharged to the adjacent Greenport Harbor. Influent and effluent sampling would be performed at the treatment system to monitor system performance. A long-term groundwater monitoring program would also be implemented over the life of the active groundwater remediation program (estimated at 10 years).

- Reduction of Toxicity, Mobility, and Volume of Contaminants

Based on the site contaminants, the excavated soil, except for the UST excavation areas, would likely be managed as a non-hazardous for disposal at a permitted landfill. Since this off-site disposal option would not involve treatment, the toxicity, mobility or volume of hazardous materials in the soil would be unaffected. Soil from the Texaco Alley and South UST Areas contain petroleum hydrocarbon related VOCs and/or SVOCs. Given that the source of these contaminants are former gasoline and/or diesel USTs that contained virgin product, soil from these areas could be recycled at a permitted recycling facility. The toxicity, mobility and volume of the impacted soil would be reduced through this off-site recycling option.

Capture of contaminated groundwater would reduce the overall mobility of contaminants in groundwater. With active groundwater treatment, the groundwater concentrations will continue to decrease. Also, once the Texaco Alley source area has been remedied, no additional contaminant mass is being released to the groundwater plume, thus allowing for a more expedient cleanup.

Activated carbon that is used to treat the groundwater will need to be regenerated after reaching its adsorptive capacity. Because on-site carbon regeneration would not be cost effective, the spent carbon would be regenerated at an off-site facility.

- Feasibility

Excavation activities to remove most of the site soils are readily implementable using conventional construction equipment and methods. However, because this remedy encompasses the removal of all impacted site soils, the soil (containing arsenic) that has already been placed beneath the foundation of the carousel and amphitheater buildings would also be removed. This would require the demolition and rebuilding of both structures. Removal of soil from beneath these newly constructed structures, although technically implementable, is not feasible or practical to undertake. Furthermore, removal of this soil will not provide for any greater degree of protection to human health since these structures are already acting as an effective cap. Therefore, there are no distinct benefits gained to justify the incremental cost and the delays that will be created in the completing the park construction if this soil were to be removed.

This alternative involves the installation of five extraction wells, underground piping, and a treatment system. Installation of the groundwater collection system would utilize conventional well drilling and construction methods. Contractors and materials are readily available. Similarly, process equipment for the GAC treatment system is also readily available and easily installed.

Order of magnitude cost estimates for soil removal and the construction of the groundwater treatment are presented in Table 3.5. The total present worth (assuming 10 years of operation, at 5%) is estimated at approximately $1,807,290. This cost includes capital costs associated with soil excavation and disposal and the installation of the groundwater extraction wells, and a central treatment system that utilizes granular activated carbon. Annual O&M costs include maintenance and upkeep of the treatment system, vapor phase carbon replacement, utilities, operating labor and groundwater monitoring. Groundwater monitoring includes quarterly sampling for the presence of floating product for the first two years, and semi-annual groundwater sampling, analysis and reporting for dissolved VOCs for a period of 10 years.

3.4 Comparative Analysis

This section of the RA presents a comparative analysis of the remedial alternatives and a discussion of whether the alternatives would be capable of meeting the remedial action objectives for this site. A summary of this evaluation is provided in Table 3.6.

- Alternative 1 - The No Action alternative does not meet the remedial action objectives for this site in that it is not protective of human health or the environment. Surface soil poses a potential direct contact exposure risk. Also, the continued presence of a source area at Texaco Alley will continue to degrade groundwater quality beneath the site. This alternative is not an appropriate management option for this site.

- Alternative 2 - This remedial alternative includes soil removal (top 1 foot) from the entire site, soil removal to 2 feet bgs at the Light Pole Area, groundwater monitoring for 5 years and a deed restriction for the entire site. No active soil remediation would be undertaken for the Texaco Alley Area under this remedial action alternative. This alternative meets the remedial action objectives for protection of human health, but is not protective of groundwater. Removing and replacing the top 1-foot of surface soil, and 2 feet a the Light Pole Area minimizes the risk for exposure via the direct contact pathway. However, the continued presence of a source area at Texaco Alley will further degrade groundwater quality beneath the site. Groundwater concentrations are likely to remain above the NYSDEC SCGs. The total present worth cost for this remedial alternative is approximately $ 643,586.

- Alternative 3 - This remedial alternative includes soil removal (top 1 foot) from the entire site, soil removal to 2 feet bgs at the Light Pole Area, soil removal to 7 feet bgs at Texaco Alley, groundwater monitoring for 2 years and a deed restriction for the entire site. This alternative meets the remedial action objectives and is protective of human health and the environment. Soil removal from the top 1-foot across the site and 2 feet at the Light Pole Area, and backfilling would adequately minimize and control risks via direct contact, whereas removal of VOC-impacted soils from the Texaco Alley is protective of groundwater. With removal of the Texaco Alley source area, groundwater would achieve the SCGs through natural attenuation/degradation processes. The total present worth cost for this remedial alternative is approximately $689,092.

- Alternative 4 - This remedial alternative includes soil removal (top 1 foot) from the entire site, soil removal to 2 feet bgs at the Light Pole Area, an air sparge/SVE system at Texaco Alley, groundwater monitoring for 2 years and a deed restriction for the entire site. This alternative also meets the remedial action objectives for this site, and is protective of human health and the environment. Risks via the direct contact exposure pathway are effectively mitigated by soil removal. The use of an air sparge/vapor extraction would eventually address VOCs in soil and groundwater at the Texaco Alley Area. The total present worth cost for this remedial alternative is approximately $842,578.

- Alternative 5 - This alternative includes the removal of all soil from the site that are above the NYSDEC RSCOs or TCLP AGVs, including the Dredge Spoil Area, the Water Line Area, the Boat Bottom Scraping Area and the South UST Area, and from beneath the foundation of the new carousel and amphitheater buildings. When compared with Alternatives 3 or 4, Alternative 5 does not provide any significant degree of additional protection to public health to justify the incremental cost and time delays that would be associated with implementing this remedial action. Alternative 5 also includes aquifer rehabilitation via an active pump and treat system. However, there are no downgradient receptors or routes of potential exposure for contaminated groundwater associated with this site. Therefore, by implementing an active groundwater remediation, the residual level of human health risk would only be decreased beyond what is already considered to be acceptable for groundwater.

Of the five alternatives evaluated, only Alternatives 3, 4 and 5 meet the remedial action objectives for this site and are protective of human and the environment. While Alternative 5 is more comprehensive in terms of seeking to restore sitewide soil and groundwater quality to pre-release conditions, this alternative does not provide for any significant degree of protection to human health or the environment compared to other less costly and less exhaustive remedies. Between the two remaining alternatives (Alternative 3 and Alternative 4), Alternative 3 is the preferred remedy. Both alternatives include surface soil removal from the entire site, soil removal from the Light Pole Area, and source area remediation at Texaco Alley. Alternative 3 would employ soil excavation and off-site disposal while Alternative 4 would utilize an air sparge/SVE system for source area (soil) remediation. Both of these alternatives provide beneficial effects on groundwater. The removal of any floating product on top of the exposed groundwater during excavation activities would provide for immediate improvement to groundwater quality. Groundwater quality beneath the site would achieve SCGs under both of these alternatives. However, the use of the air sparge/SVE system, in Alternative 4 would have limited effect on the SVOCs in the soils in the Texaco Alley area. Alternative 3 would remove the source area soils, thereby eliminated any potential for further groundwater impacts from these soils. Furthermore, of the three remedial alternatives that meet the remedial action objectives, Alternative 3 is also the most cost-effective.

Therefore, the recommended remedial alternative for this site is Alternative 3, which includes:

1. Excavation with off-site disposal of the top 1 foot of arsenic-impacted soil from the entire site, placement of clean fill, and capping of some of the arsenic-impacted soils beneath the new building structures,
2. Excavation of SVOC-impacted soil to 2 feet bgs from the Light Pole Area with off-site disposal,
3. Excavation with off-site disposal of VOC and SVOC-impacted soils to 7 feet bgs in the Texaco Alley Area,
4. Periodic groundwater monitoring (for at least two years), and
5. Deed restriction for the entire site.

FIGURES

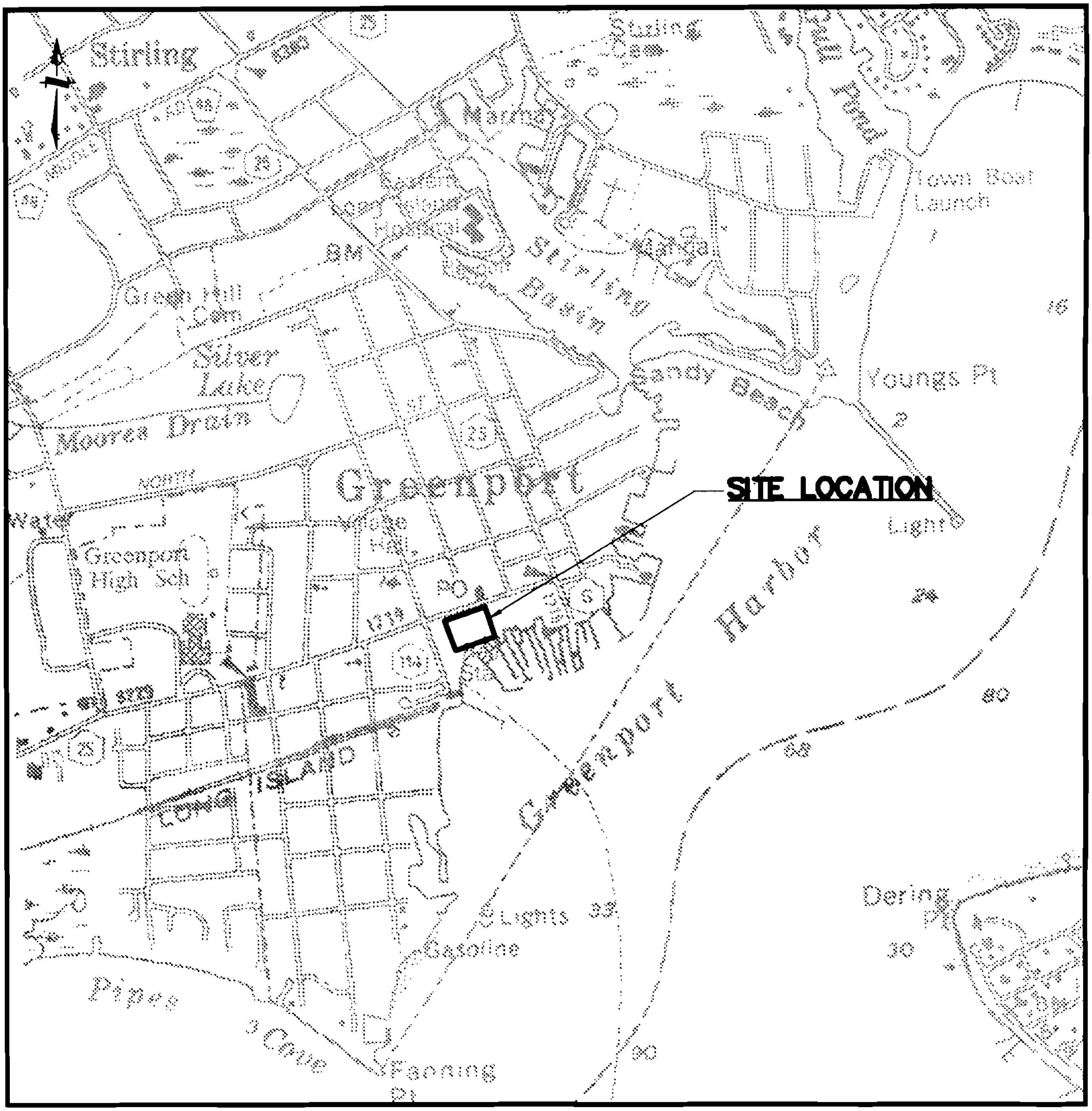


FIGURE 1.1

SITE LOCATION MAP
115 FRONT STREET PROPERTY
SITE LOCATION MAP

SCALE: 1" = 2000'

SOURCE: U.S.G.S. AMITYVILLE QUADRANGLE 1969

H2MGROUP ENGINEERS • ARCHITECTS • PLANNERS • SCIENTISTS • SURVEYORS
MELVILLE, N.Y. TOTOWA, N.J.

TOPOGRAPHICAL SURVEY

LEGEND

(S)	SEWER MANHOLE
(T)	TELEPHONE MANHOLE
(W)	WATER MANHOLE
(E)	ELECTRIC MANHOLE
	GAS VALVE
	WATER VALVE
	LOW PRESS. FIRE HYDRANT
	HIGH PRESS. FIRE HYDRANT
	PARKING METER
	UTILITY AND LIGHT POLE
	DRAIN INLET
	CATCH BASIN
CMB	MAIL BOX
TCB	TRAFFIC CONTROL BOX
	DIRECTION OF WATER FLOW
	SINGLE TRAFFIC FLOW
	TWO WAY TRAFFIC FLOW
(R)	RECORD INFORMATION
12 W	12" WATER MAIN
6"G	6" GAS LINE
12"	SEWER LINE W/ SIZE & DIRECTION OF FLOW
	UTILITY POLE
	BULKHEAD
	O.H. WIRES
13"	TREE WITH DIAMETER
	STONE BOULDERS
6.00	SPOT GRADE WITH LOCATION
	FENCE
B	BENCH
	METAL POSTS
6	CONTOUR LINE
	CHAIN
	TRAFFIC SIGN
	PLANTER
TB	TELEPHONE BOOTH
	WATER VALVE
UMH	UNKNOWN MANHOLE
	SITE BOUNDARY

ABBREVIATIONS:

TC	TOP OF CURB
BC	BOTTOM OF CURB
O.H. WIRES	OVERHEAD WIRES
CONC.	CONCRETE
CH.L.F.	CHAIN LINK FENCE
SQ.FT.	SQUARE FEET
ACT.	ACTUAL
R.O.W.	RIGHT OF WAY
N.I.F.	NOT IN FIELD

NOTES:

1) ELEVATIONS SHOWN HEREON REFER TO THE NGVD 1929 DATUM.
2) THE INFORMATION GIVEN ON THIS SURVEY PERTAINING TO UTILITIES AND/OR SUBSTRUCTURES IS NOT CERTIFIED AS TO ACCURACY OR COMPLETENESS.
3) ON-SITE SUBSURFACE UTILITY INFORMATION IS SHOWN BASED ON THE INFORMATION RECEIVED IN AN IN-FIELD WALK THROUGH WITH OWNER REPRESENTATIVES AND OR THE INFORMATION FROM THE AVAILABLE DRAWING RECORDS.

SURVEY OF: DESCRIBED PROPERTY

LOCATED AT: Incorporated Village of Greenport, Town of Southold, State of New York

TAX DESIG: District 1001, Section 005, Block 4, Lot No.'s 7.3, 7.4, 8.1, 40.1

UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW. COPIES OF THIS SURVEY MAP NOT BEARING THE LAND SURVEYOR'S INKED SEAL OR EMBOSSED SEAL SHALL NOT BE CONSIDERED TO BE A VALID TRUE COPY.

CERTIFICATION INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON, AND TO THE ASSIGNEES OF THE LENDING INSTITUTION. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS.

THE EXISTANCE OF RIGHT OF WAYS AND/OR EASEMENTS OF RECORD, IF ANY, NOT SHOWN ARE NOT CERTIFIED.

SOURCE OF BASE MAP: SHAPLES ARCITECHURE

No	Date:	Revisions:	By

Designed By: RJB	Project No. GRP1 9801
Date FEB 1999	Scale: 1"=30'
Drawn By: JEM	File name FIG12.DWG
Checked By: --	Xref File Name: --
Reviewed By: --	File Location: GF2

INCORPORATED VILLAGE OF GREENPORT

FIGURE 1.2
SITE MAP WITH AREA OF CONCERN

H2MGROUP
516-756-8000
203-929-3788
973-942-0700

Holzmacher, McLendon & Murrell, P.C.
CONSULTING ENGINEERS · ARCHITECTS · PLANNERS · SCIENTISTS · SURVEYORS
MELVILLE, N.Y. SHELTON, CT. TOTOWA, N.J.

Sheet Title: SITE MAP WITH AREAS OF CONCERN

Sheet NO.

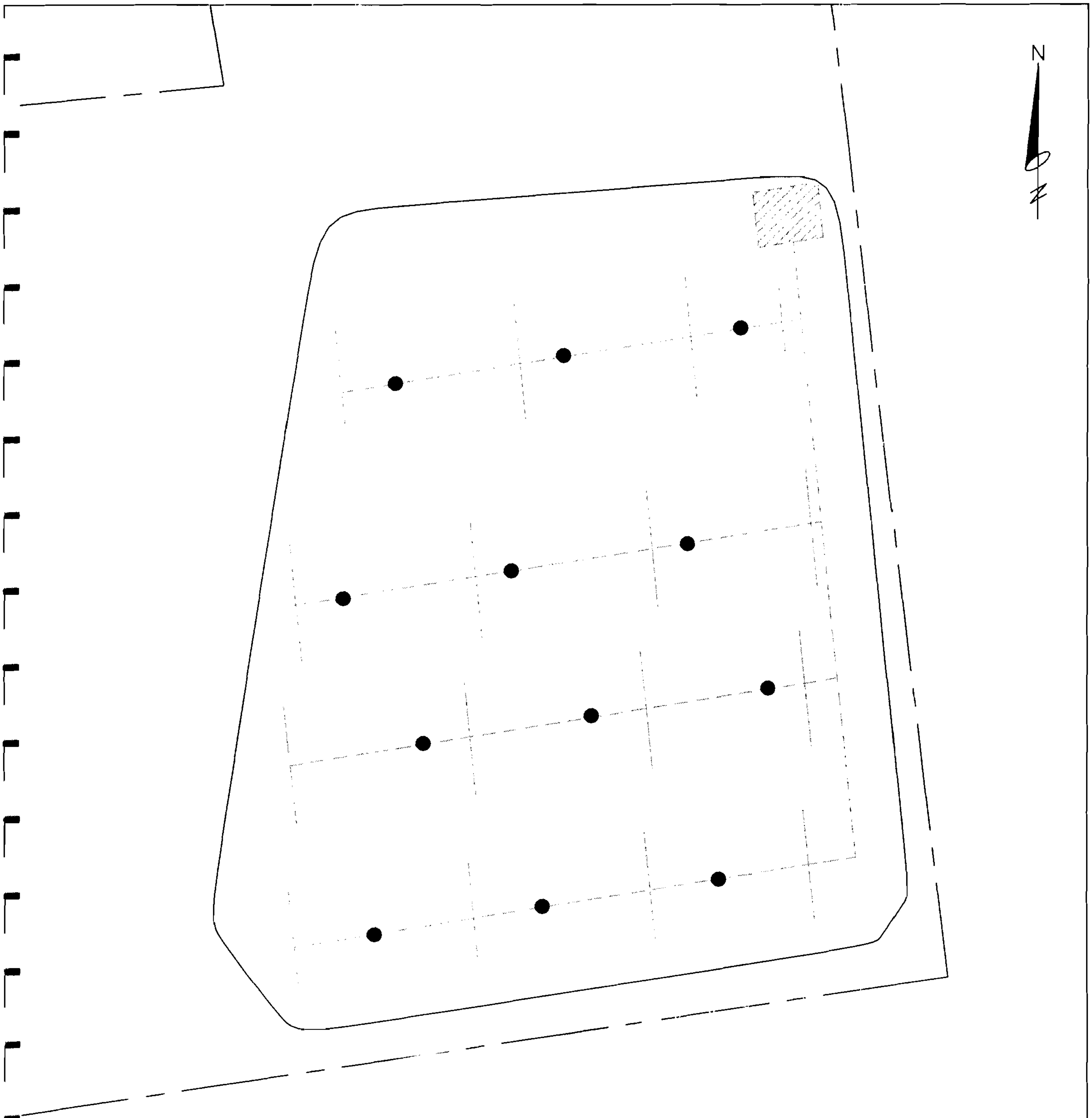
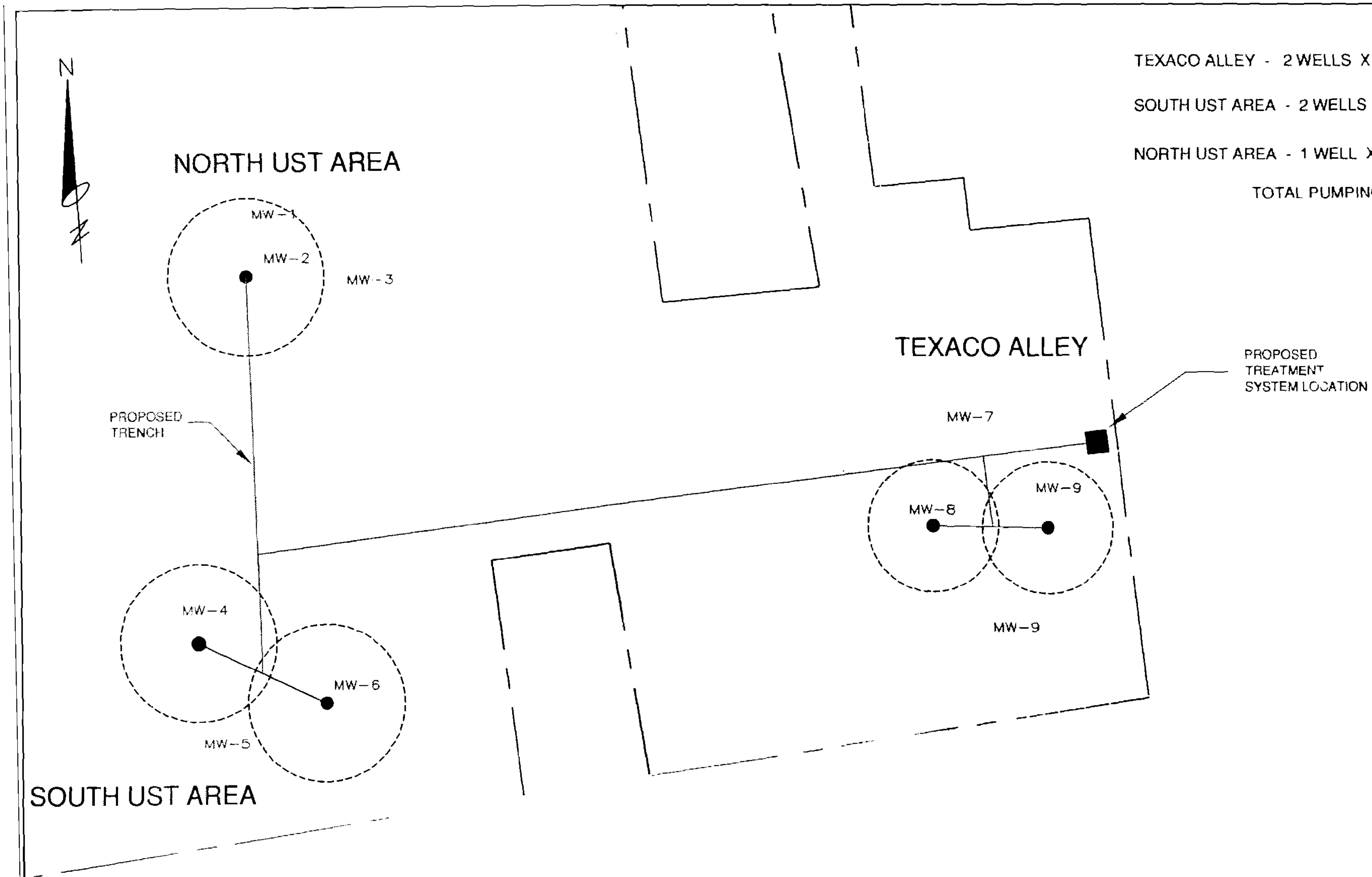


FIGURE 3.1
TEXACO ALLEY AREA
CONCEPTUAL LAYOUT OF
AIR SPARGE/SVE
115 FRONT STREET
VILLAGE OF GREENPORT, NEW YORK

APPROXIMATE SCALE
0 30
(IN FEET)

LEGEND:
PROPOSED SOIL VAPOR EXTRACTION LEGS
● PROPOSED AIR SPARGING LOCATIONS

H2MGROUP
ENGINEERS · ARCHITECTS · PLANNERS · SCIENTISTS · SURVEYORS
MELVILLE, N.Y. TOTOWA, N.J.



TEXACO ALLEY - 2 WELLS X 12.5 gpm	=	25 gpm
SOUTH UST AREA - 2 WELLS X 5 gpm	=	10 gpm
NORTH UST AREA - 1 WELL X 5 gpm	=	5 gpm
TOTAL PUMPING RATE	=	40 gpm

APPROXIMATE SCALE

0 60

(IN FEET)

FIGURE 3.2
GROUNDWATER EXTRACTION AND TREATMENT
CONCEPTUAL LAYOUT OF EXTRACTION WELL NETWORK

LEGEND:

EXISTING MONITORING WELL

PROPOSED EXTRACTION WELL

APPROXIMATE ZONE OF INFLUENCE

H2M GROUP ENGINEERS · ARCHITECTS · PLANNERS · SCIENTISTS · SURVEYORS
MELVILLE, N.Y. RIVERHEAD, N.Y. SHELTON, CT. TOTOWA, N.J.

TABLES

Table 2.1
Identification and Preliminary Screening of Remedial Technologies
115 Front Street (Mitchell Property)
Village of Greennport, New York

REMEDIAL ALTERNATIVE	TREATMENT PROCESS	EVALUATION/COMMENTS	RETAIN OR ELIMINATE
EXCAVATION	EXCAVATION FOR OFF-SITE DISPOSAL	FEASIBLE FOR SOIL	RETAIN
CONTAINMENT	SLURRY WALLS/SHEET PILING	NOT FEASIBLE DUE TO LARGE AREAL EXTENT OF PLUME	ELIMINATE
IN-SITU BIOLOGICAL TREATMENT	DECOMPOSITION OF ORGANIC CONTAMINANTS VIA THE USE OF MICROORGANISMS AND INTRODUCTION OF OXYGEN RELEASING COMPOUNDS	INDIGENOUS MICROORGANISMS MAY OR MAY NOT BE PRESENT. TECHNOLOGY IS UNPROVEN IN SALINE WATERS. FULL SCALE TREATABILITY TESTING WOULD BE NECESSARY TO DETERMINE VIABILITY OF THIS ALTERNATIVE	ELIMINATE
IN-SITU CHEMICAL TREATMENT (OXIDATION-REDUCTION REACTION)	INJECTION OF CHEMICALS (USING STRONG OXIDIXING OR REDUCING AGENT) TO RENDER CONTAMINANTS NON-HAZARDOUS	CONTAMINANTS COULD BE TRANSFORMED TO MORE TOXIC SUBSTANCES STORAGE OF HAZARDOUS OXIDIZING/REDUCING CHEMICALS.	ELIMINATE
IN-SITU PHYSICAL TREATMENT: AIR SPARGING	INJECTION OF PRESSURIZED AIR BELOW THE WATER TABLE TO INCREASE THE RATE OF VOLATILIZATION OF VOCs IN THE SATURATED ZONE.	AIR SPARGING HAS PROVEN TO BE AN EFFECTIVE METHOD FOR REMOVING VOCs FROM GROUNDWATER	RETAIN
IN-SITU PHYSICAL TREATMENT: IN-WELL STRIPPING	AERATION OF GROUNDWATER BY INTRODUCING AIR THROUGH THE WELL BORE. GROUNDWATER IS DRAWN INTO THE WELL BY DENSITY-DRIVEN CONVECTION OR WITH A PUMP, AND TREATED BY VOLATILIZING VOCs.	AN EMERGING TECHNOLOGY; HAS BEEN EFFECTIVELY UTILIZED AT SITES WITH SIMILAR CONTAMINANTS. GROUNDWATER IS TOO SHALLOW FOR APPLICATION OF THIS TREATMENT TECHNOLOGY.	ELIMINATE
GROUNDWATER EXTRACTION, TREATMENT, DISCHARGE	PUMP, TREAT, DISCHARGE GROUNDWATER	TECHNOLOGY POTENTIALLY APPLICABLE	RETAIN

Table 2.1
Identification and Preliminary Screening of Remedial Technologies
115 Front Street (Mitchell Property)
Village of Greennport, New York

REMEDIAL ALTERNATIVE	TREATMENT PROCESS	EVALUATION/COMMENTS	RETAIN OR ELIMINATE
EX-SITU BIOLOGICAL TREATMENT	CONTROLLED ENVIRONMENT TO ENHANCE THE GROWTH OF MICROORGANISMS USING ACTIVATED SLUDGE SYSTEMS, TRICKLING FILTERS OR ROTATING BIOLOGICAL CONTRACTORS	NOT EFFECTIVE IN THE TREATMENT OF RELATIVELY LOW LEVELS OF VOCS IN GROUNDWATER	ELIMINATE
ULTRAVIOLET OXIDATION	CHEMICAL OXIDATION PROCESS UTILIZING UV LIGHT AS A CATALYST	HIGH NATURAL IRON CONTENT OF GROUNDWATER WOULD CAUSE SCALING, RESULTING IN HIGH MAINTENANCE AND LOWERED TREATMENT EFFICIENCY	ELIMINATE
CHEMICAL PRECIPITATION (COAGULATION & FLOCCULATION)	COMBINATION OF CHEMICAL ADDITION AND MECHANICAL MIXING	NOT EFFECTIVE IN THE TREATMENT OF VOLATILE ORGANICS	ELIMINATE
SEDIMENTATION	REMOVAL OF PARTICULATE MATTER BY GRAVITY	NOT COMPLETELY EFFECTIVE IN THE REMOVAL OF DISSOLVED CONTAMINANTS	ELIMINATE
ION EXCHANGE	REMOVAL OF CONTAMINANTS BY PASSING GROUNDWATER THROUGH A CHEMICAL ADSORPTIVE RESIN	DIFFERENT CONTAMINANTS REQUIRE DIFFERENT RESINS PRETREATMENT OF THE GROUNDWATER REQUIRED	ELIMINATE
FILTRATION	REMOVAL OF SUSPENDED MATTER FROM WATER	NOT EFFECTIVE IN REMOVAL OF VOCs.	ELIMINATE
CARBON ADSORPTION	CONTAMINANT ADSORPTION VIA ACTIVATED CARBON	POTENTIALLY APPLICABLE. CAPABLE OF TREATING VOCS TO REQUIRED EFFLUENT STANDARDS.	RETAIN
AIR STRIPPING	TRANSFER OF CONTAMINANTS FROM LIQUID PHASE TO AIR PHASE BY COUNTERCURRENT AIR FLOW	HIGH NATURAL IRON CONTENT OF GROUNDWATER WILL CAUSE FOULING OF PACKING MATERIAL, REQUIRING HIGH MAINTENANCE TO CLEAN PACKING	ELIMINATE
NO FURTHER ACTION	NONE	PROCEDURAL REQUIREMENT	RETAIN

Table 3.1
Cost Analysis
Alternative No. 1
115 Front Street Property
Village of Greenport, New York

I. Capital Costs	Unit Price	Quantity	Cost
a. Deed Restriction			$ 2,000
		Subtotal:	$ 2,000
		Administration (10%):	$ 200
		Engineering (10%):	$ 200
		Contingency (20%):	$ 400
		Subtotal Estimated Capital Cost:	**$ 2,800**

II. Annual Operating Costs	Unit Cost	Quantity	Cost
a. Quarterly Groundwater Monitoring For	$ 900 /event	4 events/yr.	$ 3,600
b. Semi-Annual Groundwater Sampling for	$ 10,000 /event	2 events/yr.	$ 20,000
		Subtotal Estimated Annual Operating Cost:	**$ 23,600**

III. Present Worth Capital Costs and Annual Operating Costs	
Total Estimated Capital Cost	$ 2,800
Total Estimated Annual Operating Cost	$ 23,600
Present Worth (5 yrs., 5%)	$ 102,164
Present Worth (Total Capital & Operating)	**$ 104,964**

Notes:

1. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.
2. Operating (monitoring) costs are assumed for 5 years.

Table 3.2
Cost Analysis
Alternative No. 2
115 Front Street Property
Village of Greenport, New York

I. Capital & Installation Costs:	Unit Price		Quantity		Cost
a. Remove 1 Foot Soil From Site					
- Excavate 1 Foot Soil (3,040 cy)	$ 1,500	/day	12	days	$ 18,000
- Dispose of Soil (Non-Haz., 3,040 cy)	$ 55	/ton*	4,256	tons	$ 234,080
- Dispose of Previously Excavated Soil (Non-Haz., 1200 cy)	$ 55	/ton*	1,200	tons	$ 66,000
					$ 300,080
b. Remove Soil From 1' to 2' bgs From Light Pole Area					
- Excavate Soil (50 cy)	$ 1,500	/day	1	day	$ 1,500
- Dispose of Non-Haz. Soil (50 cy)	$ 60	/ton	70	tons	$ 4,200
					$ 5,700
c. - Backfill and Grading (Labor & Material)					
Clean Fill (6-inches)	$ 13	/cy	2,550	cy	$ 33,150
Topsoil (6-inches)	$ 17	/cy	2,500	cy	$ 42,500
					$ 75,650
d. Misc. Repairs for Existing Wells	$ 300	/well	11	wells	$ 3,300
e. Deed Restriction					$ 2,000
				Subtotal:	$ 386,730
				Administration (10%):	$ 38,673
				Engineering (10%):	$ 38,673
				Contingency (20%):	$ 77,346
				Subtotal Estimated Capital Cost:	**$ 541,422**

II. Annual Operating Costs	Unit Cost		Quantity	Cost
a. Quarterly Groundwater Monitoring For Presence of Floating Product	$ 900	/event	4 events/yr.	$ 3,600
b. Semi-Annual Groundwater Sampling for VOCs and SVOCs	$ 10,000	/event	2 events/yr.	$ 20,000
			Subtotal Estimated Annual Operating Cost:	**$ 23,600**

III. Present Worth Capital Costs and Annual Operating Costs	
Total Estimated Capital Cost	$ 541,422
Total Estimated Annual Operating Cost	$ 23,600
Present Worth (5 yrs., 5%)	$ 102,164
Present Worth (Total Capital & Operating)	**$ 643,586**

Notes:
1. Soil density of approximately 1.4 tons/cy was assumed.
2. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.
3. Operating (monitoring) costs are assumed for 5 years.
4. Assumes that backfill and grading will occur simultaneously with excavation operations

* This cost estimate is considered a conservative industry standard used for purposes of this report. However, costs for disposal may be as low as $10 to $15 per ton if soils can be re-used (i.e., landfill capping, etc.).

Table 3.3
Cost Analysis
Alternative No. 3
115 Front Street Property
Village of Greenport, New York

I. **Capital & Installation Costs:**	Unit Price		Quantity	Cost
a. Remove 1 Foot Soil From Site				
- Excavate 1 Foot Soil (3,040 cy)	$ 1,500	/day	12 days	$ 18,000
- Dispose of Soil (Non-Haz., 2,480 cy)	$ 55	/ton*	3,472 tons	$ 190,960
- Dispose of Previously Excavated Soil (Non-Haz., 1,200 cy)	$ 55	/ton*	1,680 tons	$ 92,400
				$ 301,360
b. Remove Soil From 1' to 2' bgs From Light Pole Area				
- Excavate Soil (50 cy)	$ 1,500	/day	1 days	$ 1,500
- Dispose of Non-Haz. Soil (50 cy)	$ 60	/ton	70 tons	$ 4,200
				$ 5,700
c. Remove Soil to 7' bgs From Texaco Alley Area				
- Excavate Soil (784 cy)	$ 1,500		3 days	$ 4,500
- Dispose of Non-Haz. Soil (784 cy)	$ 60		1,098 tons	$ 65,880
				$ 70,380
d. Application of Absorbant Boom in Excavation				
- Hydrophillic Absorbant Boom	$ 103	/40 ft	80 ft	$ 206
d. Backfill and Grading				
Clean Fill (6-inches, 2,725 cy)	$ 13	/cy	2,725 cy	$ 35,425
Topsoil (6-inches, 2,500 cy)	$ 17	/cy	2,500 cy	$ 42,500
				$ 77,925
e. Misc. Repairs for Existing Wells	$ 300	/well	11 wells	$ 3,300
f. Deed Restriction				$ 2,000
			Subtotal:	$ 460,871
			Administration (10%):	$ 46,087
			Engineering (10%):	$ 46,087
			Contingency (20%):	$ 92,174
			Subtotal Estimated Capital Cost:	**$ 645,219**

II. **Annual Operating Costs**	Unit Cost		Quantity	Cost
a. Quarterly Groundwater Monitoring For Presence of Floating Product	$ 900	/event	4 events/yr.	$ 3,600
b. Semi-Annual Groundwater Sampling for VOCs and SVOCs	$ 10,000	/event	2 events/yr.	$ 20,000
			Subtotal Estimated Annual Operating Cost:	**$ 23,600**

III. **Present Worth Capital Costs and Annual Operating Costs**	
Total Estimated Capital Cost	$ 645,219
Total Estimated Annual Operating Cost	$ 23,600
Present Worth (2 yrs., 5%)	$ 43,872
Present Worth (Total Capital & Operating)	**$ 689,092**

Notes:

1. Soil density of approximately 1.4 tons/cy was assumed.
2. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.
3. Operating (monitoring) costs are assumed for 2 years.
4. Assumes that 560 cy of Arsenic impacted soils will be used as backfill in the Texaco Alley excavation area. Backfill prices also are based on contractors being able to haul back clean fill to the site after disposal has been accomplished.

* This cost estimate is considered a conservative industry standard used for purposes of this report. However, costs for disposal may be as low as $10 to $15 per ton if soils can be re-used (i.e., landfill capping, etc.).

Table 3.4
Cost Analysis
Alternative No. 4
115 Front Street Property
Village of Greenport, New York

I. Capital & Installation Costs:	Unit Price	Quantity	Cost
a. Remove 1 Foot Soil From Site			
- Excavate 1 Foot Soil (3,040 cy)	$ 1,500 /day	12 days	$ 18,000
- Dispose of Soil (Non-Haz., 2,480 cy)	$ 55 /ton*	3,472 tons	$ 190,960
- Dispose of Previously Excavated Soil (Non-Haz., 1,200 cy)	$ 55 /ton*	1,680 tons	$ 92,400
			$ 301,360
b. Remove Soil From 1' to 2' bgs From Light Pole Area			
- Excavate Soil (50 cy)	$ 1,500 /day	1 day	$ 1,500
- Dispose of Non-Haz. Soil (50 cy)	$ 60 /ton	70 tons	$ 4,200
			$ 5,700
c. In-Situ Air Sparge/SVE System For Texaco Alley Area			
- Pilot Testing			$ 10,000
- Air Sparge/SVE Well Installation (12 AS Wells to 15' bgs and 16 Horizontal Extraction Legs)			$ 15,000
- Trenching/Subsurface Lines			$ 40,000
- Dispose of Non-Haz. Soil (100 cy)		140 tons	$ 8,400
- Electrical Installation			$ 10,000
- Mechanical Installation (Blower, Compressor, Controls)			$ 30,000
- Enclosure			$ 10,000
- Vapor Phase Control (2 GAC Units)			$ 6,000
- System Start-Up			$ 7,000
			$ 136,400
d. - Backfill and Grading (Labor & Material)			
Clean Fill (6-inches 2,725 cy)	$ 13 /cy	2,725 cy	$ 35,425
Topsoil (6-inches 2,500 cy)	$ 17 /cy	2,500 cy	$ 42,500
			$ 77,925
c. Misc. Repairs for Existing Wells	$ 300 /well	11 wells	$ 3,300
d. Deed Restriction			$ 2,000
		Subtotal:	$ 526.685
		Administration (10%):	$ 52,669
		Engineering (10%):	$ 52,669
		Contingency (20%):	$ 105,337
		Subtotal Estimated Capital Cost:	**$ 737,359**

II. Annual Operating Costs	Unit Cost	Quantity	Cost
a. Quarterly Groundwater Monitoring For Presence of Floating Product	$ 900 /event	4 events/yr.	$ 3,600
b. Semi-Annual Groundwater Sampling for VOCs and SVOCs	$ 10,000 /event	2 events/yr.	$ 20,000
c. Electricity	$ 6,000 /year	1	$ 6,000
d. Carbon Consumption/Changeouts	$ 9,000 /year	1	$ 9,000
e. Operator/Maintenance/Monitoring	$ 18,000 /year	1	$ 18,000
		Subtotal Estimated Annual Operating Cost:	**$ 56,600**

III. Present Worth Capital Costs and Annual Operating Costs	
Total Estimated Capital Cost	$ 737,359
Total Estimated Annual Operating Cost	$ 56,600
Present Worth (2 yrs., 5%)	105,219.40
Present Worth (Total Capital & Operating)	**$ 842,578**

Notes:
1. Soil density of approximately 1.4 tons/cy was assumed.
2. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.
3. Operating (monitoring) costs are assumed for 2 years.
4. Assumes that backfill and grading will occur simultaneously with excavation operations

* This cost estimate is considered a conservative industry standard used for purposes of this report. However, costs for disposal may be as low as $10 to $15 per ton if soils can be re-used (i.e., landfill capping, etc.).

Table 3.5
Cost Analysis
Alternative No. 5
115 Front Street Property
Village of Greenport, New York

I. Capital Costs - Soil Removal:	Unit Price		Quantity		Cost	
a. Remove 1 Foot Soil From Site						
- Excavate 1 Foot Soil (3,040 cy)	$ 1,500	/day	12	days	$	18,000
- Dispose of Soil (Non-Haz., 2,480 cy)	$ 55	/ton*	3,472	tons	$	190,960
- Dispose of Previously Excavated Soil (Non-Haz., 1,200 cy)	$ 55	/ton*	1,680	tons	$	92,400
					$	301,360
b. Remove Soil From 1' to 2' bgs From Light Pole Area						
- Excavate Soil (50 cy)	$ 1,500	/day	1	days	$	1,500
- Dispose of Non-Haz. Soil (50 cy)	$ 60	/ton	70	tons	$	4,200
					$	5,700
c. Remove Soil to 7' bgs From Texaco Alley Area						
- Excavate Soil (784 cy)	$ 1,500		3	days	$	4,500
- Dispose of Non-Haz. Soil (784 cy)	$ 60		1,098	tons	$	65,880
					$	70,380
d. Dredge Spoil Area						
- Excavate Soil (30 cy)	$ 1,500	/day	1	days	$	1,500
- Dispose of Soil (Non-Haz., 30 cy)	$ 60	/ton	42	tons	$	2,520
					$	4,020
e. Water Line Area						
- Excavate Soil (390 cy)	$ 1,500	/day	3	day	$	4,500
- Dispose of Non-Haz. Soil (390 cy)	$ 60	/ton	546	tons	$	32,760
					$	37,260
f. South UST Area						
- Excavate Soil (210 cy)	$ 1,500	/day	2	day	$	3,000
- Dispose of Non-Haz. Soil (210 cy)	$ 60	/ton	294	tons	$	17,640
					$	20,640
g. Boat Bottom Scraping Area						
- Excavate Soil (490 cy)	$ 1,500	/day	4	day	$	6,000
- Dispose of Non-Haz. Soil (490 cy)	$ 60	/ton	686	tons	$	41,160
					$	47,160
h. Backfill and Grading						
Clean Fill (6-inches, 3,895 cy)	$ 13	/cy	3,895	cy	$	50,635
Topsoil (6-inches, 2,500 cy)	$ 17	/cy	2,500	cy	$	42,500
					$	93,135
Subtotal Estimated Capital Cost for Soil:					$	579,655

Notes:
1. Cost estimate does not include removal and reconstruction of either the carousel or amphitheater
2. Soil density of approximately 1.4 tons/cy was assumed.
3. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.
4. Assumes that 560 cy of Arsinic Contaminated soil will be used as backfill in Texaco Alley.
5. Assumes that backfill and grading will occur simultaneously with excavation operations

* This cost estimate is considered a conservative industry standard used for purposes of this report. However, costs for disposal may be as low as $10 to $15 per ton if soils can be re-used (i.e., landfill capping, etc.).

Table 3.5 (Continiued)
Cost Analysis
Alternative No. 5 (Continued)
115 Front Street Property
Village of Greenport, New York

II. Capital Costs - Groundwater:	Unit Cost			Quantity	Cost	
Extraction						
Extraction Wells	$	3,000	ea.	5	$	15,000
Pump System	$	3,000	ea.	5	$	15,000
Utility Vault	$	5,000	ea.	5	$	25,000
Transmission Pipe/Conduit (LF)	$	40	/LF	600 LF	$	24,000
					$	79,000
Treatment						
Treatment Building	$	15,000	ea.	1	$	15,000
Eqpt. Foundation	$	5,000	ea.	1	$	5,000
Filter	$	2,000	ea.	2	$	4,000
Liquid-Phase GAC Unit	$	5,000	ea.	2	$	10,000
Power Source	$	10,000	ea.	1	$	10,000
Process Piping & Valves	$	10,000	ea.	1	$	10,000
System Control	$	10,000	ea.	1	$	10,000
					$	49,000
Discharge						
Drainage Piping	$	40	/LF	50 LF	$	2,000
				Subtotal for Groundwater:	$	130,000
				Subtotal for Soil (From Previous Page):	$	579,655
				Subtotal Soil & Groundwater:	$	709,655
				Admin./Constr. Mgmt. (20%):	$	70,966
				Engineering (10%):	$	70,966
				Contingency (20%):	$	141,931
				Subtotal Estimated Capital Cost for Soil & Groundwater:	**$**	**993,517**

1. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.

Table 3.5 (Continiued)
Cost Analysis
Alternative No. 5 (Continued)
115 Front Street Property
Village of Greenport, New York

III. Annual Operating Costs	Unit Cost			Quantity		Cost	
Electricity	$	3,000	L.S.	1		$	3,000
System Engineer	$	70	/hr.	100	hours/yr.	$	7,000
System Operator	$	50	/hr.	250	hours/yr.	$	12,500
Maintenance Materials	$	10,000	L.S.	1		$	10,000
Liquid-Phase GAC Replacement	$	25,000	L.S.	1		$	25,000
Solids Disposal	$	250	/drum	2	drums/yr.	$	500
Monthly System Performance Monitoring [1]	$	2,210	/event	12	events/yr.	$	26,520
Quarterly Groundwater Monitoring For Presence of Floating Product [2]	$	900	/event	4	events/yr.	$	3,600
Semi-Annual Groundwater Sampling for VOCs and SVOCs [1]	$	10,000	/event	2	events/yr.	$	20,000
Subtotal Estimated Annual Operating Cost (Years 1 and 2):						**$**	**108,120**
Subtotal Estimated Annual Operating Cost (Years 3 through 10):						**$**	**104,520**

IV. Present Worth Capital Costs and Annual Operating Costs

Total Estimated Capital Cost for Soil and Groundwater (From Previous Page)	$	993,517
Total Estimated Annual Operating and Monitoring Cost for Groundwater(Years 1 and 2)	$	108,120
Present Worth (5%)		201,046
Total Estimated Annual Operating and Monitoring Cost for Groundwater(Years 3 through 1(	$	104,520
Present Worth (5%)		612,728
Present Worth (Total Capital & Operating)	**$**	**1,807,290**

These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.

[1] Monitoring for life of treatment system (10 years)

[2] Monitoring for first two years of treatment system (2 years)

Cost Analysis
Additional Areas
115 Front Street Property
Village of Greenport, New York

I. **Capital & Installation Costs:**	Unit Price	Quantity	Cost
a. Dredge Spoil Area			
- Excavate Soil (30 cy)	$ 1,500	1 days	$ 1,500
- Dispose of Soil (Non-Haz., 30 cy)	$ 55	42 tons	$ 2,310
			$ 3,810
b. Water Line Area			
- Excavate Soil (390 cy)	$ 1,500	3 day	$ 4,500
- Dispose of Non-Haz. Soil (390 cy)	$ 55	546 tons	$ 30,030
			$ 34,530
c. South UST Area			
- Excavate Soil (210 cy)	$ 1,500	2 day	$ 3,000
- Dispose of Non-Haz. Soil (210 cy)	$ 55	294 tons	$ 16,170
			$ 19,170
d. Boat Bottom Scraping Area			
- Excavate Soil (490 cy)	$ 1,500	4 day	$ 6,000
- Dispose of Non-Haz. Soil (490 cy)	$ 55	686 tons	$ 37,730
			$ 43,730
e. Backfill and Grading			
- Clean Fill (1,120)	$ 13 /cy	1,120 cy	$ 14,560
	Subtotal Estimated Capital Cost:		**$ 115,800**

Notes:

1. Soil density of approximately 1.4 tons/cy was assumed.
2. These Cost Estimates represent our opinion as design professionals of probable order of magnitude construction and operating costs and are provided for general guidance in the evaluation of alternatives. Actual contractor bids or cost to the client are a function of final design, competitive bidding and market conditions.

Table 3.6
Evaluation of Remedial Action Alternatives
115 Front Street (Mitchell Property)
Village of Greenport, New York

Evaluation Criteria	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4	Alternative No. 5
Overall Protection of Human Health and the Environment					
Protectiveness	Not protective of human heath and the environment. Surface soil poses a potential direct contact exposure. Continued source area at Texaco Alley will further degrade groundwater quality. However, there is currently no risk to public health from groundwater ingestion since there are no users of groundwater downgradient of the plume.	Protective of human health. Risk associated with the direct contact exposure pathway is being adequately addressed by soil removal. Site groundwater does not pose any human health threats since there are no downgradient human receptors. Source of VOCs at Texaco Alley will further degrade groundwater quality.	Protective of public health and the environment. Surface soil removal mitigates risk for exposure via the direct contact pathway. This remedial action also provides for protection of groundwater and the environment. With source area removal at Texaco Alley, aquifer rehabilitation under natural processes can eventually be achieved.	Protective of public health and the environment. Surface soil removal mitigates risk for exposure via the direct contact pathway. This remedial action also provides for protection of groundwater and the environment. With source area remediation and localized groundwater treatment at Texaco Alley, aquifer rehabilitation can be achieved more readily.	Protective of public health and the environment. Soil removal minimizes the potential for direct contact exposure and provides for source area remediation. This remedial action also includes active groundwater treatment for aquifer rehabilitation.
Compliance with Standards, Criteria, and Guidance (SCGs)	Contaminants in soil and groundwater will continue to exceed standards and criteria.	Would meet NYSDEC SCGs for soil at the Light Pole Area and for surface soil across the entire site, but not for soils at the Texaco Alley Area. Groundwater concentrations will remain above NYSDEC SCGs because of the continued presence of a source area.	This alternative would meet the SCGs for soil. Initially, VOCs in groundwater would exceed standards. With the contaminant source at the Texaco Alley Area removed, the groundwater plume would eventually achieve SCGs through natural attenuation processes.	This alternative would meet SCGs for soil. By remediating the source and locally treating groundwater using AS/SVE, groundwater will also meet SCGs. For the portion of the plume outside the treatment area, groundwater quality would eventually achieve SCGs through natural attenuation processes.	This alternative would meet the SCGs for soil and groundwater. Groundwater will also achieve SCGs with implementation of an active on-site treatment system. Portions of the plume not captured by the pump and treat system would eventually achieve SCGs via further dilution and natural attenuation.

Table 3.6
Evaluation of Remedial Action Alternatives
115 Front Street (Mitchell Property)
Village of Greenport, New York

Evaluation Criteria	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4	Alternative No. 5
Short Term Effectiveness Protection of Workers and Residents	There will be no short-term effects to the community, to workers, or to the environment.	Any potential risks posed to site workers and the community from soil excavation activities can be effectively minimized through administrative and engineering controls taken during field activities. Air monitoring would be conducted. Personnel protective equipment will be worn to minimize any risk from inhalation, ingestion, or direct contact.	Administrative and engineering controls would be taken to minimize the potential for release of airborne dusts and particles. Air monitoring would be conducted. Personnel protective equipment will be worn to protect site workers.	Administrative and engineering controls, and air monitoring would be employed to minimize the potential for release of airborne dusts and particles. The AS/SVE can be operated safely. Off-gas from the AS/SVE would be treated prior to discharging to the atmosphere. There would not be any impact to air quality in the surrounding community.	Administrative and engineering controls would be taken to minimize the potential for release of airborne dust and runoff. A community air monitoring program would be conducted. Personnel protective equipment will be worn to protect site workers. The GAC groundwater treatment system can be operated safely.
Long-Term Effectiveness and Permanence Adequacy, Reliability of Controls, and Permanence	Leave site in present condition. Contaminants in soil and groundwater would continue to be in contravention of standards or criteria. No efforts would be needed to maintain this remedy.	Soil excavation and off-site disposal is a permanent remedy. Arsenic contaminated soils beneath the raised structure of the carousel and the amphitheater building are capped in place. Soil removal is effective in eliminating potential future risk to the public. VOCs from the Texaco Alley source area which could further degrade groundwater quality.	Provides for long term protection to public health via the direct contact pathway and to the environment through aquifer protection. Source area remediation offers long range protection to the environment by preventing additional release of contaminants to groundwater.	Provides for long term protection to public health via the direct contact pathway and to the environment through aquifer protection. Source area remediation with localized groundwater treatment (using AS/SVE) offers long range protection to the environment by preventing impacted groundwater from migrating further off-site.	Provides for long term protection to public health via the direct contact pathway and to the environment through aquifer protection. GAC is deemed reliable and has been shown to be effective with similar VOC contaminants. Soil and groundwater remedies are considered a permanent solution since contaminants will be removed from the soil and groundwater media.

Table 3.6
Evaluation of Remedial Action Alternatives
115 Front Street (Mitchell Property)
Village of Greenport, New York

Evaluation Criteria	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4	Alternative No. 5
Reduction of Toxicity, Mobility, and Volume					
Reductions in Toxicity, Mobility, and Volume	Not Applicable	The excavated soils would be managed as a non-hazardous waste for off-site disposal. This disposal option would not involve treatment, therefore, the toxicity, mobility or volume of the waste materials would be unaffected.	Arsenic contaminated soils would be landfilled. The toxicity, volume or mobility of the waste material is unaffected. VOC and SVOC-impacted soil from the Texaco Alley Area could be recycled, thus reducing the toxicity, mobility and volume of the hazardous substances in the soil.	Arsenic contaminated soils would be landfilled. Air sparge/vapor extraction would reduce VOC levels in both soil and groundwater. Except for carbon, no significant amounts of residual waste are generated. Spent carbon would be regenerated off-site. Provides for long-term protection to the public and to the environment through aquifer rehabilitation.	Excavated soil will be disposed of off-site by landfilling or recycling. GAC treatment technology effectively removes VOCs contaminants (with removal efficiencies of >95%). Periodic regeneration of spent GAC is needed.
Feasibility					

Table 3.6
Evaluation of Remedial Action Alternatives
115 Front Street (Mitchell Property)
Village of Greenport, New York

Evaluation Criteria	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4	Alternative No. 5
Ease of Undertaking Additional Remedial Actions	Not Applicable	Soil excavation and backfilling/grading is readily achievable using conventional construction equipment. A deed restriction would be recorded to restrict an alternate use of the site without NYSDEC approval.	Soil excavation and backfilling/grading is readily achievable using conventional construction equipment. A deed restriction would be recorded to restrict an alternate use of the site without NYSDEC approval.	Soil excavation/backfilling, and installation of air sparge points and extraction legs is readily achievable using conventional construction, drilling and trenching methods. A deed restriction would be recorded to restrict an alternate use of the site without NYSDEC approval.	The groundwater treatment system is readily implementable. However, this alternative requires removal of soil from under the new carousel and amphitheater building. Removing this soil will not provide for any greater degree of protection to human health; does not justify the incremental cost or the construction delays.
Cost					
Capital Cost	$2,800	$541,422	$645,219	$737,359	$908,383
Annual O&M Costs	$23,600	$23,600	$23,600	$56,600	$108,120 / $104,520 (1)
Total Present Worth (Capital plus O&M)	$104,964	$643,586	$689,092	$842,578	$1,807,290

Notes

(1) For Years 1 and 2 is $108, 120. And for Years 3 to 10 is $104,520.

APPENDIX A

Chemical-Specific SCDs

Table A.2

Chemical-Specific SCGs for Groundwater Cleanup Criteria [1]

Compound	Class GA Groundwater Quality Standards [1] (ug/L)	New York State Drinking Water (MCLs) Standards [2] (ug/L)	Surface Water Effluent Standards [1] (ug/L)
Benzene	0.7	5	0.7
Ethylbenzene	5	5	5
Toluene	5	5	5
Xylenes (total)	5	5	5
Isopropylbenzene	5	5	5
p-Isopropyltoluene	5	5	5
1,2,4-Trimethylbenzene	5	5	5
1,3,5-Trimethylbenzene	5	5	5
n-Butylbenzene	5	5	5
sec-Butylbenzene	5	5	5

(1) 6 NYCRR 703

(2) 10 NYCRR 5-1.52.