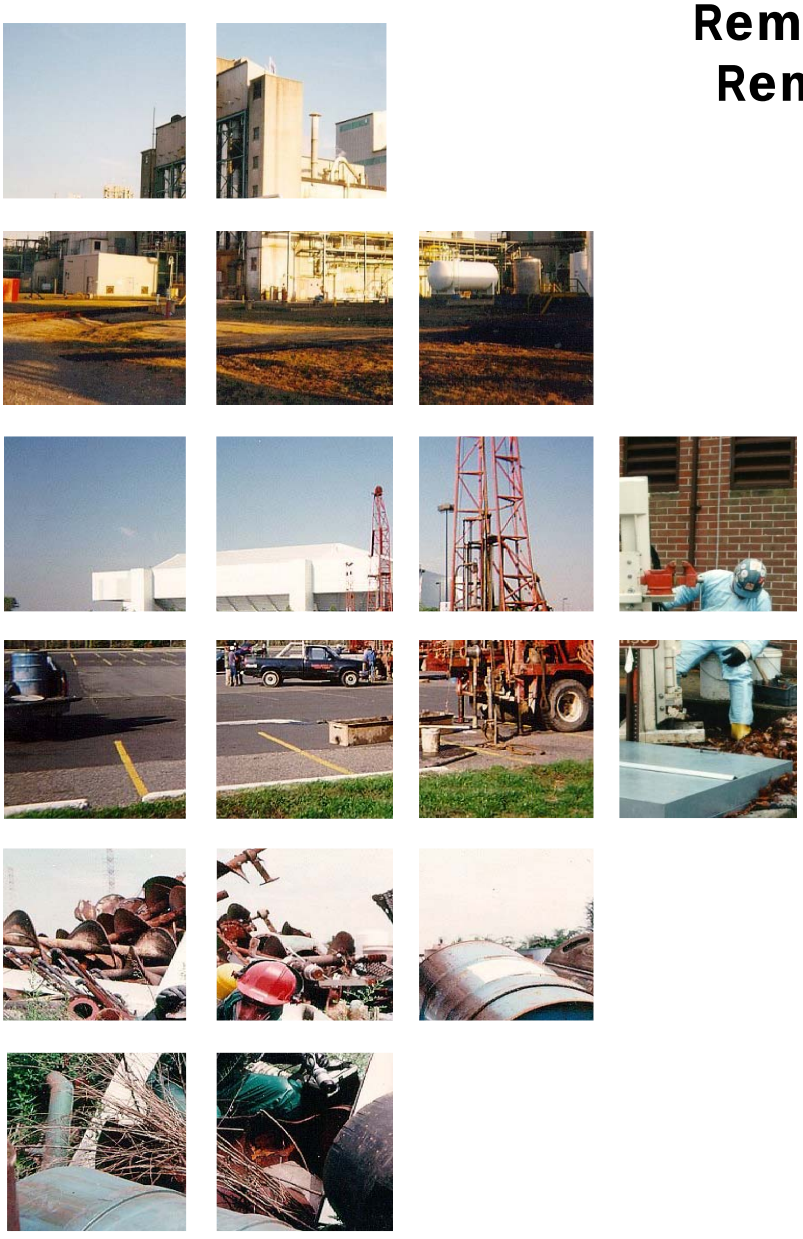
REMEDIAL ACTION SELECTION REPORT

# Param Petroleum Site

## Burlington, New Jersey

## Remedial Investigation and Remedial Action Selection

## Term Contract No. A-60243



Submitted to:

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# 1.0 INTRODUCTION

The Louis Berger Group, Inc. (Berger) has prepared this Remedial Action Selection (RAS) report on behalf of the New Jersey Department of Environmental Protection (NJDEP) to evaluate remedial alternatives for the Param Petroleum Service Station (the "Site"). The Site is located at the intersection of Route 130 South and Wood Street in the City of Burlington, Burlington County, New Jersey (Figure 1). This RAS Report was completed by Berger as part of a statewide contract with the NJDEP to perform site-specific Remedial Investigations (RI) and Remedial Action Selections (RAS) at multiple sites throughout the state (RI/RAS Term Contract A-60243).

The Param Petroleum Service Station has reportedly been operating as a retail gasoline/diesel service station since at least 1979, and currently remains active. The Site is approximately 1-acre in size, and is almost entirely paved with asphalt or concrete. There are two structures on the Site: one small building near the center of the Site, which houses the office and restroom; and a larger building that is leased to a car wash located on the eastern portion of the Site. A site plan showing the existing Site layout and neighboring facilities is provided (Figure 2).

In December 1991 and January 1992, the NJDEP received several notifications of odors indicating possible gasoline discharges, following the delivery of gasoline to the Param facility. Free phase product was observed in November 1994 during underground storage tank (UST) replacement activities. During June 2000 and March 2001, the NJDEP completed two field efforts at the Site. Soil sampling and analysis indicated the presence of Methyl Tert Butyl Ether (MTBE), Xylenes, and other gasoline-related constituents occurring in subsurface soils at levels in excess of the most stringent NJDEP Soil Cleanup Criteria (SCC) (NJDEP, 1999). Groundwater contamination was also identified at the Site above the New Jersey Ground Water Quality Standards (GWQS) (NJDEP, 2005a). Subsequently, NJDEP contracted Berger to conduct remedial investigations in 2004 and 2006 to determine the nature and extent of site contamination. Findings of the remedial investigation activities were discussed in the Remedial Investigation Report (RIR) submitted to the NJDEP in August 2008 (Berger, 2008).

This RAS Report has been developed based on the findings of previous remedial investigation activities to identify and evaluate appropriate remedial strategies to address the contamination, with focus on the best ways to reduce the risk associated with current and future uses of the Site and its surroundings. The RAS was developed according to the following four major steps:

- Identification of the remedial action goals and objectives;
- Identification of Remedial Action Alternatives (RAAs);

- Evaluation of the RAAs against applicable selection criteria; and
- Determination of remediation scenarios that consider the effect of combining alternatives for the media of concern for a site-wide approach.

This RAS has been prepared in accordance with the *Technical Requirements for Site Remediation, N.J.A.C. 7:26E* (NJDEP, 2005b) and associated requirements under NJDEP Term Contract No. A-60243.

# 2.0 PHYSICAL SETTING

The Site is an approximately 1-acre lot located in an urban area of the City of Burlington, Burlington County (Figures 1 and 2). Since at least 1979, the Site has been operating as a retail gasoline station. Route 130 South forms the northern border, Wood Street borders the site to the west, retail business properties form the eastern border and an empty field is located immediately south of the Site. Additionally, just south of the empty field is a drainage canal that flows towards the northwest.

Land uses in the surrounding area include commercial, educational, recreational, and residential. Recreational fields currently under construction are located north of Route 130. Wilbur Watts High School is located adjacent to the fields. West of Wood Street, a small stream drains to the northwest into the lake located in John F. Kennedy Park. A small strip of commercial properties are located to the immediate northwest of the Site. Single-family residences are located south and southeast of the Site, on the south side of Route 130. Several commercial properties are located immediately to the east of the Site.

The following subsections provide a description of the physical setting of the Site, including details regarding site topography, regional climate, geology, groundwater, and nearby surface water.

## 2.1 Topography

Situated in the Coastal Plain Physiographic Province, the topography of the surrounding area is gently sloping towards the north and west, with elevations ranging from 5 to 85 feet above mean sea level (amsl). The Site is generally flat with elevations below 20 feet amsl.

## 2.2 Climate

This region is characterized by a humid and temperate climate. Typical monthly air temperatures range from a low of 22°F in January to a high of 87°F in July; the annual mean temperature is 63°F. Typically, precipitation in the area is nearly equally distributed throughout the year. July and August, however, average the heaviest rainfall amounts due to frequent shower and thunderstorm activity; October, December, and February are usually slightly drier months. The annual average precipitation amount is 44 inches (Markley, 1971).

## 2.3 Geology and Soils

The upper two geological formations that underlie the Site are the undifferentiated Raritan and Magothy Formation and the younger, overlying Cape May Formation. The Raritan and Magothy

Formation is described as a "light gray to white, cross-stratified, medium to course grained sand, arkosic in part and interbeded with discontinuous white to red and white variegated clays" (Rush 1968). Two distinct clay units have been identified: the more common whitish-yellow stiff clay and gray lignitic clay. The Cape May Formation unconformably overlies the Raritan Formation in this area of Burlington County. This formation is described as "quartz sand, light colored, heterogeneous, clayey, pebbly formation" (Rush, 1968). Beds generally strike north 55 degrees east and dip 0.1 to 1.0 degrees to the southeast.

## 2.4 Hydrogeology

The Cape May, a shallow unconfined aquifer, and Raritan–Magothy, a deeper semi-confined aquifer, underlie the Burlington County region. The aquifers in this area of Burlington County have been extensively developed with the undifferentiated Raritan and Magothy Formations being the primary source for groundwater. Between the two aquifers are discontinuous clay layers consisting of either stiff whitish-yellow clay or gray lignitic clay. Because the clay layer is discontinuous, it is expected that the unconfined and semi-confined aquifers are hydraulically connected. The shallow groundwater table beneath the Site is encountered at approximately ten feet below ground surface (bgs). During the remedial investigation, groundwater was found to flow northwest in the eastern portion of the site and southwest in the western portion of the Site, toward an unnamed tributary of the Delaware River.

The Raritan-Magothy aquifer is a part of the New Jersey Coastal Plain Aquifer System. This system is included in the United States Environmental Protection Agency's (USEPA) Sole-Source Aquifer (SSA) Protection Program. As a SSA, more than 50% of the drinking water to a specific area must be contributed from that aquifer.

## 2.5 Surface Water

The surface water bodies in the immediate area of the Site include the drainage channel that is immediately adjacent to the Site to the west, across Wood Street. Downstream the drainage channel, and approximately 0.25 miles to the northwest of the Site is the John F. Kennedy Park and Lake. The lake drains westerly and presumably discharges into the Delaware River. Delaware River (0.66 miles from the Site) and its tributaries (0.5 miles from the Site), as depicted on the 7.5-minute Bristol, New Jersey Quadrangle topographic map (USGS, 1976) are shown in Figure 1. The tributaries within this watershed are classified by the NJDEP as general fresh water/non-trout-producing water bodies (FW2-NT) (N.J.A.C. 7:9B).

# 3.0 REMEDIAL ACTION GOALS AND OBJECTIVES

This section describes media of concern; presents a conceptual model developed for the Site with regard to the media of concern and contaminant migration; and documents the establishment of remediation standards that serve as remedial action endpoints. The remediation standards described in this section form the basis for the proposed remedial alternatives to address the contamination in the media of concern (Section 4.0).

## 3.1 Media of Concern

The media of concern are defined as those that contain contamination above Federal or State of New Jersey standards or criteria. Based on the results of previous investigations including the 2004 and 2006 remedial investigations conducted by Berger (Berger, 2008), contaminants of concern (COCs) were detected in groundwater above the GWQS. No soil contamination was detected above the SCC during July 2004 soil sampling event. Since then, the NJDEP introduced new Soil Remediation Standards (SRS) in June 2008 (NJDEP, 2008). The soil sampling results have been compared to the new SRS and there are no exceedances of the new criteria. During the 2006 remedial investigation, surface water and sediment samples collected at depositional locations along the unnamed tributary of the Delaware River located southwest of the Site indicated some exceedances above the NJDEP Surface Water Quality Standards (SWQS) and NJDEP Lowest Effects Level (LEL), respectively.

In this RAS, however, groundwater is the only considered medium of concern since no soil exceedances were detected at the Site. The surface water and sediment samples were collected outside of the Site boundary in order to identify the extent of contamination and its migration pathway. No direct contamination migration pathway from the Site to the channel was observed. Additionally, based on the conclusion of the Baseline Ecological Evaluation (BEE), the unnamed tributary is not considered a sensitive ecological receptor. Therefore, surface water and sediment are not considered as the media of concern for this Site and will not be pursued as part of this RAS Report.

Groundwater samples were collected and analyzed for Target Compound List Volatile Organic Compounds (TCL VO+10) with Tertiary Butyl Alcohol (TBA) and MTBE, Total Petroleum Hydrocarbons (TPHC), Target Compound List (TAL) Semi-Volatile Organic Compounds (SVOC)+20, and Target Analyte List (TAL) Metals. As presented on Figure 3, results of groundwater sampling in December 2006, which is the most recent groundwater results for this Site, indicated the presence of benzene, TBA, and lead above the GWQS. Benzene concentrations were detected at MW-2 and MW-4 at the levels of 483 µg/L and 151 µg/L, which were above the GWQS

for benzene of 1 µg/L. TBA concentrations detected at MW-1 (screened at approximate depth interval of 1 to 11 feet bgs) and MW-7 (screened at approximate depth interval of 42 to 52 feet bgs) were at 6,870 µg/L and 261 µg/L, respectively, compared to its GWQS of 100 µg/L. Compared to October 2004 and September 2006 groundwater results (Appendix A), it appears that concentrations of benzene and TBA have been decreasing over time. Further, the relatively low concentrations of TBA at depth (MW-7), coupled with a slight upward gradient and clean samples collected in associated with Hydropunch® screening activities, indicate that TBA at depth is not a primary concern for remediation.

Lead was also detected at MW-8 at the concentration of 5.4 µg/L, which was slightly above the GWQS of 5 µg/L. However, lead was never detected in any of the previous groundwater sampling events conducted at the Site. MW-8 is also located off-Site. Therefore, lead contamination detected at MW-8 is not considered as site-related.

In summary, the primary contaminants of concern that will be addressed as part of this RAS Report are gasoline-related contaminants in groundwater (e.g., benzene and TBA). These contaminants are related to historical site operations as discussed earlier in this document.

## 3.2 Conceptual Model

This section presents an overall conceptual model of the Site focusing on the sources of contamination, interpreted contaminant pathways, and potential receptors, as documented in the 2008 RIR (Berger, 2008).

### 3.2.1 Sources

In 1994, ten (10) gasoline and three (3) diesel USTs, totaling 52,000 gallons in capacity, were removed from the Site. Many of the tanks were found to be in poor condition, with groundwater entering at least one of the tanks and free product was observed in one of the tank excavations. Investigation conducted by the NJDEP in 2000 and 2001 confirmed the presence of soil contamination at the Site. Limited soil sampling conducted at select locations during this RI did not exhibit exceedances of the SCC.

Based on the groundwater elevation and analytical data from the monitoring wells, it is apparent that the groundwater contamination originates within the Site. TBA was found to be more prevalent in the western portion of the Site (and at depth), and benzene was found to be more prevalent in the eastern portion of the Site, indicating that there may be multiple sources (which would be a reasonable assumption considering the numerous USTs that were historically present at the Site

### 3.2.2 Migration Pathways

Groundwater beneath the Site was generally found to flow northwest in the eastern portion of the site, and southwest in the western portion of the Site, towards an unnamed tributary of the Delaware River. Despite a minor exceedance of the lead GWQS in MW-8, the groundwater analytical results indicate that the contamination is mainly confined to the Site, as no exceedances of the GWQS were identified in upgradient wells MW-3 and MW-5, the sidegradient well MW-9, or the downgradient well MW-6. Groundwater samples collected from the deep well (MW-7) only showed exceedances of TBA, which was detected at concentrations one order of magnitude lower than the corresponding shallow well, MW-1. The screen interval of MW-7 is approximately 40 feet lower in elevation than that of MW-1; a slight upward vertical gradient was found in the well pair.

There does appear to be a migration of contaminants from the groundwater onsite to the unnamed tributary across Wood Street. This is indicated by the groundwater flow direction (Appendix B) and the fact that there are minor exceedances of the applicable criteria for surface water and sediment samples collected from the unnamed tributary.

### 3.2.3 Potential Receptors

The potential receptors of site contamination are expected to be humans that may be exposed to groundwater from supply wells, humans that may be exposed to indoor air vapor associated with groundwater vapor intrusion, and biota associated with the nearby stream. The review of a well search obtained by the NJDEP Bureau of Water allocation indicated that there are no domestic wells present within 0.5 miles of the Site, and no supply wells within 1 mile of the Site. As public potable water is supplied in this area, there are no potential human receptors that would be impacted by ingestion of groundwater impacted by site contaminants. An assessment of the potential for vapor intrusion in Site and nearby structures using the Johnson-Ettinger modeling indicates that there is potentially an unacceptable risk associated with vapor intrusion resulting from Site groundwater contamination. However, since assumptions used in the model were extremely conservative, it is expected that the risks are overstated at this time that there is no need for further vapor intrusion investigations at this Site. These assumptions include:

- The highest documented detections are used;
- The highest detections are assumed to be directly beneath the structure in question;
- There is no dissipation, diffusion, attenuation or horizontal migration of contaminants; and

- The structure has a basement with existing pathways, such as cracked foundations.

Finally, based on the results of the surface water and sediment sampling analysis, the biota associated with surface waters and wetlands of the unnamed tributary are potential receptors of contamination associated with the Site. It was concluded as a result of the BEE, however, that the unnamed tributary is not considered a sensitive ecological receptor. Therefore, no further ecological investigation or remediation is required. Based on the potential receptor evaluation described including well search; vapor intrusion evaluation; and BEE, it is concluded that there is no real receptor of Site contamination.

## 3.3 Applicable Remediation Standards

The *Technical Requirements for Site Remediation, N.J.A.C. 7:26E* (NJDEP, 2005b) define the applicable remediation standard as "the standard to which contaminants must be remediated for soil, groundwater or surface water, or other environmental media, to allow for a specified site use." This section discusses the development of applicable remediation standards for groundwater, which is the only medium of concern for the Site.

Groundwater at the Site is subject to *NJDEP Class IIA Ground Water Quality Standards* (GWQS), which will serve as applicable remediation standards for groundwater. The GWQS includes the *Interim Groundwater Quality Criteria* (IGWQC), including both Interim Specific and Interim Generic Criteria (NJDEP, 2005a).

# 4.0 REMEDIAL ALTERNATIVES

This section presents the remedial alternatives selected for evaluation to address groundwater contamination at the Site. A brief description of each alternative is first presented and then followed by a discussion of the major strengths and weaknesses of each with respect to the remedial action criteria set forth in the *Technical Requirements for Site Remediation, N.J.A.C. 7:26E* (NJDEP, 2005b). The components of each alternative are then presented at a conceptual level only for estimating cost and comparing with appropriate criteria in Section 5; the development of more detailed designs for the selected remedial alternatives will be addressed in the next phase of the project.

As stated earlier, groundwater is the only medium of concern at the Site. Based on the findings of remedial investigations, benzene, lead, and TBA were detected above the GWQS. The horizontal extent of groundwater contamination is limited within the site boundary except for minor exceedance of lead in MW-8. Vertical flow exchange between deep and shallow groundwater in MW-1 and MW-7 was determined to be minimal as indicated by a slight upward vertical gradient.

The potential remedial alternatives selected to address the gasoline-related contaminants in groundwater at the Site are: No Further Action, Monitored Natural Attenuation (MNA), Enhanced Monitored Natural Attenuation (EMNA), In-Situ Chemical Oxidation (ISCO), and Air Sparging/Soil Vapor Extraction (AS/SVE), as detailed in the following subsections.

## 4.1 No Further Action

The "No Further Action" alternative involves leaving the Site in its current condition with no remedial action considered. This remedial alternative does not entail any measures to control exposure to the contaminants of concern at the Site. The contaminants may continue to pose risks to human health and the environment. Additionally, the alternative may be perceived as unprotective by the community. Therefore, this remedial alternative is not pursued further in this evaluation process.

## 4.2 Monitored Natural Attenuation

The Monitored Natural Attenuation (MNA) remedial alternative uses institutional controls to limit exposure, and long-term monitoring to track contaminant migration and exposure to potential receptors. The institutional controls for the Site would consist of establishment of a Classification Exception Area (CEA).

Accompanying the institutional control are natural processes which can reduce groundwater contamination levels over time through degradation, volatilization, adsorption/desorption, solubility/dilution, chemical transformation, advection, and dispersion. Review of groundwater monitoring results from 2004 and 2006 remedial investigations indicate that natural processes have begun to attenuate contamination in groundwater at the Site. Contaminant concentrations previously detected above the GWQS at MW-2 and MW-4 in 2004 continued to degrade overtime as demonstrated by the 2006 sampling results (Figure 3).

A CEA at the Site would be implemented in accordance with the *NJDEP Final Guidance on Designation of Classification Exception Areas* (NJDEP, 1998) and the *Technical Requirements for Site Remediation, N.J.A.C. 7:26E-8.4* (NJDEP, 2005b). As such, a biennial certification is required to be submitted for the duration of the CEA. The biennial certification report is required to ensure the remediation of the Site remains protective to human health and the environment. The reporting obligation ends when contaminants attenuate to concentrations that are below the GWQS.

Proposed monitoring activities for the MNA alternative include sampling of groundwater at monitoring wells MW-1 through MW-9 semi-annually for the first 8 years and quarterly thereafter for 2 years to track the effectiveness of contaminant degradation by natural processes at the Site. Additionally, the Mann-Whitney U test will be conducted after the last eight (8) quarters of groundwater monitoring to evaluate the trend of groundwater contaminant degradation (Weidemeier et al., 1999).

The total estimated cost for this alternative is $350,000, which assumes a 10-year groundwater monitoring period. A more detailed discussion of cost is provided in Section 5.1.8, and a full cost breakdown for this alternative is provided in Appendix C.

## 4.3 Enhanced Monitored Natural Attenuation

The Enhanced Monitored Natural Attenuation (EMNA) remedial technology entails the injection of materials enhancing biodegradation activities of subsurface microorganisms to degrade Site contamination such as Oxygen Release Compound Advanced (ORC Advanced®) by Regenesis Inc, EHC-O™ by Adventus Americas, Inc., etc. These products entail similar mechanisms to enhance biodegradation; however, a bench scale treatability study would need to be conducted to evaluate for the most appropriate product for the Site. In this report, a conceptual design of ORC Advanced® is discussed for technology evaluation and selection purpose as follow:

ORC Advanced® is a proprietary formulation of calcium oxy-hydroxide that releases oxygen for approximately 12 months to stimulate indigenous aerobic microbes to significantly accelerate rates

of biodegradation. It is anticipated that ORC Advanced® would be injected at a total of approximately 40 locations to the target depth interval of 5 to 15 feet bgs with a couple of deep injections located around monitoring well MW-7 for the injection of ORC Advanced® to the target depth interval of 5 to 55 feet bgs.

ORC Advanced® would be applied based on a 20-foot grid injection pattern using direct-push technology as shown on Figure 4. It is assumed that one (1) mandatory injection event plus an optional injection event (approximately one year later) would be implemented at the Site. The injection locations for each of the following injection event would be shifted by 10 feet from the original locations to optimize the contact between ORC Advanced® solution and contaminants in soil pores. An equal dosage of 10 lbs/foot would be used for both injections. Therefore, a total of approximately 9,000 pounds of ORC Advanced® would be injected (approximately 4,500 lbs of ORC Advanced® for each injection event).

The Geoprobe® would be advanced to the bottom of contaminated zone and then pulled up to the top of contaminated zone while delivering ORC Advanced® throughout the vertical length of the impacted aquifer. Proposed ORC Advanced® injection locations are presented on Figure 4. A field pilot study would need to be conducted to increase effectiveness and applicability of this technology to the Site conditions.

To track the effectiveness of the remedial action, a groundwater monitoring program consisting of quarterly groundwater monitoring for two (2) years, semi-annual groundwater monitoring for the next three (3) years, and quarterly thereafter for two (2) years to track the effectiveness of contaminant degradation at the Site. Additionally, the Mann-Whitney U test will be conducted after the last eight (8) quarters of groundwater monitoring to evaluate the trend of groundwater contaminant degradation (Weidemeier et al., 1999) is proposed. Groundwater samples would be collected from monitoring wells MW-1 through MW-9. A CEA would also be established to protect human health and the environment until contaminant concentrations are reduced to applicable standards.

This groundwater remedial technology offers a more active approach than the MNA approach by actively degrading the contaminants via enhanced bioremediation. The total estimated cost development of this approach is $600,000, which assumes a 5-year groundwater monitoring period. A more detailed discussion of cost is provided in Section 5.1.8, and a full cost breakdown for this approach is provided in Appendix C.

## 4.4 In-Situ Chemical Oxidation

The In-situ Chemical Oxidation (ISCO) remedial technology entails the use of chemical oxidizing agent such as RegenOx® (by Regenesis Inc.) and Modified Fenton's Reagent (by In-Situ Oxidative Technologies, Inc). Similar to EMNA, a bench scale treatability study would need to be conducted to evaluate for the most compatible chemicals for the Site. A conceptual design of RegenOx® is discussed below for technology evaluation and selection purpose.

RegenOx® promotes in-situ oxidation via the use of a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula. The chemical consists of two parts (i.e., an oxidizer and activator) that are combined and injected into the subsurface. Once in the subsurface, RegenOx® produces oxidation reactions via a number of mechanisms including: surface mediated oxidation, direct oxidation and free radical oxidation. However, compared to the EMNA alternative, RegenOx® has a short "life span", about 30 days in-situ; thus this alternative depends on the distribution of RegenOx® in the subsurface; so that it contacts the contamination soon after injection.

An approximate total of 30,000 lbs of RegenOx® is proposed to be applied to the subsurface at approximately 5 to 15 feet bgs and at multiple locations using direct push method (e.g., Geoprobe®). A total of 150 injection points with a spacing to allow approximately 10 feet radius of influence are proposed based on the Site's hydrogeological characteristics, groundwater elevations and contamination conditions; similar to EMNA, a few deep injections would be located around MW-7 for the injection of RegenOx® to the target depth interval of 5 to 55 feet bgs.

The ISCO alternative would entail a total of two (2) applications (one mandatory injection event plus one optional injection event) of equal amount of RegenOx® injection.(i.e., approximately 10 lbs/foot or 15,000 lbs for each application). Injection locations of the second application would be shifted from the original locations by 5 feet to optimize the contact between RegenOx solution and contaminants in soil pores. The Geoprobe® would be advanced to the bottom of contaminated zone and then pulled up to the top of contaminated zone while delivering RegenOx® throughout the vertical length of the impacted aquifer. Proposed RegenOx® injection locations are presented on Figure 5. A field pilot study would need to be conducted to increase effectiveness and applicability of this technology to the Site conditions.

To track the effectiveness of the remedial action, a groundwater monitoring program consisting of quarterly groundwater monitoring for one (1) year, semi-annual groundwater monitoring for the following three (3) years, and quarterly sampling thereafter for two (2) years to track the effectiveness of contaminant degradation at the Site. Additionally, the Mann-Whitney U test will be

conducted after the last eight (8) quarters of groundwater monitoring to evaluate the trend of groundwater contaminant degradation (Weidemeier et al., 1999) is proposed. Groundwater samples would be collected from monitoring wells MW-1 through MW-9. A CEA would also be established to protect human health and the environment until contaminant concentrations are reduced to applicable standards.

The total estimated cost development of this approach is $550,000, which assumes a 5-year groundwater monitoring period. A more detailed discussion of cost is provided in Section 5.1.8, and a full cost breakdown for this approach is provided in Appendix C.

## 4.5 Air Sparging/Soil Vapor Extraction

Air Sparging/Soil Vapor Extraction (AS/SVE) is a proven in-situ remediation technology for the saturated and unsaturated (vadose) zones. This alternative involves the injection of air into the groundwater source zone, volatilizing volatile and semi-volatile organic contaminants into the unsaturated zone. The application of SVE concurrently in the unsaturated soil removes the generated vapor-phase contaminants from the vadose zone. The extracted contaminated vapor would then be treated by GAC adsorption or other processes prior to discharge into the atmosphere.

The AS/SVE alternative is a favorable technique for the minimization and control of risk to human health. It is a proven and widely used technology that can effectively reduce contaminant concentrations in both the saturated and unsaturated zones. However, this alternative requires the installation and potentially long-term O&M of an ex-situ treatment system, and thus, would likely incur higher costs; and the relative shallow groundwater table would limit the effectiveness of the AS/SVE alternative due to 1) the potential local air short circuiting of the SVE system, and 2) uptake of groundwater by the system in the trenches. The technology may also not be effective to address TBA at depth in the vicinity of monitoring well MW-7 because the existence of clay layer at approximately from 24 to 30 feet bgs may block the vapor-phase contaminant sparged by the deep AS well. Finally, this alternative has the potential limitation of introducing uncontrolled movement of potentially dangerous vapors in the subsurface.

As presented on Figure 6, it is proposed that nine (9) AS wells to be installed to the depth of approximately 15 feet bgs and one (1) AS wells located close to monitoring well MW-7 to be installed to the depth of 55 feet bgs. Based on the preliminary site information (e.g., hydrogeological conditions), a radius of influence of 15 to 20 feet (approximately 40 feet well spacing) is estimated for the AS wells assuming an air flow rate of 5 cubic feet per minute (cfm). Horizontal extraction trenches would be installed to collect extracted vapor due to shallow groundwater table at the Site.

The flow rate of the AS wells is estimated to be 50 cfm. The extracted vapor is assumed to be treated ex-situ by GAC adsorption for this alternative. A field pilot study would be conducted to ensure effectiveness of the design specifications (e.g., flow rate and radius of influence).

In order to determine the effectiveness of the AS/SVE system, four (4) soil gas monitoring points would be installed in the treatment area for monitoring and sampling. Groundwater samples would be collected from a total of nine (9) groundwater monitoring wells (MW-1 through MW-9) as shown on Figure 3. It is estimated that this alternative would require approximately five (5) years of operation to accomplish remedial goal. Groundwater sampling would be conducted quarterly for the first five (5) years and semi-annually for the next three (3) years to track the effectiveness of the remedial action. Additional two (2) years of groundwater monitoring along with the Mann-Whitney U test would be conducted thereafter to evaluate the trend of groundwater contaminant degradation (Weidemeier et al., 1999). Weekly vapor pressure and/or flow rate readings would also be recorded at the AS/SVE wells and the monitoring points to monitor the system performance. The SVE wells and the GAC system influent/effluent would be sampled and tested monthly to determine the need for carbon replacement and monitor the air discharge, respectively.

The total estimated cost development of this approach is $1,700,000, which assumes a 8-year groundwater monitoring period. A more detailed discussion of cost is provided in Section 5.1.8, and a full cost breakdown for this approach is provided in Appendix C.

# 5.0 EVALUATION OF REMEDIAL ALTERNATIVES

A critical component of the remedial action selection is comparative analysis of each alternative among the remedial action criteria set forth in the *Technical Requirements for Site Remediation*. This section compares the strengths and weaknesses of the groundwater remedial alternatives relative to one another with respect to the specified criteria, and how reasonable variations of key uncertainties could change the expectations of their relative performance. The following subsections present the evaluation of the proposed remedial alternatives against each evaluation criterion. The results of the evaluation are summarized in Table 1. A qualitative ranking system has also been developed to aid in the remedial selection process using levels defined as good, fair, and poor. The rankings (Table 2) reflect the relative effectiveness of each remedial alternative to meet the conditions of a particular criterion.

## 5.1 Effectiveness and Reliability of Attaining the Applicable Remediation Standards

This criterion considers the technical performance of each remedial alternative evaluated to effectively attain compliance with the applicable remediation standard for the Site and maintain it in the long term. The applicable remediation standards are indirect measures of potential risk to human health and the environment. The more effective and reliable a remedial alternative, the higher the ranking.

Contaminants would effectively be degraded by chemical reaction of the ISCO alternative; however, its effectiveness may depend highly on the contact between the reducing/oxidizing materials and the contaminants. EMNA offers less aggressive contaminant degradation, but would allow longer-lifespan ORC Advanced® to contact with contaminants for a longer time. Generally, the AS/SVE alternative is expected to have relatively high effectiveness for this site due to high permeability of the impact aquifer. Also, the AS process would increase the amount of air flow rate in the aquifer and could enhanced natural degradation processes of the contaminants. However, the technology may not be effective to address TBA concentration at depth around MW-7. MNA is only intended to monitor and restrict use of the groundwater; however, historic and recent groundwater results indicated that contaminants have been degraded by natural processes. Therefore, ISCO and EMNA are considered to be best suited for meeting this criterion, equally followed by AS/SVE and MNA.

## 5.2 Reduction of Toxicity, Mobility, or Volume

The degree to which each remedial alternative reduces the toxicity, mobility, or volume (TMV) of

contaminants through treatment, reuse or recycling is integral to the protection of human health and the environment. The greater the reduction of TMV by a remedial action, the higher the ranking.

EMNA and ISCO offer the most significant reduction in TMV by actively promoting contaminant degradation. The AS/SVE alternative, although considered to be more aggressive in reducing mobility and volumes of the contaminants than EMNA and ISCO, would not directly degrade the contaminants. MNA offers little reduction in TMV, relying only on the natural attenuation process to reduce toxicity. Therefore, EMNA, ISCO, and AS/SVE are considered to be equally suited for meeting this criterion, followed by MNA.

## 5.3 Risk Minimization

The risk minimization category refers to the degree to which the proposed remedial action minimizes risk associated with the Site. Of specific importance is the minimization of any short-term risk associated with implementation of the remedy and possible contamination left on-site, while still providing long-term risk protection with regard to any future use of the Site. The greater the risk minimized by a remedial action, the higher the ranking.

Risk would be reduced most effectively via the EMNA and ISCO alternatives; which would degrade the contaminants. However, these alternatives would also likely have moderate risks/impacts to nearby residents and their properties during the material injection. Among these two alternatives, the ISCO alternative would likely have slightly higher risks/impacts to workers during injection due to a larger number of injection locations and potential hazard from chemical reaction. The AS/SVE alternative may have a higher short-term risk to workers during installation of the systems and would likely also involve greater long-term risks due to its longer operation period compared to the EMNA and ISCO alternatives. MNA relies only on natural attenuation process and use restriction of the groundwater to minimize the risk. This alternative would entail minimum short-term risks, but maximum long-term risks compared to other alternatives evaluated. Therefore, EMNA is expected to result in the most significant risk reduction, followed by MNA, ISCO, and AS/SVE.

## 5.4 Implementability

Implementability of each remedial alternative is defined as the engineering and scientific feasibility, availability, and suitability of the remedial alternative and the ability of the alternative to achieve the remedial standard set for the Site use, in a timely and cost effective manner. A remedial action is considered timely if the applicable remediation standard is achieved within five years from the time the remedy is implemented. The more feasible, available, suitable, and timely a remedial action, the higher the ranking.

All of the alternatives proposed are considered readily implementable. However, only the ISCO alternative is considered timely because it is expected to achieve the applicable remediation standards within 5 years. Implementation of EMNA and ISCO would involve some injection activities. AS/SVE would require considerable system installation and system maintenance efforts. Applicable remediation standards are unlikely to be achieved by EMNA or AS/SVE within 5 years. Although MNA would require very little effort to implement, it may take longest period to achieve the standards. In summary, ISCO is considered to be best suited to meet this criterion, followed by EMNA and AS/SVE, with MNA considered the least favorable.

## 5.5 Compliance with Applicable Laws and Regulations

This criterion considers the relative performance of each remedial action evaluated to achieve compliance with Federal, State, and local laws and regulations, and was designed to draw particular attention to more specialized provisions such as those of the Pinelands Protection Act and the National Parks and Recreation Act. In this case, the *Technical Requirements for Site Remediation* govern the majority of the work, as well as specialized provisions specific to the remedial action evaluated, which are discussed in each section for the media of concern. If a remedial alternative is not in compliance with any applicable laws and/or regulations, it will receive a low ranking in this measure.

All of the groundwater remedial alternatives are consistent with all applicable laws and regulations, including the Federal Safe Drinking Water Act (40 CFR parts 141, 142, and 143) and State Safe Drinking Water Act (N.J.A.C. 7:10-1) that regulate levels of contaminants in drinking water. In summary, MNA, EMNA, ISCO, and AS/SVE are considered equally compliant.

## 5.6 Potential Impacts on the Local Community

Potential impacts on the local community of each remedial action alternative are defined by the balance between adverse short-term impacts to the community due to implementation, and the degree to which the remedial action promotes the ability of the local community to use the Site for the local land use master plan. The greater the long-term ability of the local community to use the Site compared to short-term impacts due to implementation, the higher the ranking.

Implementation of ISCO and EMNA would have moderate short-term impacts to the community due to multiple injection applications. Compared to ISCO, the EMNA alternative provides slightly lower short-term impacts due to its smaller number of injection points, but the alternative may provide higher long-term impacts due to its longer required period to reach the cleanup standards. Even though the MNA alternative would have little disturbance to the local community, it may be

perceived by the community as unprotective with the potential for long-term maintenance of CEA. Installation of AS/SVE system may provide some ongoing disturbance to the community due to noise, exhaust and other operational activities. In summary, ISCO and EMNA are considered to subject the community the least potential impacts, followed by MNA and finally AS/SVE.

## 5.7 Potential for Natural Resource Injury

This criterion considers the potential for injury to natural resources, defined as "all land, biota, fish, shellfish, and other wildlife, and waters among other such resources," from implementation of the remedial action. The more a remedial alternative reduces the potential for natural resources injury, the higher the ranking.

MNA, EMNA, and ISCO are considered equal and subject natural resources to minimal potential for injury due to their implementation. AS/SVE requires excavation during construction and could result in sediment runoff to downgradient streams/waterways, etc; thus considered the least favorable in this criterion. In summary, MNA, EMNA, and ISCO are considered equal to satisfy this criterion, followed by AS/SVE.

## 5.8 Cost

The cost of the remedial alternative is a measure of its economic feasibility and is integral to the cost-benefit analysis. The cost estimates for the RAS were developed, in part, using the parametric cost modeling software Remedial Action Cost Engineering and Requirements (RACER) (Earth Tech, Ltd., Long Beach, CA). RACER's costs were adopted from the 2006 Environmental Cost Handling Options and Solutions (ECHOS) cost database published by RS Means. Berger adjusted the estimated costs by applying an escalation factor assuming the proposed remedial alternatives would take place in January 2010. Berger supplemented the database, where appropriate, with costs for items not included in ECHOS. The final cost estimates were developed as Net Present Value (NPV) before taxes and after inflation (i = 5%) and also include markups.

For the Param Petroluem Site, modifiers reflecting local adjustments for the New Jersey State average area have been applied to the direct costs (i.e., costs of materials, labor, and equipment). The modifications applied represent industry standards defined by Means and account for overhead, profit, contingency, administrative, management, and oversight costs.

The unit costs that have the greatest impact on the cost estimates for the remedial alternatives detailed within this RAS were verified with contractor quotes from similar projects and deemed to be accurate and acceptable. These line items include transportation and disposal, lab analysis, material

cost, drilling, excavation and backfilling. The costs for the alternatives are believed to be within 20% of the actual cost.

The MNA alternative is the least expensive at approximately $350,000, followed by EMNA at $600,000, ISCO at $550,000, and AS/SVE at $1,700,000. A summary of the costs for each alternative addressing groundwater contamination is provided in Table 3, and raw cost data are provided in Appendix C.

# 6.0 REFERENCES

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# TABLES

**Table 1**
*Param Petroleum Site*
*Burlington., NJ*
**Evaluation of Remedial Action Alternatives**
**(Groundwater)**

| Remedial Alternative | Protection of Human Health and the Environment | | | Implementability | Consistency With Applicable Laws and Regulations | Potential Impacts on the Local Community | Potential for Natural Resource Injury | Estimated Costs (Net Present Value) |
|---|---|---|---|---|---|---|---|---|
| | Effectiveness and Reliability in Attaining Applicable Remediation Standard | Reduction of Toxicity, Mobility or Volume | Risk Minimization | | | | | |
| **Monitored Natural Attenuation (MNA)** | MNA is only intended to monitor and restrict use of the groundwater; however historic and recent groundwater results indicated that contaminants have been effectively attenuated by natural processes. | The MNA alternative offers relatively little reduction in toxicity, mobility, or volume. It relies only on natural attenuation to reduce toxicity by eventually degrading the compounds. | MNA relies only on natural attenuation process and use restriction of the groundwater to minimize the risk. This alternative would entail minimum short-term risks, but increased long-term risks compared to other alternatives evaluated. | The MNA alternative is readily implementable as it is a common, well-established approach. It would require very little effort to implement. | The MNA alternative is consistent with the *New Jersey Technical Requirements for Remediation*. | Even though the MNA alternative would have little disturbance to the local community, it may be perceived by the community as unprotective. | MNA, EMNA, and ISCO are considered to equally offer minimum potential for natural resource injury due to their implementation. | Capital Costs ≅ $10,000<br><br>O&M Costs ≅ $340,000<br><br>**TOTAL =$350,000** |
| **Enhanced Monitored Natural Attenuation (EMNA)** | EMNA, although offers less aggressive contaminant degradation than ISCO, would allow Advanced ORC to contact with contaminants for up to 12 months. | The EMNA offers the greatest reduction in the toxicity, mobility, or volume of the contaminants through natural degradation enhanced with ORC Advanced injection. | The EMNA alternative will reduce the risk most effectively by degrading and reducing the contaminant concentrations on site. The alternative may have moderate risks/impacts to nearby residents due to injection activities. | The EMNA alternative is readily implementable, as it is an easily applied treatment with demonstrated effectiveness. Its implementation would involve some injection activities. | The EMNA alternative is consistent with the *New Jersey Technical Requirements for Remediation*. | Compared to ISCO, the EMNA alternative provides slightly lower short-term impacts due to its smaller number of injection points, but the alternative may provide higher long-term impacts due to its longer required period to reach the cleanup standards. | MNA, EMNA, and ISCO are considered to equally offer minimum potential for natural resource injury due to their implementation. | Capital Costs ≅ $250,000<br><br>O&M Costs ≅ $400,000<br><br>**TOTAL = $600,000** |
| **In-Situ Chemical Oxidation (ISCO)** | Contaminants would effectively be degraded by chemical reaction of the ISCO alternative; however, its effectiveness will depend on the contact between the reducing/oxidizing materials and the contaminants. | The ISCO offers the greatest reduction in the toxicity, mobility, or volume by actively pursuing contaminant degradation through injection of RegenOx. | The ISCO alternative may entail slightly higher risks/impacts to workers, compared to EMNA due to a larger number of injection locations and potential hazard from chemical reaction. | The ISCO alternative is readily implementable. The alternative is expected to achieve the applicable remediation standards most quickly, but would likely require higher effort for injection activities compared to EMNA. | The ISCO alternative is consistent with the *New Jersey Technical Requirements for Remediation*. | The ISCO alternative is expected to have slightly higher short-term impacts to the community, compared to EMNA, due to its larger number of injection locations. The alternative, however, would greatly reduce long-term impacts to the community because its short period required to achieve the cleanup standards | MNA, EMNA, and ISCO are considered to equally offer minimum potential for natural resource injury due to their implementation. | Capital Costs ≅ $300,000<br><br>O&M Costs ≅ $250,000<br><br>**TOTAL = $550,000** |
| **Air Sparging /Soil Vapor Extraction (AS/SVE)** | Relatively high effectiveness of extraction system as part of the AS/SVE alternative is expected for this site due to high permeability of the impact aquifer. However, it may not be effective to address TBA at depth. | The AS/SVE alternative, although considered to be more aggressive in reducing mobility and volumes of the contaminants than EMNA and 'ISCO, would not directly degrade the contaminants. | The AS/SVE alternative may have a higher short-term risk to workers during installation of the systems and would likely also involve greater long-term risks due to its longer operation period compared to the EMNA and ISCO alternatives. | AS/SVE is readily implementable; however, it is considered slightly less favorable than other alternatives because it would require considerable system installation and system maintenance efforts. | The AS/SVE alternative is consistent with the *New Jersey Technical Requirements for Remediation*. | Installation of AS/SVE system may provide some disturbance to the community due to noise, exhaust and other operational activities | AS/SVE would result in potential for water runoff to downgradient streams/waterways, etc; thus considered as the least favorable in meeting this criterion. | Capital Costs ≅ $500,000<br><br>O&M Costs ≅ $1,200,000<br><br>**TOTAL = $1,700,000** |

**Table 2**
*Param Petroleum Site*
*Burlington, NJ*
**Comparative Analysis of Remedial Alternatives**
**(Groundwater)**

| Criteria | Monitored Natural Attenuation | Enhanced Monitored Natural Attenuation | In-Situ Chemical Oxidation | Air Sparging/Soil Vapor Extraction |
|---|---|---|---|---|
| Effectiveness and Reliability of Attaining Remediation Standard | ■ | ■ | ■ | ■ |
| Reduction in Toxicity, Mobility, or Volume | ◘ | ■ | ■ | ■ |
| Risk Minimization | ◘ | ■ | ◘ | ◘ |
| Implementability | ◘ | ◘ | ■ | □ |
| Consistency with Applicable Laws and Regulations | ■ | ■ | ■ | ■ |
| Potential Impacts on Local Community | ◘ | ■ | ■ | □ |
| Potential for Natural Resource Injury | ■ | ■ | ■ | ◘ |
| Estimated Costs | ■ | ◘ | ◘ | □ |

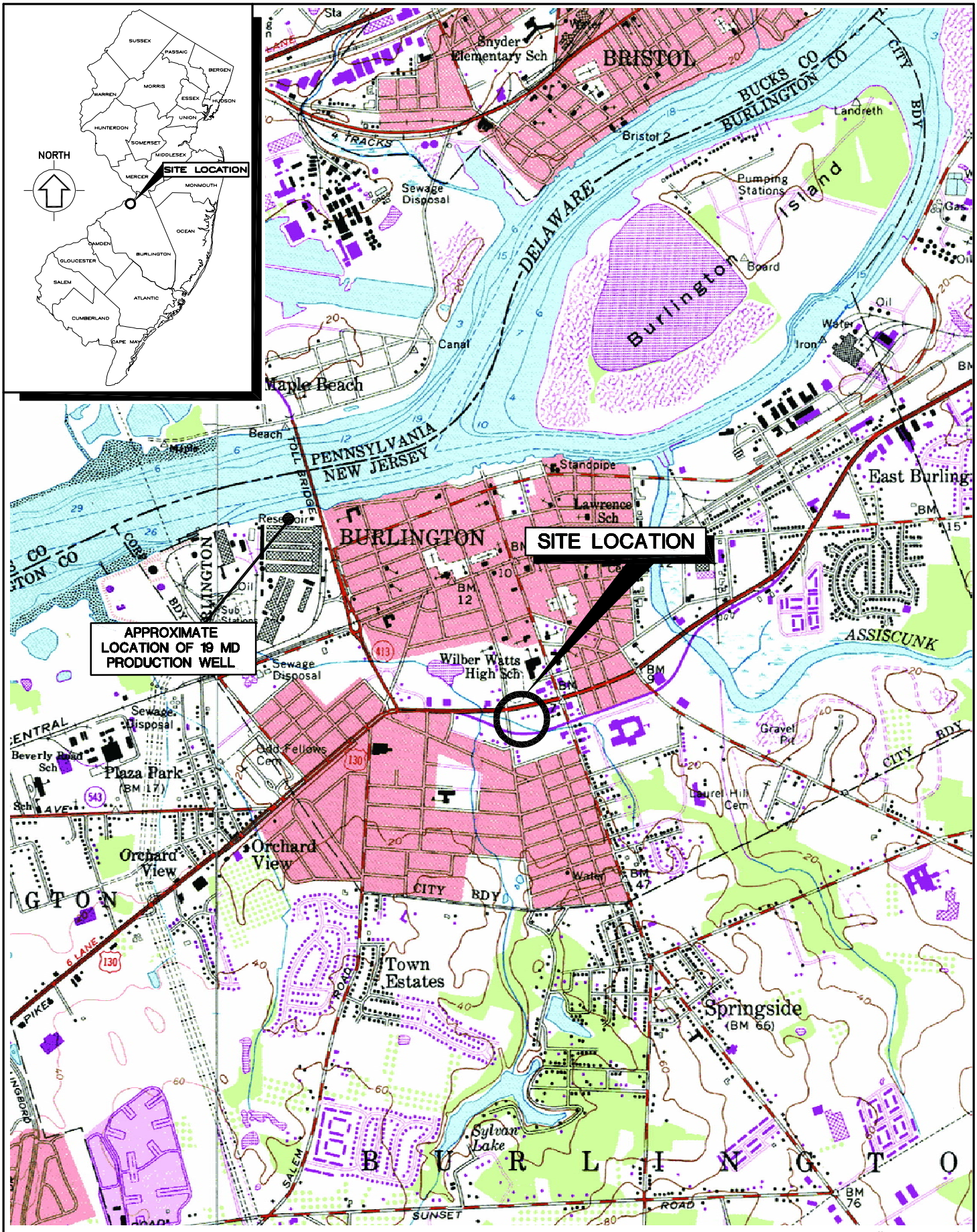
The legend below refers to the ability of the remedial alternatives relative to one another to effectively meet the specified criteria defined by the *New Jersey Technical Requirements for Site Remediation (NJAC 7:26E)* and the *NJDEP RI/RASE Statement of Work (SOW).*

■ Good
◘ Fair
□ Poor

**Table 3**
*Param Petroleum Site*
*Burlington, NJ*
**Comparison of Total Estimated Cost among Remedial Alternatives**

| Media of Concern | Remedial Action Alternative | Cost |
|---|---|---|
| Groundwater | Monitored Natural Attenuation | $350,000 |
| | Enhanced Monitored Natural Attenuation | $600,000 |
| | In-Situ Chemical Oxidation | $550,000 |
| | Air Sparging/Soil Vapor Extraction | $1,700,000 |

# FIGURES




Source: USGS 7.5 Min. Quadrangle, Beverly, N.J., Bristol, PA. – N.J. Scale: 1" = 2000'

N.J. Department of Environmental Protection

PARAM PETROLEUM SITE, ROUTE 130 AND WOOD STREET
BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

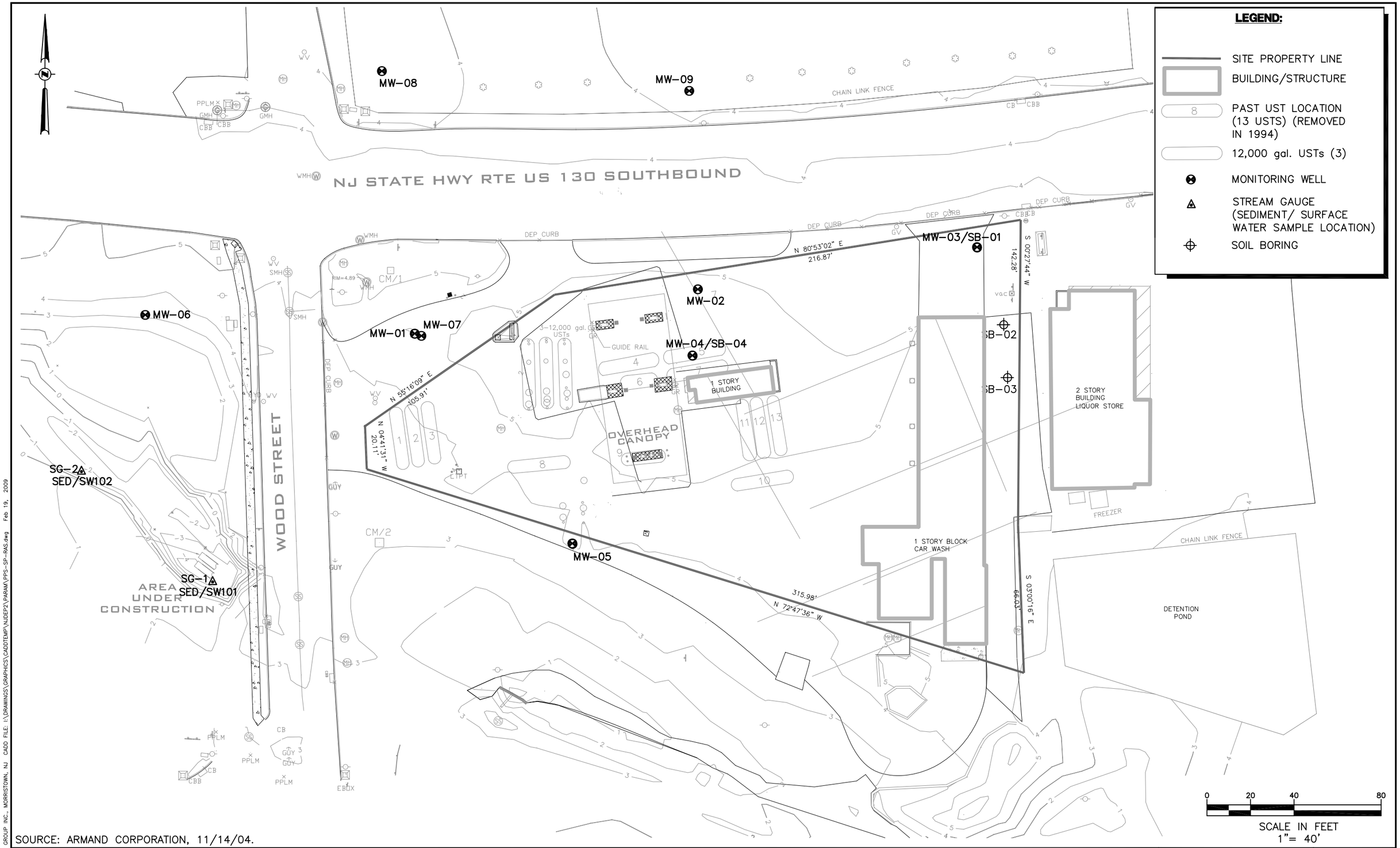
**SITE LOCATION MAP**

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 1**

I:\DRAWINGS\GRAPHICS\CADDTEMP\NJDEP2\PARAM\PPS-LOC.dwg Feb 19, 2009




SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

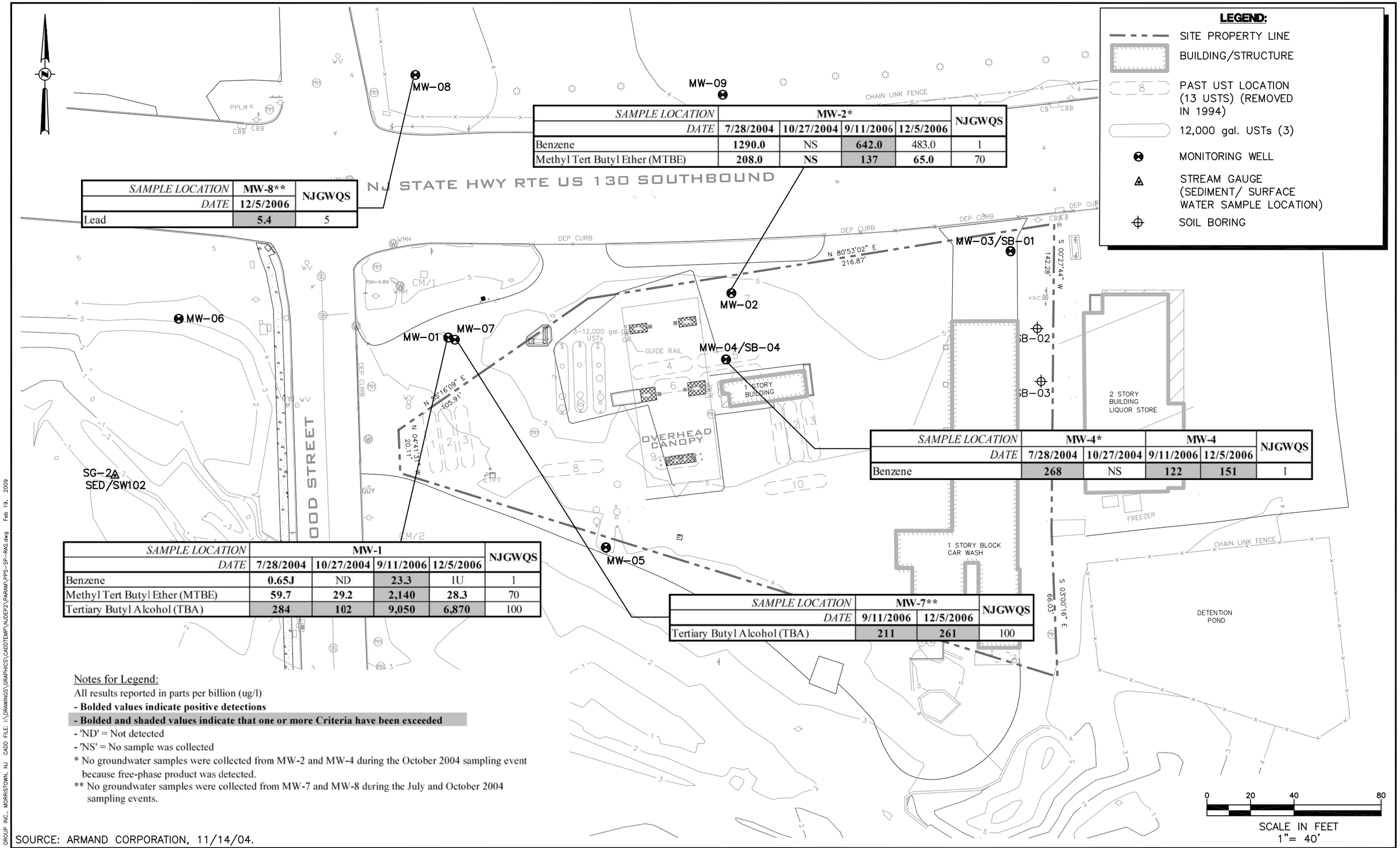
PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

**SITE PLAN**

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 2**




| SAMPLE LOCATION | MW-8** | NJGWQS |
|---|---|---|
| DATE | 12/5/2006 | |
| Lead | **5.4** | 5 |

| SAMPLE LOCATION | MW-2* | | | | NJGWQS |
|---|---|---|---|---|---|
| DATE | 7/28/2004 | 10/27/2004 | 9/11/2006 | 12/5/2006 | |
| Benzene | **1290.0** | NS | **642.0** | 483.0 | 1 |
| Methyl Tert Butyl Ether (MTBE) | **208.0** | **NS** | **137** | **65.0** | 70 |

| SAMPLE LOCATION | MW-4* | | MW-4 | | NJGWQS |
|---|---|---|---|---|---|
| DATE | 7/28/2004 | 10/27/2004 | 9/11/2006 | 12/5/2006 | |
| Benzene | **268** | NS | **122** | **151** | 1 |

| SAMPLE LOCATION | MW-1 | | | | NJGWQS |
|---|---|---|---|---|---|
| DATE | 7/28/2004 | 10/27/2004 | 9/11/2006 | 12/5/2006 | |
| Benzene | **0.65J** | ND | **23.3** | 1U | 1 |
| Methyl Tert Butyl Ether (MTBE) | **59.7** | **29.2** | **2,140** | **28.3** | 70 |
| Tertiary Butyl Alcohol (TBA) | **284** | **102** | **9,050** | **6,870** | 100 |

| SAMPLE LOCATION | MW-7** | | NJGWQS |
|---|---|---|---|
| DATE | 9/11/2006 | 12/5/2006 | |
| Tertiary Butyl Alcohol (TBA) | **211** | **261** | 100 |

Notes for Legend:

All results reported in parts per billion (ug/l)

- **Bolded values indicate positive detections**
- **Bolded and shaded values indicate that one or more Criteria have been exceeded**
- 'ND' = Not detected
- 'NS' = No sample was collected

* No groundwater samples were collected from MW-2 and MW-4 during the October 2004 sampling event because free-phase product was detected.

** No groundwater samples were collected from MW-7 and MW-8 during the July and October 2004 sampling events.

SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

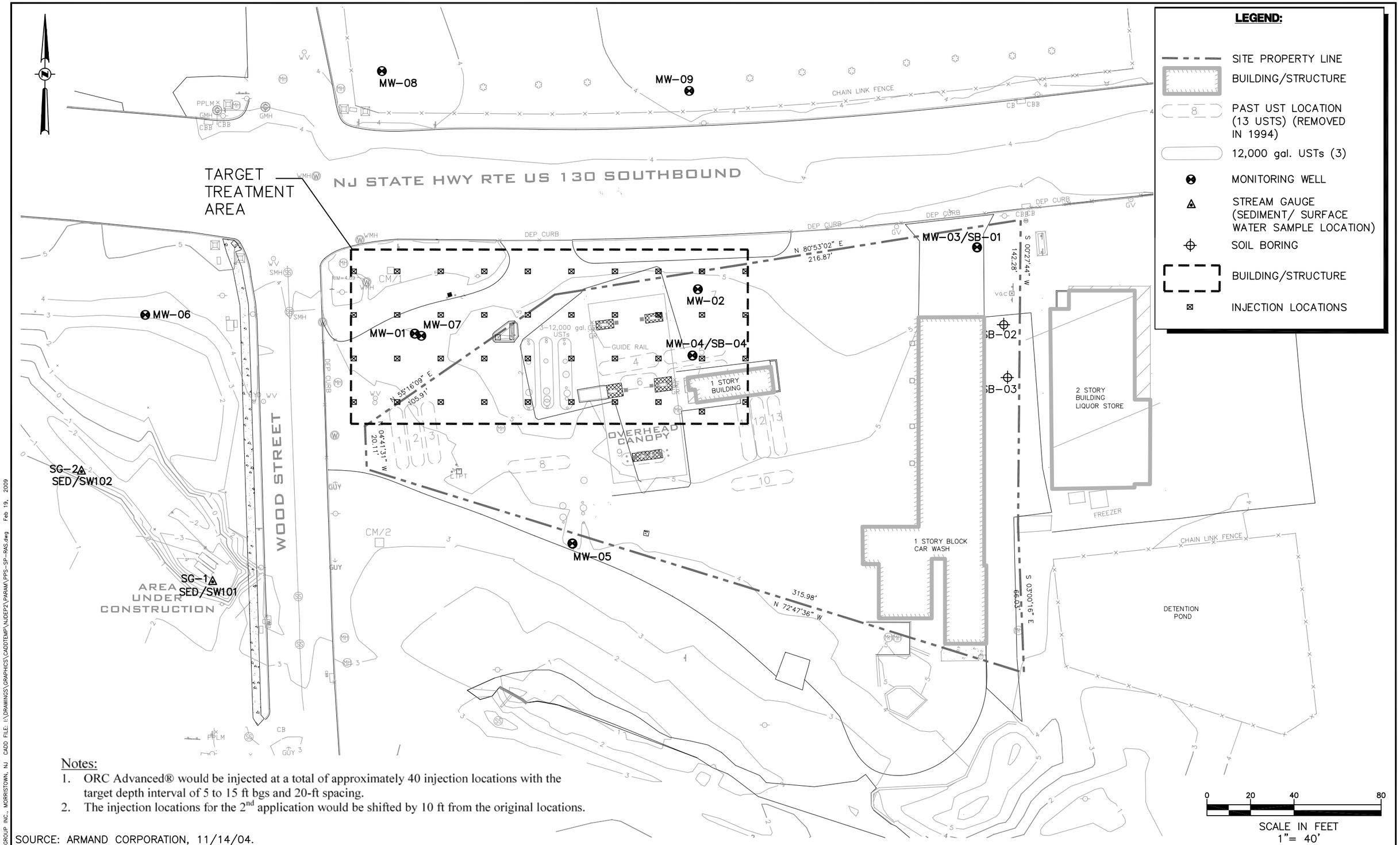
PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

# GROUNDWATER EXCEEDANCE MAP - 2004 TO 2006

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 3**




Notes:

1. ORC Advanced® would be injected at a total of approximately 40 injection locations with the target depth interval of 5 to 15 ft bgs and 20-ft spacing.
2. The injection locations for the 2nd application would be shifted by 10 ft from the original locations.

SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

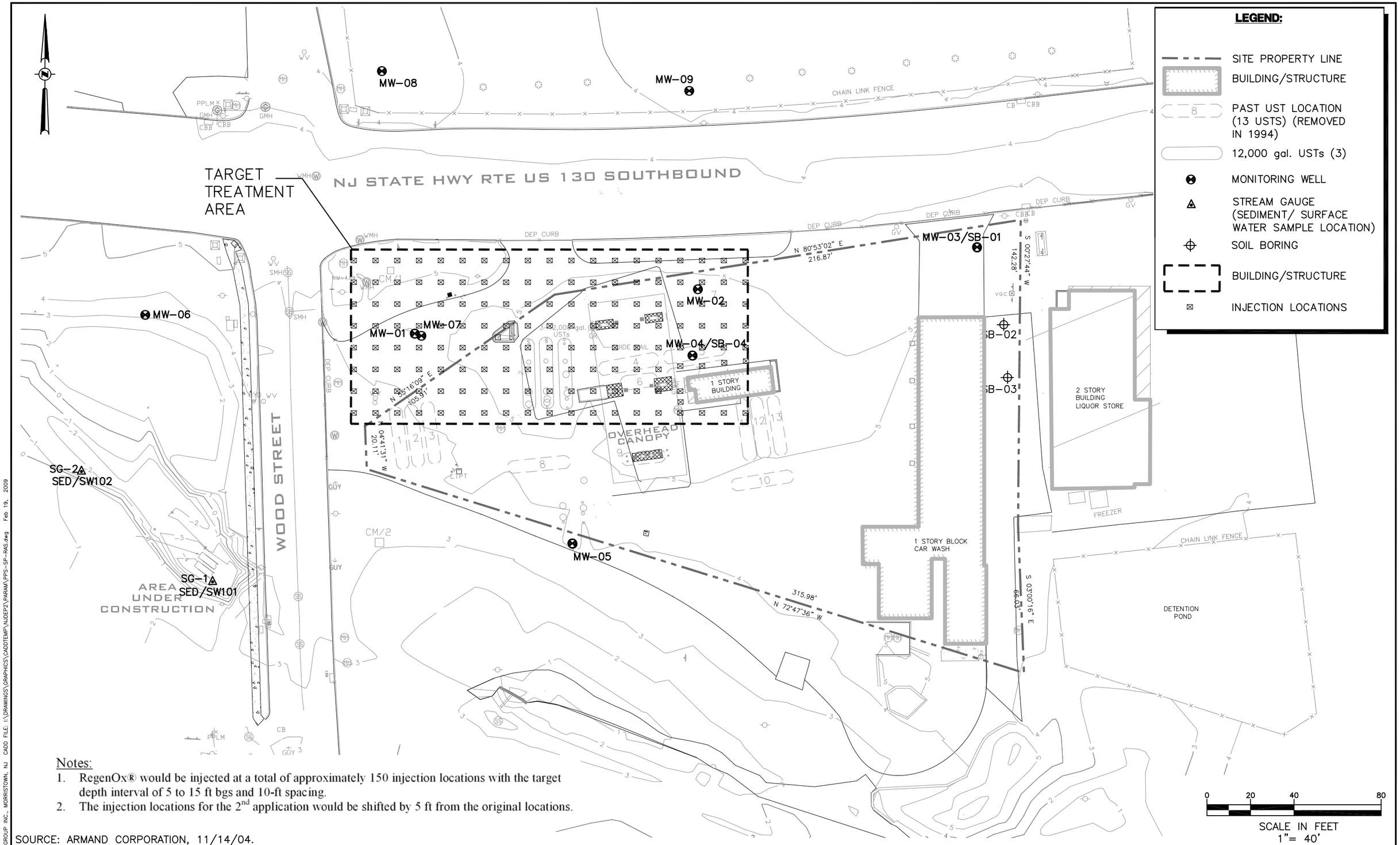
PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

**PROPOSED ORC ADVANCED® INJECTION LOCATIONS**

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 4**




Notes:

1. RegenOx® would be injected at a total of approximately 150 injection locations with the target depth interval of 5 to 15 ft bgs and 10-ft spacing.
2. The injection locations for the 2nd application would be shifted by 5 ft from the original locations.

SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

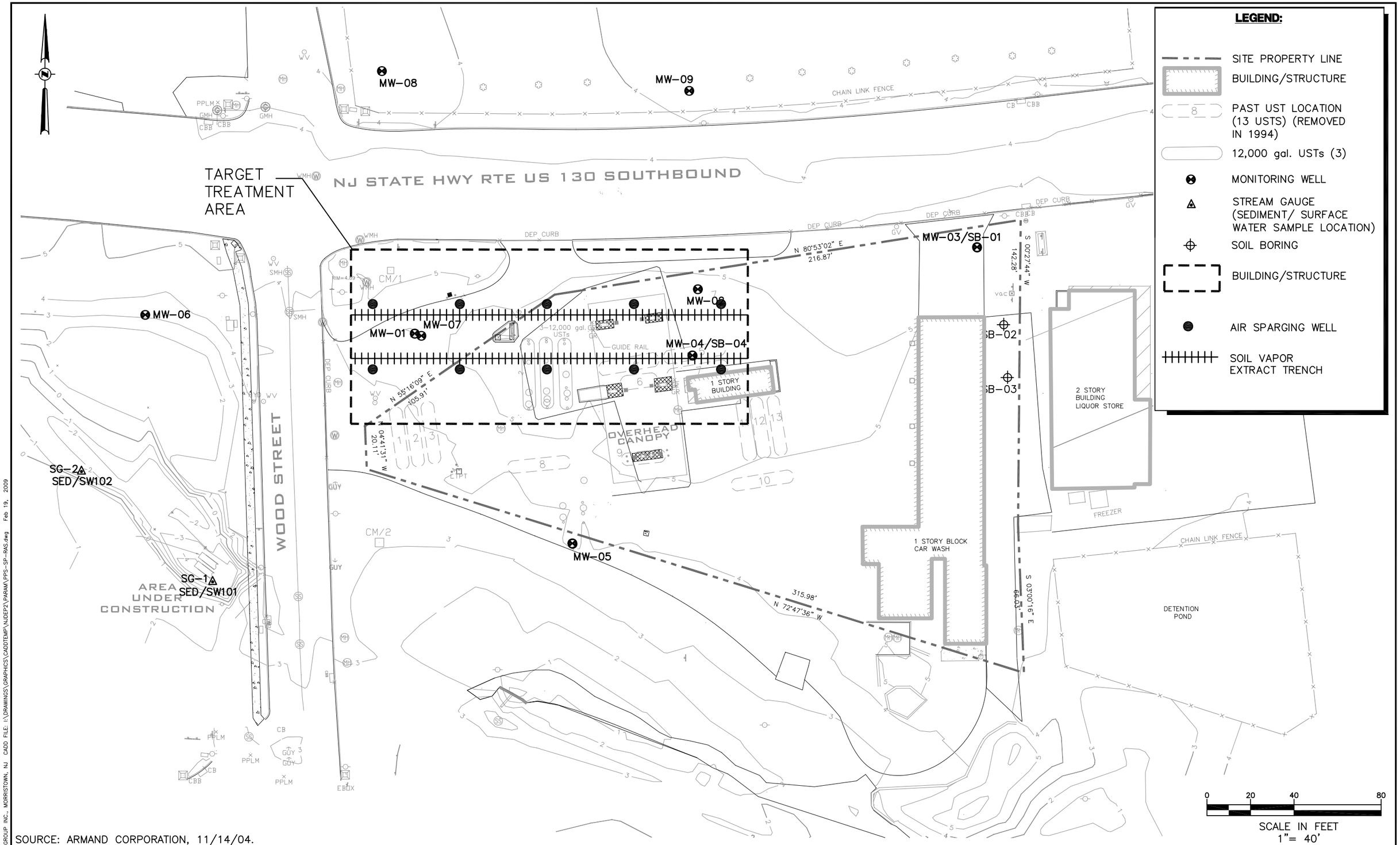
PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

**PROPOSED REGENOX® INJECTION LOCATIONS**

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 5**




SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

# PROPOSED SOIL VAPOR EXTRACTION/AIR SPARGING SYSTEM

NJDEP CONTRACT No. A-60243

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 6**

# APPENDICES

# APPENDIX A
# 2004 and 2006 Groundwater Analytical Results

**Table 6**
New Jersey Department of Environmental Protection
*Param Petroleum*
*Burlington, New Jersey*
**Groundwater Results July 2004**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *SAMPLE LOCATION* | **MW-1** | **MW-2** | **MW-3** | **MW-4** | | **MW-5** | **FB-01** |
| | | *FIELD SAMPLE ID* | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **DUPE-01** | **MW-5** | **FB-01** |
| | | *LAB ID* | **N73626-1** | **N73626-2** | **N73626-3** | **N73626-4** | **N73626-6** | **Not Sampled** | **N73626-5** |
| | | *DATE COLLECTED* | **7/28/2004** | **7/28/2004** | **7/28/2004** | **7/28/2004** | **7/28/2004** | **-** | **7/28/2004** |
| *ANALYTE* | **NJGWQS** | **Interim NJGWQS** | | | | | | | |
| **Volatile Organic Compounds +10** | | | | | | | | | |
| Acetone | 700 | NC | 3.9 U | **48** | 3.9 U | 3.9 U | **17.8** | Not Sampled Well Inaccessible | 3.9 U |
| Benzene | 1 | NC | **0.65 J** | **1,290** | 0.33 U | **268** | **194** | | 0.33 U |
| Ethylbenzene | 700 | NC | 0.22 U | **403** | 0.22 U | **172** | **131** | | 0.22 U |
| Methyl Tert Butyl Ether | NC | 70 | **59.7** | **208** | **1.8** | **13** | **13.5** | | 0.41 U |
| Tertiary Butyl Alcohol | NC | 100 | **284** | 10 U | 10 U | 10 U | 10 U | | 10 U |
| Toluene | 1,000 | NC | **0.23 J** | **315** | 0.11 U | **803** | **635** | | 0.11 U |
| Xylenes (Total) | 40 | 1000 | 0.26 U | **1,760** | 0.26 U | **1,090** | **867** | | 0.26 U |
| **Semivolatile Organic Compounds +20** | | | | | | | | | |
| 2,4-Dimethylphenol | 100 | NC | 1.0 U | **3.0 J** | 1.0 U | 1.0 U | **9.0** | Not Sampled Well Inaccessible | 1.0 U |
| 2-Methylnaphthalene | NC | 100 | **10.4** | **7** | 0.72 U | **3** | **4.7** | | 0.72 U |
| 2-Methylphenol | NC | NC | 0.72 U | 0.72 U | 0.72 U | **2.8** | **4.9** | | 0.72 U |
| 3&4-Methylphenol | NC | NC | 0.70 U | 0.70 U | 0.70 U | **1.2 J** | **1.8 J** | | 0.70 U |
| bis(2-Ethylhexyl)phthalate | 30 | NC | 0.74 U | 0.74 U | 0.74 U | **2.1** | **1.8 J** | | 0.74 U |
| Fluorene | 300 | NC | **2** | 0.89 U | 0.89 U | 0.89 U | 0.89 U | | 0.89 U |
| Naphthalene | NC | 300 | 1.0 U | **35.3** | 1.0 U | **16.3** | **24** | | 1.0 U |
| **Total TICs (VOC+SVOC)** | | | | | | | | | |
| Total TICs | NC | 500 | **351.2** | **4161.8 J** | **43.3 J** | **1507.5 J** | **1677.4 J** | NS | 0 |
| **Inorganic Compounds** | | | | | | | | | |
| Aluminum | 200 | NC | **2,500** | **1,560** | **1,010** | **1,050** | **496** | Not Sampled Well Inaccessible | 200 U |
| Arsenic | 8 | NC | **30** | **14.8** | 5 U | 5 U | 5 U | | 5 U |
| Calcium | NC | NC | **13,100** | **11,300** | **21,200** | **6,890** | **6,550** | | 5,000 U |
| Chromium | 100 | NC | **16** | 10 U | 10 U | 10 U | 10 U | | 10 U |
| Iron | 300 | NC | **99,800** | **51,800** | **3,030** | **62,800** | **64,300** | | 100 U |
| Lead | 10 | NC | **3.8** | 3 U | 3 U | 3 U | 3 U | | 3 U |
| Magnesium | NC | NC | **10,200** | **9,240** | **21,400** | **5,640** | **5,700** | | 5,000 U |
| Manganese | 50 | NC | **1,560** | **2,530** | **971** | **1,040** | **1,060** | | 15 U |
| Potassium | NC | NC | 5,000 U | **13,400** | **8,130** | 5,000 U | 5,000 U | | 5,000 U |
| Sodium | 50,000 | NC | **33,600** | **26,200** | **17,400** | **36,600** | **37,900** | | 5,000 U |
| Zinc | 5,000 | NC | **29.8** | **29.7** | **37.5** | **50.1** | **43.3** | | 20 U |
| **Total Petroleum Hydrocarbons** | | | | | | | | | |
| TPHC* | NC | NC | ND | **1.9** | ND | **0.77** | **0.86** | NS | ND |

**Notes:**
All results reported in parts per billion (ug/L).
* - Results reported in parts per million (mg/L).
NJGWQS - New Jersey Ground Water Quality Standards (N.J.A.C. 7:9-6).
NS - Not sampled
ND - Not Detected
NC - No criteria established.

U - Not detected above the Sample Quantification Limit (SQL).
J - Estimated concentration.
**Bold values indicate positive detections.**
**Bold and shaded values meet or exceed NJGWQS (N.J.A.C. 7:9-6).**

**Table 7**
New Jersey Department of Environmental Protection
*Param Petroleum*
*Burlington, New Jersey*
**Groundwater Results October 2004**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *SAMPLE LOCATION* | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **MW-5** | | **FB-02** |
| | | *FIELD SAMPLE ID* | **MW-1** | **-** | **MW-3** | **-** | **MW-5** | **DUPE02** | **FB-02** |
| | | *LAB ID* | **N81784-2** | **-** | **N81784-3** | **-** | **N81784-1** | **N81784-4** | **N81784-5** |
| | | *DATE COLLECTED* | **10/27/2004** | **Not Sampled** | **10/27/2004** | **Not Sampled** | **10/27/2004** | **10/27/2004** | **10/27/2004** |
| *ANALYTE* | **NJGWQS** | **Interim NJGWQS** | | | | | | | |
| **Volatile Organic Compounds +10** | | | | | | | | | |
| Ethylbenzene | 700 | NC | 0.22 U | Not Sampled Product Present | 1 U | Not Sampled Product Present | **0.77 J** | **0.54 J** | 0.22 U |
| Methyl Tert Butyl Ether | NC | 70 | **29.2** | | 1 U | | **1.1** | **1.1** | 0.41 U |
| Tertiary Butyl Alcohol | NC | 100 | **102** | | 10 U | | 10 U | 10 U | 10 U |
| **Semivolatile Organic Compounds +20** | | | | | | | | | |
| Acenaphthene | 400 | NC | **0.67 J** | Not Sampled Product Present | 0.30 U | Not Sampled Product Present | 0.30 U | 0.30 U | 0.30 U |
| Dibenzofuran | NC | 100 | **0.78 J** | | 0.51 U | | 0.51 U | 0.51 U | 0.51 U |
| 2-Methylnaphthalene | NC | 100 | **3.3** | | 0.74 U | | 0.74 U | 0.74 U | 0.74 U |
| bis(2-Ethylhexyl)phthalate | 30 | NC | 0.76 U | | **2.4** | | 0.76 U | 0.76 U | 0.76 U |
| Fluorene | 300 | NC | **1.8 J** | | 0.92 U | | 0.92 U | 0.92 U | 0.92 U |
| Phenanthrene | NC | 100 | **1.8 J** | | 0.24 U | | 0.24 | 0.24 | 0.24 U |
| **Total TICs (VOC+SVOC)** | | | | | | | | | |
| Total TICs | NC | 500 | **143.7 J** | NS | 0 | NS | **38.8 J** | **39 J** | 0 |
| **Inorganic Compounds** | | | | | | | | | |
| Aluminum | 200 | NC | 200 U | Not Sampled Product Present | **1,290** | Not Sampled Product Present | **3,930** | **1,760** | 200 U |
| Arsenic | 8 | NC | **28** | | 5 U | | **22.8** | **26.3** | 5 U |
| Calcium | NC | NC | **13,500** | | **21,800** | | **21,800** | **23,700** | 5000 U |
| Chromium | 100 | NC | 10 U | | 10 U | | **37.4** | **17.7** | 10 U |
| Copper | 1,000 | NC | 25 U | | 25 U | | **27** | 25 U | 25 U |
| Iron | 300 | NC | **113,000** | | **4,680** | | **58,700** | **55400** | 100 U |
| Lead | 10 | NC | 3 U | | 3 U | | **4** | 3 U | 3 U |
| Magnesium | NC | NC | **11,300** | | **22,100** | | **19,300** | **20,000** | 5000 U |
| Manganese | 50 | NC | **2,030** | | **1,030** | | **2,380** | **2,660** | 15 U |
| Potassium | NC | NC | 5000 U | | **8,340** | | **11,200** | **10,300** | 5000 U |
| Sodium | 50,000 | NC | **43300** | | **1,600** | | **26,100** | **27,800** | 5000 U |
| Zinc | 5,000 | NC | 20 U | | **25.5** | | **75** | **35** | 20 U |
| **Total Petroleum Hydrocarbons** | | | | | | | | | |
| TPHC* | NC | NC | 0.55 U | NS | 0.51 U | NS | 0.54 U | 0.54 U | 0.55 U |

**Notes:**
All results reported in parts per billion (ug/L).
* - Results reported in parts per million (mg/L).
NJGWQS - New Jersey Ground Water Quality Standards (N.J.A.C. 7:9-6).
NS - Not sampled
ND - Not Detected
NC - No criteria established.
U - Not detected above the Sample Quantification Limit (SQL).
J - Estimated concentration.
**Bold values indicate positive detections.**
**Bold and shaded values meet or exceed NJGWQS (N.J.A.C. 7:9-6).**

**Table 8**

New Jersey Department of Environmental Protection

*Param Petroleum*

*Burlington, NJ*

**Hydropunch Results**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sample ID | HP 13-14' | HP 18-19' | HP 23-24' | HP 28-29' | HP 33-34' | HP 38-39' | HP 43-44' | HP 46.5-47.5' | HP 51.5-52.5' |
| | Lab Sample ID | J37792-1 | J37792-2 | J37792-3 | J37792-4 | J37792-5 | J37792-6 | J37792-7 | J37792-8 | J37792-9 |
| | Sample Date | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 | 8/7/2006 |
| Analyte | 2005 NJDEP GWQS | | | | | | | | | |
| Acetone | 6000 | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | **10** | **5.2** | 5 U |
| Benzene | 1 | 1 U | **0.25 J** | **0.33 J** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Carbon Disulfide | 700 | 1 U | **0.54 J** | **0.35 J** | 0.33 J | 0.89 J | 0.63 J | 1 U | 1 U | 1 U |
| Total VOC TICs | 500 | 42 J | **28.8 J** | **9.5 J** | **10.5 J** | 0 | 0 | **12.6 J** | **37.6 J** | **22.4 J** |

Notes:

- Results dry weight
- All results reported in parts per million (mg\kg)
- U = Not detected above the quantitation limit; the value presented is the sample quantitation limit
- J = estimated concentration
- NC = No Criteria established
- NJDEP GWQS = New Jersey Groundwater Quality Standards N.J.A.C. 7: 9-6
- **Bolded values indicate positive detections**
- **Bolded and shaded values indicate that one or more Criteria have been exceeded**

**Table 9**
New Jersey Department of Environmental Protection
*Param Petroleum*
*Burlington, NJ*
**Groundwater Results September 2006**

| | **Location ID** | MW-1 | MW-2 | MW-3 | MW-4 | MW-5 | MW-6 | | MW-7 | MW-8 | MW-9 | FB01 | FB02 | TB | TB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Sample ID** | MW-1 | MW-2 | MW-3 | MW-4 | MW-5 | MW-6 | DUP01 | MW-7D | MW-8 | MW-9 | FB01 | FB02 | TB | TB |
| | **Lab Sample ID** | J40756-3 | J40913-5 | J40913-2 | J40913-7 | J40756-6 | J40756-4 | J40756-5 | J40756-1 | J40913-6 | J40913-3 | J40756-2 | J40913-1 | J40756-7 | J40913-4 |
| | **Sample Date** | 9/11/2006 | 9/12/2006 | 9/12/2006 | 9/12/2006 | 9/11/2006 | 9/11/2006 | 9/11/2006 | 9/11/2006 | 9/12/2006 | 9/12/2006 | 9/11/2006 | 9/12/2006 | 9/11/2006 | 9/12/2006 |
| **VOCs** | **2005 NJDEP GWQS** | | | | | | | | | | | | | | |
| Acetone | 6000 | 25 U | N/A | N/A | N/A | 5 U | 5 U | 5 U | 5 U | N/A | N/A | 5 U | 5 U | 5 U | 5 U |
| Benzene | 1 | **23.3** | **642** | 1 U | **122** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Carbon Disulfide | 700 | 5 U | N/A | N/A | N/A | 1 U | 1 U | 1 U | **2.0** | N/A | N/A | 1 U | 1 U | 1 U | 1 U |
| Ethylbenzene | 700 | 5 U | **106** | 1 U | **66.8** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Methyl Tert Butyl Ether | 70 | **2140** | **137** | **1.1** | **17.8** | **1.1** | **0.61 J** | **0.60 J** | **20.8** | **10.7** | **1.9** | 1 U | 1 U | 1 U | 1 U |
| Tert-Butyl Alcohol | 100 | **9050** | 130 U | 25 U | 25 U | 25 U | 25 U | 25 U | **211** | 25 U | 25 U | 25 U | 25 U | 25 U | 25 U |
| Toluene | 1000 | 5 U | **25.7** | 1 U | **16.5** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Xylene (Total) | 1000 | 5 U | **51.4** | 1 U | **41.8** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| **SVOCs** | | | | | | | | | | | | | | | |
| Acenaphthene | 400 | **0.46 J** | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | NA | NA |
| bis(2-Ethylhexyl)Phthalate | 3 | 2 U | 2 U | 2 U | **1.3 J** | 2 U | 1.3 J | 2 U | 2 U | **1.0 J** | 2 U | 2 U | 2 U | NA | NA |
| Fluorene | 300 | **0.80 J** | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | NA | NA |
| Naphthalene | 300 | 2 U | **6.0** | 2 U | **5.9** | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | NA | NA |
| Phenol | 2000 | 2 U | **1.7 J** | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | NA | NA |
| **Total TICs (VOC+SVOC)** | | | | | | | | | | | | | | | |
| Total TICs | 500 | **100 J** | **1523.4 J** | 0 | **1948 J** | **21.3 J** | 0 | 0 | **10 J** | 0 | 0 | **140 J** | 0 | 0 | 0 |
| **Metals** | | | | | | | | | | | | | | | |
| Lead | 5 | 3 U | 3 U | 3 U | 3 U | 3 U | 3 U | 3 U | **4.3** | 3 U | 3 U | 3 U | 3 U | NA | NA |

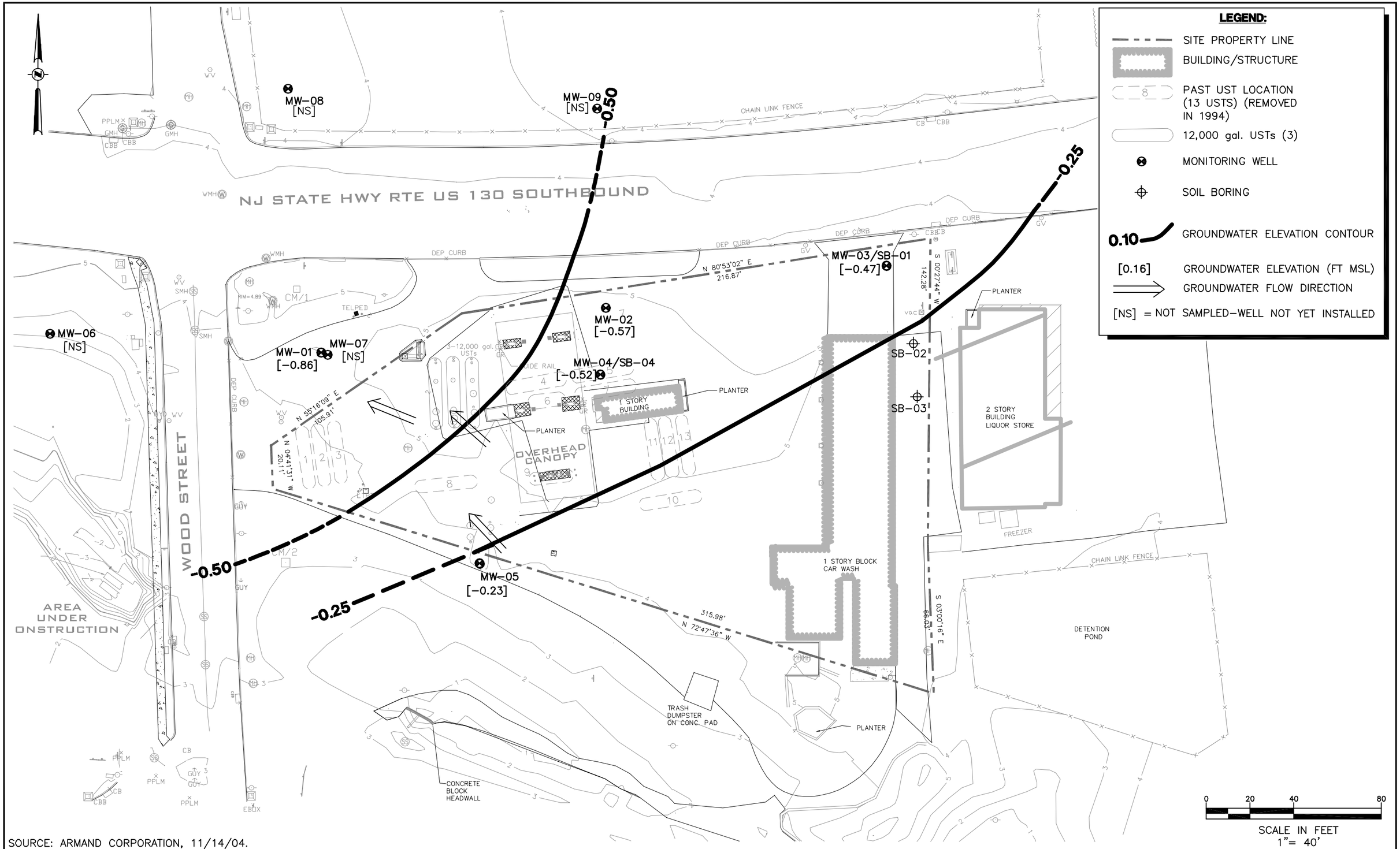
Notes:
- All results reported in parts per million (ug/L)
- U = Not detected above the quantitation limit; the value presented is the sample quantitation limit
- J = estimated concentration
- NC = No Criteria established
- NA = sample not tested for this analyte
- NJDEP GWQS = New Jersey Groundwater Quality Standards N.J.A.C. 7: 9-6
- **Bolded values indicate positive detections**
- **Bolded and shaded values indicate that one or more Criteria have been exceeded**

**Table 10**
New Jersey Department of Environmental Protection
*Param Petroleum*
*Burlington, NJ*
**Groundwater Results December 2006**

| | Location ID | MW-1 | MW-2 | MW-3 | MW-4 | MW-5 | MW-6 | MW-7 | | MW-8 | MW-9 | FB01 | FB02 | TB | TB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample ID | MW1 | MW2 | MW3 | MW4 | MW5 | MW6 | MW7 | DUP01 | MW8 | MW9 | FB01 | FB02 | TB | TB |
| | Lab Sample ID | J48480-1 | J48480-8 | J48480-6 | J48480-9 | J48386-1 | J48480-5 | J48480-3 | J48480-2 | J48386-3 | J48386-2 | J48386-4 | J48480-7 | J48386-5 | J48480-4 |
| | Sample Date | 12/6/2006 | 12/6/2006 | 12/6/2006 | 12/6/2006 | 12/5/2006 | 12/6/2006 | 12/6/2006 | 12/6/2006 | 12/5/2006 | 12/5/2006 | 12/5/2006 | 12/6/2006 | 12/5/2006 | 12/6/2006 |
| **VOC** | **2005 NJDEP GWQC** | | | | | | | | | | | | | | |
| Benzene | 1 | 1 U | **483** | 1 U | **151** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Ethylbenzene | 700 | 1 U | **80.9** | 1 U | **69.9** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Methyl Tert Butyl Ether | 70 | **28.3** | **65.0** | **1.3** | **10.4** | **0.75 J** | **0.39 J** | **14.4** | **14.9** | **1.7** | **0.86 J** | 1 U | 1 U | 1 U | 1 U |
| Tertiary Butyl Alcohol | 100 | **6870** | 50 U | 25 U | 25 U | 25 U | 25 U | **261** | **276** | 25 U | 25 U | 25 U | 25 U | 25 U | 25 U |
| Toluene | 1000 | 1 U | **24.8** | 1 U | **33.1** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Xylenes (total) | 1000 | 1 U | **84.1** | 1 U | **110** | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| **SVOC** | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | NC | 2 U | **0.84 J** | 2 U | **1.2 J** | N/A | 2 U | 2 U | 2 U | N/A | N/A | 2 U | 2 U | NA | NA |
| bis(2-Ethylhexyl)phthalate | 3 | 2 U | 2 U | **1.9 J** | 2 U | **1.1 J** | 2 U | 2 U | 2 U | 2.1 U | 2.1 U | **1.2 J** | 2 U | NA | NA |
| Dibenzofuran | NC | **0.46 J** | 5 U | 5 U | 5 U | N/A | 5 U | 5 U | 5 U | N/A | N/A | 5 U | 5 U | NA | NA |
| Fluorene | 300 | **0.94 J** | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U | 2.1 U | 2.1 U | 2 U | 2 U | NA | NA |
| Naphthalene | 300 | 2 U | **2.5** | 2 U | **5.1** | 2 U | 2 U | 2 U | 2 U | 2.1 U | 2.1 U | 2 U | 2 U | NA | NA |
| **Total TICs (VOC+SVOC)** | | | | | | | | | | | | | | | |
| Total TICs | 500 | **60 J** | **2401.2 J** | **82.1 J** | **1850.2** | **157.9 J** | 0 | **17.5 J** | **13 J** | 0 | 0 | **4.2 J** | 0 | 0 | 0 |
| **Other** | | | | | | | | | | | | | | | |
| Lead | 5 | 3 U | 3 U | 3 U | 3 U | 3 U | 3 U | 3 U | **4.2** | **5.4** | 3 U | 3 U | 3 U | NA | NA |
| Petroleum Hydrocarbons | NC | 0.51 U | **1.0** | 0.51 U | **1.5** | 0.51 U | 0.51 U | 0.51 U | 0.51 U | 0.52 U | 0.52 U | 0.51 U | 0.52 U | NA | NA |

Notes:
- All results reported in parts per million (ug/L)
- U = Not detected above the quantitation limit; the value presented is the sample quantitation limit
- J = estimated concentration
- NC = No Criteria established
- NA = sample not tested for this analyte
- NJDEP GWQS = New Jersey Groundwater Quality Standards N.J.A.C. 7: 9-6
**- Bolded values indicate positive detections**
**- Bolded and shaded values indicate that one or more Criteria have been exceeded**

# APPENDIX B
# 2004 and 2006 Groundwater Elevation Contour Map




SOURCE: ARMAND CORPORATION, 11/14/04.

N.J. Department of Environmental Protection

PARAM PETROLEUM, ROUTE 130 & WOOD STREET, BURLINGTON CITY, BURLINGTON COUNTY, NEW JERSEY

**GROUNDWATER CONTOURS - OCTOBER 14, 2004**

NJDEP CONTRACT No. A–47449

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

**FIGURE 4**

PPS–SP1–1/07JAN05/U4

N

MW-08
(-0.87)

MW-09
(-0.62)

MW-06
(-1.07)

MW-07
MW-01

MW-02
(-0.50)

SB-01/MW-03
(-0.38)

MW-04/SB-04
(-0.41)

SB-02

SB-03

MW-05
(-0.12)

SG-2
(+2.86)

SG-1

SED/SW102

SED/SW101

-1.50
-2.0
-2.50
-2.75
-2.25
-1.75
-1.25
-1.0
-0.75
-0.50
-0.25

CM/1
(-0.81)

CM/2

CHAIN LINK FENCE

DEP CURB

OVERHEAD CANOPY

1 STORY BUILDING

2 STORY BUILDING

1 STORY BLOCK CAR WASH

FREEZER

DETENTION POND

36" CMP INV -3.84

36" CMP INV -4.07

## Legend

- Site Boundary
- Existing UST Locations
- Former UST Locations
- Soil Boring
- Monitoring Well Locations
- Stream Gauge
- Sediment/Surface Water Sample Locations
- Groundwater Elevation Contour (ft)
- (-0.25) Groundwater Elevation (ft)
- Groundwater Flow Direction

0 25 50 100 Feet

FILE_PATH&NAME\10JUN05

N.J. Department of Environmental Protection

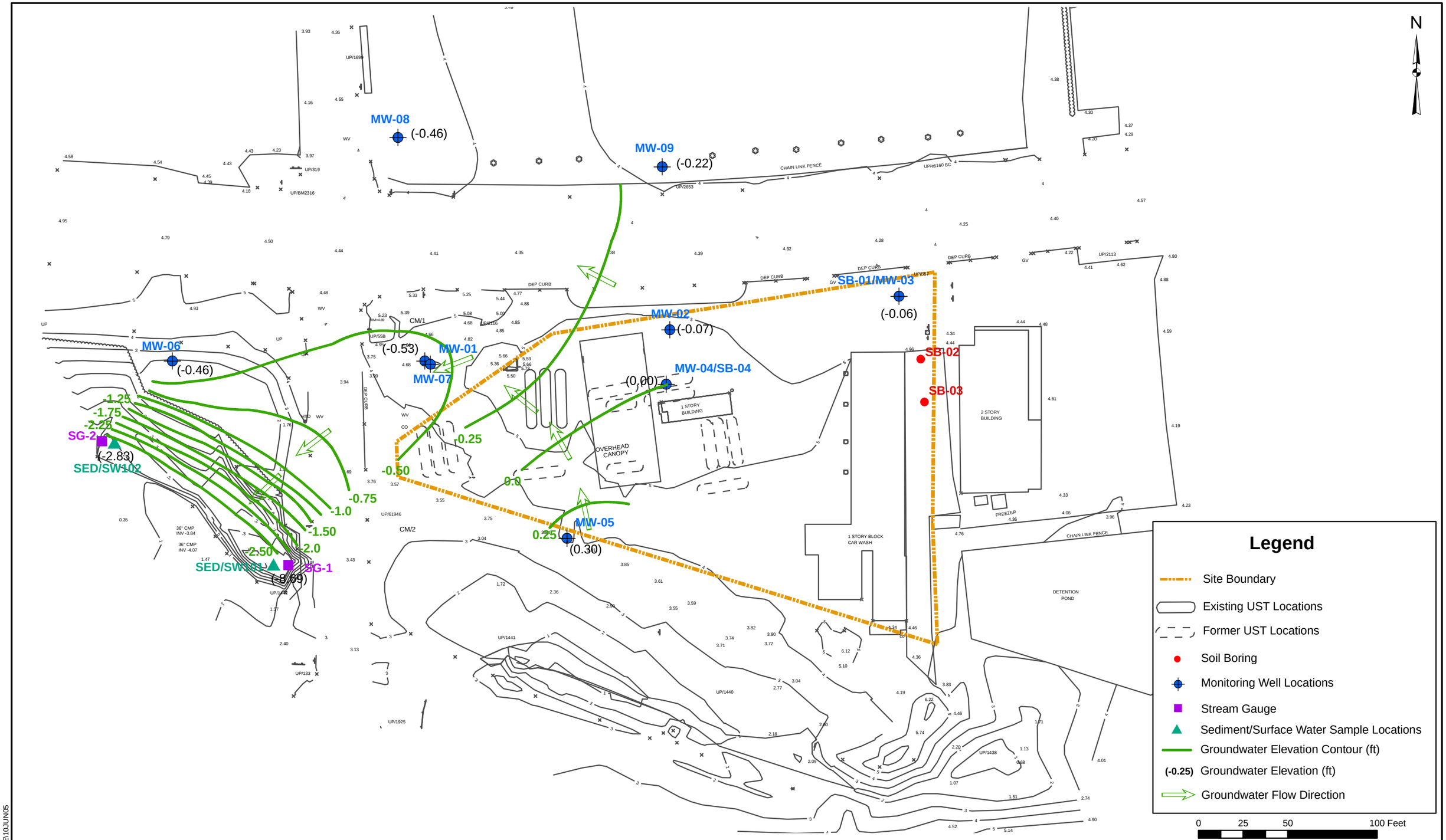
Param Site, Burlington County, New Jersey

# GROUND WATER CONTOURS - SEPTEMBER 2006

NJDEP CONTRACT No. A-47449

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

FIGURE 7




FILE_PATH&NAME\10JUN05

N.J. Department of Environmental Protection

Param Site, Burlington County, New Jersey

# GROUND WATER CONTOURS - DECEMBER 2006

NJDEP CONTRACT No. A-47449

The Louis Berger Group, Inc.
412 Mt Kemble Ave.
Morristown, NJ

FIGURE 8

# APPENDIX C
# Detailed Cost Breakdown of Groundwater Remedial Alternatives

# Monitored Natural Attenuation

**Table C1**
*Param Petroleum*
*Burlington, New Jersey*
**Estimated Cost Breakdown**
**Groundwater**
**Remediation Alternative - MNA**

| Activity | Cost[1] | Cost with Markups[2] |
|---|---|---|
| **Monitoring & Maintenance** | | |
| *Groundwater Monitoring (semiannually 1st 8 years and quarterly for the following 2 years)* | $147,356 | $334,818 |
| *Remedial Action Reevaluation (1/5 years)* | | |
| *Classification Exception Area* | | |
| **Total** | $147,356 | $334,818 |
| **Total (Rounded)** | $147,000 | $335,000 |
| **Total Net Present Value [3]** | | $332,260 |
| **Total Net Present Value (Rounded)[3]** | | **$350,000** |

[1]Refer to Phase Element Technology Cost Detail Report.

[2]Refer to Phase Element Cost Overtime Detail Report.

[3]Net Present Value includes Cost Overtime with inflation and markups, where applicable.

**Assumptions:**

- Groundwater samples would be collected from nine (9) monitoring wells (MW-1 through MW-9)

*Param Petroleum Site*
*Burlington, New Jersey*
***NET PRESENT VALUE CALCULATION***
***Groundwater***
***Remediation Alternative - MNA***

| **Technology** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** | **Year 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ 6,608.00 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | $22,296 | $22,296 | $22,296 | $22,296 | $22,296 | $54,565 | $22,296 | $22,296 | $42,652 | $42,652 | $32,269 |
| **Total Phase Element Cost** | $28,904 | $22,296 | $22,296 | $22,296 | $22,296 | $54,565 | $22,296 | $22,296 | $42,652 | $42,652 | $32,269 |
| **Escalation Factor** | 1.1465 | 1.1717 | 1.1975 | 1.2238 | 1.2508 | 1.2783 | 1.3064 | 1.3352 | 1.3645 | 1.3945 | 1.4252 |
| **Escalated Phase Element Cost** | $33,138 | $26,125 | $26,699 | $27,287 | $27,887 | $69,750 | $29,128 | $29,769 | $58,200 | $59,480 | $45,991 |
| **n = No. of Years** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Net Present Value (NPV) Assuming i - 5%** | **$33,138** | **$24,881** | **$24,217** | **$23,571** | **$22,943** | **$54,651** | **$21,736** | **$21,156** | **$39,392** | **$38,341** | **$28,234** |

| **Technology** | **Year 12** | **Year 13** | **Year 14** | **Year 15** | **Year 16** | **Year 17** | **Year 18** | **Year 19** | **Year 20** | **Year 21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | | | | | | | | | | |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Escalation Factor** | 1.4566 | 1.4886 | 1.5214 | 1.5548 | 1.5890 | 1.6240 | 1.6597 | 1.6963 | 1.7336 | 1.7717 |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **n = No. of Years** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

| **Technology** | **Year 22** | **Year 23** | **Year 24** | **Year 25** | **Year 26** | **Year 27** | **Year 28** | **Year 29** | **Year 30** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$6,608** |
| O & M Cost | | | | | | | | | | **$328,210** |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $334,818 |
| **Escalation Factor** | 1.8107 | 1.8505 | 1.8912 | 1.9328 | 1.9754 | 2.0188 | 2.0632 | 2.1086 | 2.1550 | |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$433,453** |
| **n = No. of Years** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$332,260** |

# Phase Technology Cost Detail Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Technology Cost Detail Report
# (with Markups)

## Site:

**Site ID:** Groundwater - MNA
**Site Name:** Groundwater - MNA
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** MNA
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 218.78 | 0.00 | $1,750.22 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 212.15 | 0.00 | $2,333.68 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 245.58 | 0.00 | $1,964.60 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 182.01 | 0.00 | $2,912.15 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,960.64** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 218.78 | 0.00 | $1,968.99 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 212.15 | 0.00 | $3,394.44 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 245.58 | 0.00 | $2,946.90 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 182.01 | 0.00 | $2,366.12 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,676.46** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 218.78 | 0.00 | $1,312.66 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 212.15 | 0.00 | $3,394.44 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 245.58 | 0.00 | $3,192.48 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 182.01 | 0.00 | $4,732.24 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,631.82** |
| **Total 1st Year Technology Cost** | **$32,268.92** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** INSTITUTIONAL CONTROL

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 95010203 | Classification Exception Area | 1.00 | LS | 6,721.58 | 0.00 | 0.00 | $6,721.58 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$6,721.58** |
| **Total 1st Year Technology Cost** | **$6,721.58** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 20.00 | EA | 11.59 | 0.00 | 0.00 | $231.80 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 20.00 | EA | 10.32 | 0.00 | 0.00 | $206.48 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 295.00 | LF | 0.70 | 0.00 | 0.00 | $205.23 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 324.52 | 0.00 | 0.00 | $324.52 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 20.00 | EA | 232.26 | 0.00 | 0.00 | $4,645.27 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 2.00 | DAY | 105.43 | 0.00 | 0.00 | $210.87 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 601.00 | 122.59 | 0.00 | $723.58 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$6,547.75** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 460.00 | MI | 0.17 | 0.00 | 0.00 | $76.18 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 4.00 | DAY | 99.00 | 0.00 | 0.00 | $396.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 218.78 | 0.00 | $875.11 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 8.00 | HR | 0.00 | 212.15 | 0.00 | $1,697.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 40.00 | HR | 0.00 | 182.01 | 0.00 | $7,280.38 | ☐ | ☑ |
| 33220112 | Field Technician | 40.00 | HR | 0.00 | 135.60 | 0.00 | $5,423.87 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$15,748.75** |
| **Total 1st Year Technology Cost** | **$22,296.49** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.59 | 0.00 | 0.00 | $463.60 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 10.32 | 0.00 | 0.00 | $412.96 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.70 | 0.00 | 0.00 | $393.07 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 324.52 | 0.00 | 0.00 | $324.52 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 232.26 | 0.00 | 0.00 | $9,290.54 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 105.43 | 0.00 | 0.00 | $421.73 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 601.00 | 122.59 | 0.00 | $723.58 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$12,030.00** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 218.78 | 0.00 | $875.11 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 212.15 | 0.00 | $3,394.44 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 182.01 | 0.00 | $14,560.75 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 135.60 | 0.00 | $10,847.74 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$30,622.39** |
| **Total 1st Year Technology Cost** | **$42,652.38** |
| **Total Phase Cost** | **$103,939.37** |

# Phase Cost Over Time Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Over Time Report
# (with Markups)

## Site:

**Site ID:** Groundwater - MNA
**Site Name:** Groundwater - MNA
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** MNA
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $32,269 |
| INSTITUTIONAL CONTROL | $6,722 | $0 | $0 | $0 | $0 | $0 |
| Monitoring | $22,296 | $22,296 | $22,296 | $22,296 | $22,296 | $22,296 |
| Monitoring | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total Phase Cost** | $29,018 | $22,296 | $22,296 | $22,296 | $22,296 | $54,565 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| Five-Year Review | $0 | $0 | $0 | $0 | $32,269 | $64,538 |
| INSTITUTIONAL CONTROL | $0 | $0 | $0 | $0 | $0 | $6,722 |
| Monitoring | $22,296 | $22,296 | $0 | $0 | $0 | $178,372 |
| Monitoring | $0 | $0 | $42,652 | $42,652 | $0 | $85,305 |
| **Total Phase Cost** | $22,296 | $22,296 | $42,652 | $42,652 | $32,269 | $334,936 |

# Phase Cost Summary Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Summary Report
# (with Markups)

## Site:

**Site ID:** Groundwater - MNA
**Site Name:** Groundwater - MNA
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Summary Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** MNA
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Summary Report
# (with Markups)

| Technology | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| Five-Year Review | $20,981 | $43,557 | $64,538 |
| INSTITUTIONAL CONTROL | $5,000 | $1,722 | $6,722 |
| Monitoring | $82,328 | $96,044 | $178,372 |
| Monitoring | $39,046 | $46,259 | $85,305 |
| **Total Capital Cost** | $147,356 | $187,580 | $334,936 |

| | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| **Total Phase Cost** | $147,356 | $187,580 | $334,936 |

# Enhanced Monitored Natural Attenuation

**Table C2**
*Param Petroleum*
*Burlington, New Jersey*
**Estimated Cost Breakdown**
**Groundwater**
**Remediation Alternative - EMNA**

| Activity | Cost[1] | Cost with Markups[2] |
|---|---|---|
| **ORC-Advanced Injection** | $160,825 | $228,621 |
| **Monitoring & Maintenance**<br>*Groundwater Monitoring (quarterly for 1st 2 years, semi-annually for the following 3 years, and quarterly thereafter for the next 2 years)*<br>*Remedial Action Reevaluation (1/5 years)*<br>*Classification Exception Area* | $141,016 | $320,624 |
| **Total** | $301,841 | $549,245 |
| **Total (Rounded)** | $302,000 | $549,000 |
| **Total Net Present Value [3]** | | $596,939 |
| **Total Net Present Value (Rounded)[3]** | | **$600,000** |

[1]Refer to Phase Element Technology Cost Detail Report.

[2]Refer to Phase Element Cost Overtime Detail Report.

[3]Net Present Value includes Cost Overtime with inflation and markups, where applicable.

**Assumptions:**

- Groundwater samples would be collected from nine (9) monitoring wells (MW-1 through MW-9)
- ORC Advanced® would be injected through 2 injection events (1 mandatory event and 1 optional event); target depth interval of 5 to 15 feet bgs; 20-ft grid injection pattern; 40 injection locations; 10 lbs/foot.
- An approximate total of 9,000 lbs of ORC Advanced® would be injected (4,500 lbs for each injection event)

*Param Petroleum Site*
*Burlington, New Jersey*
***NET PRESENT VALUE CALCULATION***
***Groundwater***
***Remediation Alternative - EMNA***

| **Technology** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** | **Year 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ 235,143 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | $45,077 | $45,077 | $23,484 | $23,484 | $23,484 | $76,748 | $45,077 | $31,671 | | | |
| **Total Phase Element Cost** | $280,220 | $45,077 | $23,484 | $23,484 | $23,484 | $76,748 | $45,077 | $31,671 | $0 | $0 | $0 |
| **Escalation Factor** | 1.1465 | 1.1717 | 1.1975 | 1.2238 | 1.2508 | 1.2783 | 1.3064 | 1.3352 | 1.3645 | 1.3945 | 1.4252 |
| **Escalated Phase Element Cost** | $321,272 | $52,818 | $28,122 | $28,741 | $29,373 | $98,106 | $58,889 | $42,286 | $0 | $0 | $0 |
| **n = No. of Years** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Net Present Value (NPV) Assuming i - 5%** | **$321,272** | **$50,303** | **$25,508** | **$24,827** | **$24,165** | **$76,869** | **$43,944** | **$30,052** | **$0** | **$0** | **$0** |

| **Technology** | **Year 12** | **Year 13** | **Year 14** | **Year 15** | **Year 16** | **Year 17** | **Year 18** | **Year 19** | **Year 20** | **Year 21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | | | | | | | | | | |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Escalation Factor** | 1.4566 | 1.4886 | 1.5214 | 1.5548 | 1.5890 | 1.6240 | 1.6597 | 1.6963 | 1.7336 | 1.7717 |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **n = No. of Years** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

| **Technology** | **Year 22** | **Year 23** | **Year 24** | **Year 25** | **Year 26** | **Year 27** | **Year 28** | **Year 29** | **Year 30** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$235,143** |
| O & M Cost | | | | | | | | | | **$314,102** |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $549,245 |
| **Escalation Factor** | 1.8107 | 1.8505 | 1.8912 | 1.9328 | 1.9754 | 2.0188 | 2.0632 | 2.1086 | 2.1550 | |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$659,607** |
| **n = No. of Years** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$596,939** |

# Phase Technology Cost Detail Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Technology Cost Detail Report
# (with Markups)

## Site:

**Site ID:** Groundwater - EMNA (ORC-Adv)
**Site Name:** Groundwater - EMNA (ORC-Adv)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** EMNA - ORC-Adv
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** In Situ Biodegradation (Saturated Zone)

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 32039005 | Remedial Design - User Defined Cost | 1.00 | EA | 0.00 | 16,177.35 | 0.00 | $16,177.35 | ☑ | ☑ |
| 33020667 | Direct Push Rig, Truck Mounted, Non Hydraulic, Includes Labor, Sampling, Decontamination | 8.00 | DAY | 232.19 | 0.00 | 0.00 | $1,857.53 | ☐ | ☑ |
| 33020668 | Mobilize Direct Push Rig and Crew | 8.00 | DAY | 773.97 | 0.00 | 0.00 | $6,191.78 | ☐ | ☑ |
| 33020669 | Demobilize Direct Push Rig and Crew | 8.00 | DAY | 773.97 | 0.00 | 0.00 | $6,191.78 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 2.00 | WK | 314.90 | 0.00 | 0.00 | $629.79 | ☐ | ☑ |
| 33021913 | Testing, biomonitoring & bioassay, laboratory bench-scale studies | 3.00 | EA | 996.79 | 0.00 | 0.00 | $2,990.37 | ☐ | ☑ |
| 33220105 | Project Engineer | 80.00 | HR | 0.00 | 208.22 | 0.00 | $16,657.90 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |
| 33231187 | Load Supplies/Equipment | 1.00 | LS | 195.95 | 928.35 | 488.87 | $1,613.17 | ☐ | ☑ |
| 33240102 | Bench Scale Test | 1.00 | LS | 6,522.21 | 0.00 | 0.00 | $6,522.21 | ☑ | ☑ |
| 33240103 | Pilot Scale Test | 1.00 | LS | 65,222.06 | 0.00 | 0.00 | $65,222.06 | ☑ | ☑ |
| 95010803 | ORC-Adv Material Cost | 9,000.00 | LBS | 10.44 | 0.00 | 0.00 | $93,919.50 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$228,620.30** |
| **Total 1st Year Technology Cost** | **$228,620.30** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 214.73 | 0.00 | $1,717.80 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 208.22 | 0.00 | $2,290.46 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 241.03 | 0.00 | $1,928.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 178.64 | 0.00 | $2,858.22 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,794.71** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 214.73 | 0.00 | $1,932.53 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 241.03 | 0.00 | $2,892.33 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 178.64 | 0.00 | $2,322.31 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,478.74** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 214.73 | 0.00 | $1,288.35 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 241.03 | 0.00 | $3,133.36 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 178.64 | 0.00 | $4,644.61 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,397.90** |
| **Total 1st Year Technology Cost** | **$31,671.35** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** INSTITUTIONAL CONTROL

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 95010203 | Classification Exception Area | 1.00 | LS | 6,522.21 | 0.00 | 0.00 | $6,522.21 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$6,522.21** |
| **Total 1st Year Technology Cost** | **$6,522.21** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.25 | 0.00 | 0.00 | $449.84 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 10.02 | 0.00 | 0.00 | $400.71 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.68 | 0.00 | 0.00 | $381.38 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 314.90 | 0.00 | 0.00 | $314.90 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 225.37 | 0.00 | 0.00 | $9,014.97 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 102.31 | 0.00 | 0.00 | $409.22 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 583.17 | 118.02 | 0.00 | $701.19 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,672.20** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 32.00 | HR | 0.00 | 208.22 | 0.00 | $6,663.16 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 178.64 | 0.00 | $14,291.11 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$33,404.37** |
| **Total 1st Year Technology Cost** | **$45,076.57** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 214.73 | 0.00 | $1,717.80 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 208.22 | 0.00 | $2,290.46 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 241.03 | 0.00 | $1,928.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 178.64 | 0.00 | $2,858.22 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,794.71** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 214.73 | 0.00 | $1,932.53 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 241.03 | 0.00 | $2,892.33 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 178.64 | 0.00 | $2,322.31 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,478.74** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 214.73 | 0.00 | $1,288.35 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 241.03 | 0.00 | $3,133.36 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 178.64 | 0.00 | $4,644.61 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,397.90** |
| **Total 1st Year Technology Cost** | **$31,671.35** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 20.00 | EA | 11.25 | 0.00 | 0.00 | $224.92 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 20.00 | EA | 10.02 | 0.00 | 0.00 | $200.35 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 295.00 | LF | 0.68 | 0.00 | 0.00 | $199.13 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 314.90 | 0.00 | 0.00 | $314.90 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 20.00 | EA | 225.37 | 0.00 | 0.00 | $4,507.49 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 2.00 | DAY | 102.31 | 0.00 | 0.00 | $204.61 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 583.17 | 118.02 | 0.00 | $701.19 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$6,352.58** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 460.00 | MI | 0.17 | 0.00 | 0.00 | $76.18 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 4.00 | DAY | 99.00 | 0.00 | 0.00 | $396.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220109 | Staff Scientist | 40.00 | HR | 0.00 | 178.64 | 0.00 | $7,145.56 | ☐ | ☑ |
| 33220112 | Field Technician | 40.00 | HR | 0.00 | 133.09 | 0.00 | $5,323.42 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$17,131.64** |
| **Total 1st Year Technology Cost** | **$23,484.22** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.25 | 0.00 | 0.00 | $449.84 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 10.02 | 0.00 | 0.00 | $400.71 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.68 | 0.00 | 0.00 | $381.38 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 314.90 | 0.00 | 0.00 | $314.90 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 225.37 | 0.00 | 0.00 | $9,014.97 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 102.31 | 0.00 | 0.00 | $409.22 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 583.17 | 118.02 | 0.00 | $701.19 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,672.20** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 32.00 | HR | 0.00 | 208.22 | 0.00 | $6,663.16 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 178.64 | 0.00 | $14,291.11 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$33,404.37** |
| **Total 1st Year Technology Cost** | **$45,076.57** |
| **Total Phase Cost** | **$412,122.57** |

# Phase Cost Over Time Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Over Time Report
# (with Markups)

## Site:

**Site ID:** Groundwater - EMNA (ORC-Adv)
**Site Name:** Groundwater - EMNA (ORC-Adv)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** EMNA - ORC-Adv
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | $228,621 | $0 | $0 | $0 | $0 | $0 |
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $31,671 |
| INSTITUTIONAL CONTROL | $6,522 | $0 | $0 | $0 | $0 | $0 |
| Monitoring | $45,077 | $45,077 | $0 | $0 | $0 | $0 |
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $0 |
| Monitoring | $0 | $0 | $23,484 | $23,484 | $23,484 | $0 |
| Monitoring | $0 | $0 | $0 | $0 | $0 | $45,077 |
| **Total Phase Cost** | $280,219 | $45,077 | $23,484 | $23,484 | $23,484 | $76,748 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2016 | 2017 | Total |
|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | $0 | $0 | $228,621 |
| Five-Year Review | $0 | $0 | $31,671 |
| INSTITUTIONAL CONTROL | $0 | $0 | $6,522 |
| Monitoring | $0 | $0 | $90,153 |
| Five-Year Review | $0 | $31,671 | $31,671 |
| Monitoring | $0 | $0 | $70,453 |
| Monitoring | $45,077 | $0 | $90,153 |
| **Total Phase Cost** | $45,077 | $31,671 | $549,245 |

# Phase Cost Summary Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Summary Report
# (with Markups)

## Site:

**Site ID:** Groundwater - EMNA (ORC-Adv)
**Site Name:** Groundwater - EMNA (ORC-Adv)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 02/12/2009

**Estimator Signature:** _____ **Date:** _____

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Summary Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** EMNA - ORC-Adv
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Summary Report
# (with Markups)

| Technology | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| In Situ Biodegradation (Saturated Zone) | $160,825 | $67,796 | $228,621 |
| Five-Year Review | $10,491 | $21,180 | $31,671 |
| INSTITUTIONAL CONTROL | $5,000 | $1,522 | $6,522 |
| Monitoring | $41,254 | $48,899 | $90,153 |
| Five-Year Review | $10,491 | $21,180 | $31,671 |
| Monitoring | $32,528 | $37,925 | $70,453 |
| Monitoring | $41,254 | $48,899 | $90,153 |
| **Total Capital Cost** | $301,841 | $247,404 | $549,245 |

| | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| **Total Phase Cost** | $301,841 | $247,404 | $549,245 |

# In-Situ Chemical Oxidation

**Table C3**
*Param Petroleum*
*Burlington, New Jersey*
**Estimated Cost Breakdown**
**Groundwater**
**Remediation Alternative - ISCO**

| Activity | Cost[1] | Cost with Markups[2] |
|---|---|---|
| **RegenOx Injection** | $182,383 | $277,210 |
| **Monitoring & Maintenance**<br>*Groundwater Monitoring (quarterly for 1st 2 years, semi-annually for the following 3 years)*<br>*Remedial Action Reevaluation (1/5 years)*<br>*Classification Exception Area* | $120,390 | $274,753 |
| **Total** | $302,773 | $551,963 |
| **Total (Rounded)** | $303,000 | $552,000 |
| **Total Net Present Value** [3] | | $547,910 |
| **Total Net Present Value (Rounded)**[3] | | **$550,000** |

[1]Refer to Phase Element Technology Cost Detail Report.

[2]Refer to Phase Element Cost Overtime Detail Report.

[3]Net Present Value includes Cost Overtime with inflation and markups, where applicable.

**Assumptions:**

- Groundwater samples would be collected from nine (9) monitoring wells (MW-1 through MW-9)
- RegenOx® would be injected through 2 injection events (1 mandatory event and 1 optional event); target depth interval of 5 to 15 feet bgs; 10-ft grid injection pattern; 150 injection locations; 10 lbs/foot.
- An approximate total of 30,000 lbs of RegenOx® would be injected (for each injection event)

*Param Petroleum Site*
*Burlington, New Jersey*
***NET PRESENT VALUE CALCULATION***
***Groundwater***
***Remediation Alternative - ISCO***

| **Technology** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** | **Year 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ 232,286 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | $44,924 | $23,401 | $23,401 | $23,401 | $44,924 | $76,595 | $31,671 | | | | |
| **Total Phase Element Cost** | $277,210 | $23,401 | $23,401 | $23,401 | $44,924 | $76,595 | $31,671 | $0 | $0 | $0 | $0 |
| **Escalation Factor** | 1.1465 | 1.1717 | 1.1975 | 1.2238 | 1.2508 | 1.2783 | 1.3064 | 1.3352 | 1.3645 | 1.3945 | 1.4252 |
| **Escalated Phase Element Cost** | $317,821 | $27,419 | $28,023 | $28,639 | $56,190 | $97,910 | $41,375 | $0 | $0 | $0 | $0 |
| **n = No. of Years** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Net Present Value (NPV) Assuming i - 5%** | **$317,821** | **$26,114** | **$25,417** | **$24,740** | **$46,227** | **$76,715** | **$30,875** | **$0** | **$0** | **$0** | **$0** |

| **Technology** | **Year 12** | **Year 13** | **Year 14** | **Year 15** | **Year 16** | **Year 17** | **Year 18** | **Year 19** | **Year 20** | **Year 21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | | | | | | | | | | |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Escalation Factor** | 1.4566 | 1.4886 | 1.5214 | 1.5548 | 1.5890 | 1.6240 | 1.6597 | 1.6963 | 1.7336 | 1.7717 |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **n = No. of Years** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

| **Technology** | **Year 22** | **Year 23** | **Year 24** | **Year 25** | **Year 26** | **Year 27** | **Year 28** | **Year 29** | **Year 30** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$232,286** |
| O & M Cost | | | | | | | | | | **$268,317** |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $500,603 |
| **Escalation Factor** | 1.8107 | 1.8505 | 1.8912 | 1.9328 | 1.9754 | 2.0188 | 2.0632 | 2.1086 | 2.1550 | |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$597,378** |
| **n = No. of Years** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$547,910** |

# Phase Technology Cost Detail Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Technology Cost Detail Report
# (with Markups)

## Site:

**Site ID:** Groundwater - CHEM OX (REGENOX)
**Site Name:** Groundwater - CHEM OX (REGENOX)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/04/2007

**Estimator Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** REGENOX
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| INSITU CHEMICAL OXIDATION | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 214.73 | 0.00 | $1,717.80 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 208.22 | 0.00 | $2,290.46 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 241.03 | 0.00 | $1,928.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 178.64 | 0.00 | $2,858.22 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,794.71** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 214.73 | 0.00 | $1,932.53 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 241.03 | 0.00 | $2,892.33 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 178.64 | 0.00 | $2,322.31 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,478.74** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 214.73 | 0.00 | $1,288.35 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 241.03 | 0.00 | $3,133.36 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 178.64 | 0.00 | $4,644.61 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,397.90** |
| **Total 1st Year Technology Cost** | **$31,671.35** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** INSTITUTIONAL CONTROL

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 95010203 | Classification Exception Area | 1.00 | LS | 6,436.76 | 0.00 | 0.00 | $6,436.76 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$6,436.76** |
| **Total 1st Year Technology Cost** | **$6,436.76** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.10 | 0.00 | 0.00 | $443.95 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 9.89 | 0.00 | 0.00 | $395.46 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.67 | 0.00 | 0.00 | $376.40 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 222.42 | 0.00 | 0.00 | $8,896.87 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 100.97 | 0.00 | 0.00 | $403.86 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,519.20** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 32.00 | HR | 0.00 | 208.22 | 0.00 | $6,663.16 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 178.64 | 0.00 | $14,291.11 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$33,404.37** |
| **Total 1st Year Technology Cost** | **$44,923.57** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** INSITU CHEMICAL OXIDATION

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 32039005 | Remedial Design - User Defined Cost | 1.00 | EA | 0.00 | 15,949.50 | 0.00 | $15,949.50 | ☑ | ☑ |
| 33020667 | Direct Push Rig, Truck Mounted, Non Hydraulic, Includes Labor, Sampling, Decontamination | 20.00 | DAY | 229.15 | 0.00 | 0.00 | $4,582.97 | ☑ | ☑ |
| 33020668 | Mobilize Direct Push Rig and Crew | 20.00 | DAY | 763.83 | 0.00 | 0.00 | $15,276.67 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 4.00 | WK | 310.77 | 0.00 | 0.00 | $1,243.09 | ☐ | ☑ |
| 33021913 | Testing, biomonitoring & bioassay, laboratory bench-scale studies | 3.00 | EA | 983.73 | 0.00 | 0.00 | $2,951.19 | ☐ | ☑ |
| 33220105 | Project Engineer | 200.00 | HR | 0.00 | 208.22 | 0.00 | $41,644.68 | ☐ | ☑ |
| 33220112 | Field Technician | 200.00 | HR | 0.00 | 133.09 | 0.00 | $26,617.06 | ☐ | ☑ |
| 33231187 | Load Supplies/Equipment | 1.00 | LS | 193.39 | 915.27 | 480.59 | $1,589.24 | ☐ | ☑ |
| 33240102 | Bench Scale Test | 1.00 | LS | 6,436.76 | 0.00 | 0.00 | $6,436.76 | ☑ | ☑ |
| 33240103 | Pilot Scale Test | 1.00 | LS | 64,367.62 | 0.00 | 0.00 | $64,367.62 | ☑ | ☑ |
| 95012602 | RegenOx | 30,000.00 | LB | 3.22 | 0.00 | 0.00 | $96,552.00 | ☑ | ☑ |
| | | | | **Total Element Cost** | | | **$277,210.80** | | |
| | | | | **Total 1st Year Technology Cost** | | | **$277,210.80** | | |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 214.73 | 0.00 | $1,717.80 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 208.22 | 0.00 | $2,290.46 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 241.03 | 0.00 | $1,928.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 178.64 | 0.00 | $2,858.22 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,794.71** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 214.73 | 0.00 | $1,932.53 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 241.03 | 0.00 | $2,892.33 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 178.64 | 0.00 | $2,322.31 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,478.74** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 214.73 | 0.00 | $1,288.35 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 241.03 | 0.00 | $3,133.36 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 178.64 | 0.00 | $4,644.61 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,397.90** |
| **Total 1st Year Technology Cost** | **$31,671.35** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 20.00 | EA | 11.10 | 0.00 | 0.00 | $221.98 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 20.00 | EA | 9.89 | 0.00 | 0.00 | $197.73 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 295.00 | LF | 0.67 | 0.00 | 0.00 | $196.53 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 20.00 | EA | 222.42 | 0.00 | 0.00 | $4,448.44 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 2.00 | DAY | 100.97 | 0.00 | 0.00 | $201.93 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$6,269.26** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 460.00 | MI | 0.17 | 0.00 | 0.00 | $76.18 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 4.00 | DAY | 99.00 | 0.00 | 0.00 | $396.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220109 | Staff Scientist | 40.00 | HR | 0.00 | 178.64 | 0.00 | $7,145.56 | ☐ | ☑ |
| 33220112 | Field Technician | 40.00 | HR | 0.00 | 133.09 | 0.00 | $5,323.42 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$17,131.64** |
| **Total 1st Year Technology Cost** | **$23,400.89** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.10 | 0.00 | 0.00 | $443.95 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 9.89 | 0.00 | 0.00 | $395.46 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.67 | 0.00 | 0.00 | $376.40 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 222.42 | 0.00 | 0.00 | $8,896.87 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 100.97 | 0.00 | 0.00 | $403.86 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,519.20** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 32.00 | HR | 0.00 | 208.22 | 0.00 | $6,663.16 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 178.64 | 0.00 | $14,291.11 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$33,404.37** |
| **Total 1st Year Technology Cost** | **$44,923.57** |
| **Total Phase Cost** | **$460,238.29** |

# Phase Cost Over Time Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Over Time Report
# (with Markups)

## Site:

**Site ID:** Groundwater - CHEM OX (REGENOX)
**Site Name:** Groundwater - CHEM OX (REGENOX)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/04/2007

**Estimator Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** REGENOX
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| INSITU CHEMICAL OXIDATION | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $31,671 |
| INSTITUTIONAL CONTROL | $6,437 | $0 | $0 | $0 | $0 | $0 |
| Monitoring | $44,924 | $0 | $0 | $0 | $0 | $0 |
| INSITU CHEMICAL OXIDATION | $277,210 | $0 | $0 | $0 | $0 | $0 |
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $0 |
| Monitoring | $0 | $23,401 | $23,401 | $23,401 | $0 | $0 |
| Monitoring | $0 | $0 | $0 | $0 | $44,924 | $44,924 |
| **Total Phase Cost** | $328,571 | $23,401 | $23,401 | $23,401 | $44,924 | $76,595 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2016 | Total |
|---|---|---|
| Five-Year Review | $0 | $31,671 |
| INSTITUTIONAL CONTROL | $0 | $6,437 |
| Monitoring | $0 | $44,924 |
| INSITU CHEMICAL OXIDATION | $0 | $277,210 |
| Five-Year Review | $31,671 | $31,671 |
| Monitoring | $0 | $70,203 |
| Monitoring | $0 | $89,847 |
| **Total Phase Cost** | $31,671 | $551,963 |

# Phase Cost Summary Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Summary Report
# (with Markups)

## Site:

**Site ID:** Groundwater - CHEM OX (REGENOX)
**Site Name:** Groundwater - CHEM OX (REGENOX)
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☐
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/04/2007

**Estimator Signature:** _____ **Date:** _____

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Summary Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** REGENOX
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** In Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Five-Year Review | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| INSITU CHEMICAL OXIDATION | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Summary Report
# (with Markups)

| Technology | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| Five-Year Review | $10,491 | $21,180 | $31,671 |
| INSTITUTIONAL CONTROL | $5,000 | $1,437 | $6,437 |
| Monitoring | $20,627 | $24,297 | $44,924 |
| INSITU CHEMICAL OXIDATION | $182,383 | $94,827 | $277,210 |
| Five-Year Review | $10,491 | $21,180 | $31,671 |
| Monitoring | $32,528 | $37,675 | $70,203 |
| Monitoring | $41,254 | $48,593 | $89,847 |
| **Total Capital Cost** | $302,773 | $249,190 | $551,963 |

| | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| **Total Phase Cost** | $302,773 | $249,190 | $551,963 |

# Air Sparging/Soil Vapor Extraction

**Table C4**

*Param Petroleum*

*Burlington, New Jersey*

**Estimated Cost Breakdown**

**Groundwater**

**Remediation Alternative - AS/SVE**

| Activity | Cost[1] | Cost with Markups[2] |
|---|---|---|
| **Implementation**<br>*Soil vapor Extraction/Air Sparging*<br>*Carbon Adsorption (Gas and Liquid)*<br>*Air Sparging* | $372,121 | $498,077 |
| **Monitoring & Maintenance**<br>*Operation and Maintenance (for 5 years)*<br>*Soil Gas Monitoring (quarterly for 1st two years, semi-annually for the following 6 years)*<br>*Groundwater Monitoring (quarterly for 1st two years, semi-annually for the following 6 years)*<br>*Treatment System Monitoring (monthly for 5 years)*<br>*Classification Exception Area*<br>*Remedial Action Reevaluation (1/5 years)* | $463,775 | $1,051,095 |
| **Total** | $835,896 | $1,549,172 |
| **Total (Rounded)** | $836,000 | $1,549,000 |
| **Total Net Present Value** [3] | | $1,680,228 |
| **Total Net Present Value (Rounded)**[3] | | **$1,700,000** |

[1]Refer to Phase Element Technology Cost Detail Report.

[2]Refer to Phase Element Cost Overtime Detail Report.

[3]Net Present Value includes Cost Overtime with inflation and markups, where applicable.

**Assumptions:**

- Ten (10) air sparging wells with flow rate of 5 cubic feet per minute; approximately 40 feet well spacing
- Two (2) horizontal extraction trenches
- Groundwater samples would be collected from nine (9) monitoring wells (MW-1 through MW-9)
- Four (4) soil gas monitoring points to be installed.

*Param Petroleum Site*
*Burlington, New Jersey*
***NET PRESENT VALUE CALCULATION***
***Groundwater***
***Remediation Alternative - AS/SVE***

| **Technology** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** | **Year 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ 504,514 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | $165,429 | $161,487 | $159,486 | $161,307 | $166,882 | $61,745 | $23,401 | $23,401 | $44,924 | $44,924 | $31,671 |
| **Total Phase Element Cost** | $669,943 | $161,487 | $159,486 | $161,307 | $166,882 | $61,745 | $23,401 | $23,401 | $44,924 | $44,924 | $31,671 |
| **Escalation Factor** | 1.1465 | 1.1717 | 1.1975 | 1.2238 | 1.2508 | 1.2783 | 1.3064 | 1.3352 | 1.3645 | 1.3945 | 1.4252 |
| **Escalated Phase Element Cost** | $768,090 | $189,218 | $190,985 | $197,415 | $208,731 | $78,928 | $30,571 | $31,244 | $61,300 | $62,648 | $45,138 |
| **n = No. of Years** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Net Present Value (NPV) Assuming i - 5%** | **$768,090** | **$180,208** | **$173,229** | **$170,534** | **$171,724** | **$61,842** | **$22,813** | **$22,204** | **$41,490** | **$40,384** | **$27,711** |

| **Technology** | **Year 12** | **Year 13** | **Year 14** | **Year 15** | **Year 16** | **Year 17** | **Year 18** | **Year 19** | **Year 20** | **Year 21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| O & M Cost | | | | | | | | | | |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Escalation Factor** | 1.4566 | 1.4886 | 1.5214 | 1.5548 | 1.5890 | 1.6240 | 1.6597 | 1.6963 | 1.7336 | 1.7717 |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **n = No. of Years** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

| **Technology** | **Year 22** | **Year 23** | **Year 24** | **Year 25** | **Year 26** | **Year 27** | **Year 28** | **Year 29** | **Year 30** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | **$504,514** |
| O & M Cost | | | | | | | | | | **$1,044,657** |
| **Total Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $1,549,171 |
| **Escalation Factor** | 1.8107 | 1.8505 | 1.8912 | 1.9328 | 1.9754 | 2.0188 | 2.0632 | 2.1086 | 2.1550 | |
| **Escalated Phase Element Cost** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$1,864,268** |
| **n = No. of Years** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| **Net Present Value (NPV) Assuming i - 5%** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$1,680,228** |

# Phase Technology Cost Detail Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Technology Cost Detail Report
# (with Markups)

## Site:

**Site ID:** Groundwater - AS/SVE
**Site Name:** Groundwater - AS/SVE
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☑
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/22/2007

**Estimator Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Technology Cost Detail Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** AS/SVE
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Soil Vapor Extraction | Yes | 100 | 0 |
| Air Sparging | Yes | 100 | 0 |
| Carbon Adsorption (Gas) | Yes | 100 | 0 |
| Carbon Adsorption (Liquid) | Yes | 100 | 0 |
| SVE VAPOR MONITORING POINT | Yes | 100 | 0 |
| Residual Waste Management | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Soil Vapor Extraction

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 17020201 | Demolish Bituminous Road with Power Equipment | 14.81 | CY | 0.00 | 35.59 | 8.02 | $645.98 | ☐ | ☑ |
| 17030201 | Backfill, waste excess excavated materials on site | 102.22 | LCY | 0.00 | 1.11 | 0.26 | $140.33 | ☐ | ☑ |
| 17030257 | Excavating, trench, medium soil, 4""" to 6""" deep, 1 C.Y. bucket, gradall, excludes sheeting or dewatering | 88.89 | BCY | 0.00 | 1.37 | 0.36 | $153.92 | ☐ | ☑ |
| 17030423 | Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction | 109.50 | CY | 7.89 | 3.59 | 2.53 | $1,534.84 | ☐ | ☑ |
| 18020301 | Asphalt Pavement - 10" Subgrade, 9" Base, 1 1/2" Topping | 88.89 | SY | 7.20 | 3.32 | 1.42 | $1,061.76 | ☐ | ☑ |
| 32039005 | Remedial Design - User Defined Cost | 1.00 | EA | 0.00 | 15,949.50 | 0.00 | $15,949.50 | ☑ | ☑ |
| 33132360 | 500 SCFM, Vapor Recovery System | 1.00 | EA | 26,007.60 | 0.00 | 0.00 | $26,007.60 | ☐ | ☑ |
| 33132377 | Equipment Enclosure, 8""" x 15""", Portable Building/Shed; lined, insulated, skid mounted, w/exhaust fan | 1.00 | EA | 3,313.56 | 0.00 | 0.00 | $3,313.56 | ☐ | ☑ |
| 33220112 | Field Technician | 40.00 | HR | 0.00 | 133.09 | 0.00 | $5,323.42 | ☐ | ☑ |
| 33230101 | 2" PVC, Schedule 40, Well Casing | 12.00 | LF | 1.50 | 6.85 | 9.43 | $213.38 | ☐ | ☑ |
| 33230112 | 4" PVC, Schedule 80, Well Casing | 40.00 | LF | 6.01 | 10.27 | 14.15 | $1,217.12 | ☐ | ☑ |

# Phase Technology Cost Detail Report (with Markups)

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33230212 | 4" PVC, Schedule 80, Well Screen | 360.00 | LF | 8.32 | 10.27 | 14.15 | $11,785.21 | ☐ | ☑ |
| 33230302 | 4" PVC, Well Plug | 4.00 | EA | 30.61 | 15.07 | 20.75 | $265.69 | ☐ | ☑ |
| 33231407 | Gravel Pack for Horizontal Well Installation | 30.00 | CF | 32.00 | 20.71 | 10.01 | $1,881.57 | ☐ | ☑ |
| 33240103 | Pilot Scale Test | 1.00 | LS | 128,735.25 | 0.00 | 0.00 | $128,735.25 | ☑ | ☑ |
| 33260428 | 2" PVC, Schedule 80, Connection Piping | 200.00 | LF | 1.11 | 7.45 | 0.00 | $1,711.26 | ☐ | ☑ |
| 33260460 | 4" PVC, Schedule 80, Manifold Piping | 100.00 | LF | 3.32 | 16.04 | 0.00 | $1,935.58 | ☐ | ☑ |
| 33270124 | 2" PVC, Schedule 80, Tee | 4.00 | EA | 15.95 | 0.00 | 0.00 | $63.82 | ☐ | ☑ |
| 33270134 | 2" PVC, Schedule 80, 90 Degree, Elbow | 4.00 | EA | 4.34 | 0.00 | 0.00 | $17.35 | ☐ | ☑ |
| 33270136 | 4" PVC, Schedule 80, 90 Degree, Elbow | 4.00 | EA | 17.93 | 0.00 | 0.00 | $71.74 | ☐ | ☑ |
| 33270167 | 4" x 2" Reducer, PVC Schedule 80 | 4.00 | EA | 46.75 | 0.00 | 0.00 | $186.99 | ☐ | ☑ |
| 33310209 | Pressure Gauge | 4.00 | EA | 82.04 | 118.53 | 0.00 | $802.26 | ☐ | ☑ |
| 95013001 | Technology Mobilization and Demobilization | 1.00 | LS | 25,747.05 | 0.00 | 0.00 | $25,747.05 | ☑ | ☑ |
| 99040104 | Temporary Office 50""""" x 12""""" | 60.00 | MO | 569.21 | 0.00 | 0.00 | $34,152.53 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$262,917.71** |
| **Total 1st Year Technology Cost** | **$262,917.71** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Air Sparging

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010101 | Mobilize/DeMobilize Drilling Rig & Crew | 1.00 | LS | 0.00 | 2,440.73 | 1,281.56 | $3,722.29 | ☐ | ☑ |
| 33020303 | Organic Vapor Analyzer Rental, per Day | 2.00 | DAY | 152.77 | 0.00 | 0.00 | $305.53 | ☐ | ☑ |
| 33139005 | Air Sparge System, Blower 98 SCFM, 3.2 HP, 5 PSI, base, intake filter, silencer, pulleys, belt, belt guard. | 1.00 | EA | 11,593.79 | 0.00 | 0.00 | $11,593.79 | ☐ | ☑ |
| 33170808 | Decontaminate Rig, Augers, Screen (Rental Equipment) | 2.00 | DAY | 22.25 | 952.46 | 0.00 | $1,949.43 | ☐ | ☑ |
| 33220112 | Field Technician | 32.00 | HR | 0.00 | 133.09 | 0.00 | $4,258.74 | ☐ | ☑ |
| 33230102 | 4" PVC, Schedule 40, Well Casing | 130.00 | LF | 3.53 | 10.27 | 14.15 | $3,632.95 | ☐ | ☑ |
| 33230202 | 4" PVC, Schedule 40, Well Screen | 20.00 | LF | 7.90 | 13.77 | 18.95 | $812.51 | ☐ | ☑ |
| 33231103 | Hollow Stem Auger, 11" Dia Borehole, Depth <= 100 ft | 160.00 | LF | 0.00 | 29.35 | 40.41 | $11,160.86 | ☐ | ☑ |
| 33231178 | Move Rig/Equipment Around Site | 9.00 | EA | 74.13 | 350.85 | 184.22 | $5,482.89 | ☐ | ☑ |
| 33231402 | 4" Screen, Filter Pack | 40.00 | LF | 6.88 | 10.27 | 14.15 | $1,251.91 | ☐ | ☑ |
| 33231812 | 4" Well, Portland Cement Grout | 100.00 | LF | 2.18 | 0.00 | 0.00 | $217.72 | ☐ | ☑ |
| 33232102 | 4" Well, Bentonite Seal | 10.00 | EA | 28.96 | 57.80 | 79.58 | $1,663.50 | ☐ | ☑ |
| 33260428 | 2" PVC, Schedule 80, Connection Piping | 150.00 | LF | 1.11 | 7.45 | 0.00 | $1,283.45 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33260460 | 4" PVC, Schedule 80, Manifold Piping | 100.00 | LF | 3.32 | 16.04 | 0.00 | $1,935.58 | ☐ | ☑ |
| 33270124 | 2" PVC, Schedule 80, Tee | 10.00 | EA | 15.95 | 0.00 | 0.00 | $159.54 | ☐ | ☑ |
| 33270134 | 2" PVC, Schedule 80, 90 Degree, Elbow | 10.00 | EA | 4.34 | 0.00 | 0.00 | $43.39 | ☐ | ☑ |
| 33270167 | 4" x 2" Reducer, PVC Schedule 80 | 10.00 | EA | 46.75 | 0.00 | 0.00 | $467.47 | ☐ | ☑ |
| 33270440 | 2" PVC, Sch 80, Ball Valve | 10.00 | EA | 111.54 | 0.00 | 0.00 | $1,115.35 | ☐ | ☑ |
| 33310209 | Pressure Gauge | 10.00 | EA | 82.04 | 118.53 | 0.00 | $2,005.65 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$53,062.54** |
| **Total 1st Year Technology Cost** | **$53,062.54** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Carbon Adsorption (Gas)

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 18020322 | 8" Structural Slab on Grade | 40.00 | SF | 4.92 | 7.82 | 0.17 | $516.64 | ☐ | ☑ |
| 33021501 | Air & process gas purification, carbon adsorption, vapor phase, modular carbon adsorbers | 1.00 | EA | 63.24 | 0.00 | 0.00 | $63.24 | ☐ | ☑ |
| 33021502 | Thermostat & Humidity Control Devices | 1.00 | EA | 119.48 | 210.12 | 0.00 | $329.60 | ☐ | ☑ |
| 33021506 | Plug, steel, malleable iron, black, threaded, 300 lb., 1/4" | 2.00 | EA | 2.35 | 29.77 | 0.00 | $64.24 | ☐ | ☑ |
| 33131910 | Air & process gas purification, carbon adsorption, vapor phase, modular carbon adsorbers, 500 CFM, 1400 lb fill, closed upflow, 11.5" pressure drop | 4.00 | EA | 8,873.64 | 2,138.61 | 73.48 | $44,342.90 | ☐ | ☑ |
| 33131950 | 25""""" x 6" Flexible Stainless Steel High-pressure Hose | 1.00 | EA | 103.47 | 227.57 | 0.00 | $331.05 | ☐ | ☑ |
| 33131971 | 1 KW Hazardous Air Heater | 1.00 | EA | 2,890.00 | 0.00 | 0.00 | $2,890.00 | ☐ | ☑ |
| 33310108 | Air & process gas purification, packaged high pressure carbon adsorption blower, belt drive, 750 CFM, 12" pressure, 5 HP, 3920 RPM | 1.00 | EA | 1,868.15 | 1,290.07 | 0.00 | $3,158.21 | ☐ | ☑ |
| 33310209 | Pressure Gauge | 2.00 | EA | 82.04 | 118.53 | 0.00 | $401.13 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$52,097.01** |
| **Total 1st Year Technology Cost** | **$52,097.01** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Carbon Adsorption (Liquid)

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 18020322 | 8" Structural Slab on Grade | 45.00 | SF | 4.92 | 7.82 | 0.17 | $581.22 | ☐ | ☑ |
| 33132019 | Aqueous organic & highly toxic wastes, carbon adsorption, liquid phase, modular carbon adsorbers, 75 GPM, 1650 lb fill, HDPE lined steel, permanent | 1.00 | EA | 11,371.48 | 1,745.33 | 122.46 | $13,239.27 | ☐ | ☑ |
| 33290122 | 75 GPM, 3 HP, Transfer Pump with Motor, Valves, Piping | 1.00 | EA | 4,668.86 | 3,370.84 | 0.00 | $8,039.70 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$21,860.20** |
| **Total 1st Year Technology Cost** | **$21,860.20** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** SVE VAPOR MONITORING POINT

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010101 | Mobilize/DeMobilize Drilling Rig & Crew | 1.00 | LS | 0.00 | 2,440.73 | 1,281.56 | $3,722.29 | ☐ | ☑ |
| 33020303 | Organic Vapor Analyzer Rental, per Day | 1.00 | DAY | 152.77 | 0.00 | 0.00 | $152.77 | ☐ | ☑ |
| 33230101 | 2" PVC, Schedule 40, Well Casing | 40.00 | LF | 1.50 | 6.85 | 9.43 | $711.28 | ☐ | ☑ |
| 33230201 | 2" PVC, Schedule 40, Well Screen | 40.00 | LF | 3.47 | 8.84 | 12.17 | $978.75 | ☐ | ☑ |
| 33230301 | 2" PVC, Well Plug | 4.00 | EA | 7.30 | 10.27 | 14.15 | $126.90 | ☐ | ☑ |
| 33231101 | Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 ft | 60.00 | LF | 0.00 | 18.78 | 25.86 | $2,678.60 | ☐ | ☑ |
| 33231178 | Move Rig/Equipment Around Site | 4.00 | EA | 74.13 | 350.85 | 184.22 | $2,436.84 | ☐ | ☑ |
| 33231401 | 2" Screen, Filter Pack | 10.00 | LF | 3.90 | 5.82 | 8.02 | $177.35 | ☐ | ☑ |
| 33231504 | Surface Pad, Concrete, 2""""" x 2""""" x 4" | 4.00 | EA | 48.37 | 32.11 | 2.33 | $331.22 | ☐ | ☑ |
| 33231811 | 2" Well, Portland Cement Grout | 4.00 | LF | 1.45 | 0.00 | 0.00 | $5.81 | ☐ | ☑ |
| 33232101 | 2" Well, Bentonite Seal | 4.00 | EA | 11.58 | 23.12 | 31.83 | $266.11 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$11,587.92** |
| **Total 1st Year Technology Cost** | **$11,587.92** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Residual Waste Management

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 95012901 | Residual Waste Management Per Truck | 50.00 | EA | 1,931.03 | 0.00 | 0.00 | $96,551.44 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$96,551.44** |
| **Total 1st Year Technology Cost** | **$96,551.44** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** INSTITUTIONAL CONTROL

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 95010203 | Classification Exception Area | 1.00 | LS | 6,436.76 | 0.00 | 0.00 | $6,436.76 | ☑ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$6,436.76** |
| **Total 1st Year Technology Cost** | **$6,436.76** |

# Phase Technology Cost Detail Report (with Markups)

**Technology:** Five-Year Review

**Element:** Document Review

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 8.00 | HR | 0.00 | 214.73 | 0.00 | $1,717.80 | ☐ | ☑ |
| 33220105 | Project Engineer | 11.00 | HR | 0.00 | 208.22 | 0.00 | $2,290.46 | ☐ | ☑ |
| 33220108 | Project Scientist | 8.00 | HR | 0.00 | 241.03 | 0.00 | $1,928.22 | ☐ | ☑ |
| 33220109 | Staff Scientist | 16.00 | HR | 0.00 | 178.64 | 0.00 | $2,858.22 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$8,794.71** | | |

**Element:** Site Inspection

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 9.00 | HR | 0.00 | 214.73 | 0.00 | $1,932.53 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 12.00 | HR | 0.00 | 241.03 | 0.00 | $2,892.33 | ☐ | ☑ |
| 33220109 | Staff Scientist | 13.00 | HR | 0.00 | 178.64 | 0.00 | $2,322.31 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$10,478.74** | | |

**Element:** Report

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220102 | Project Manager | 6.00 | HR | 0.00 | 214.73 | 0.00 | $1,288.35 | ☐ | ☑ |
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220108 | Project Scientist | 13.00 | HR | 0.00 | 241.03 | 0.00 | $3,133.36 | ☐ | ☑ |
| 33220109 | Staff Scientist | 26.00 | HR | 0.00 | 178.64 | 0.00 | $4,644.61 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

| | |
|---|---|
| **Total Element Cost** | **$12,397.90** |
| **Total 1st Year Technology Cost** | **$31,671.35** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.10 | 0.00 | 0.00 | $443.95 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 9.89 | 0.00 | 0.00 | $395.46 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.67 | 0.00 | 0.00 | $376.40 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 222.42 | 0.00 | 0.00 | $8,896.87 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 100.97 | 0.00 | 0.00 | $403.86 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,519.20** | | |

**Element:** Soil Gas

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020306 | Monitoring Gas Vents | 16.00 | EA | 0.00 | 27.78 | 0.00 | $444.42 | ☐ | ☑ |
| 33029505 | Volatile Organic Carbon (TO-15) | 18.00 | LS | 386.21 | 0.00 | 0.00 | $6,951.70 | ☑ | ☑ |
| | | | | **Total Element Cost** | | | **$7,396.12** | | |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** Air

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020346 | Portable Air Sampler, Continuous, Weekly Rental | 1.00 | WK | 114.58 | 0.00 | 0.00 | $114.58 | ☐ | ☑ |
| 33029505 | Volatile Organic Carbon (TO-15) | 27.00 | LS | 386.21 | 0.00 | 0.00 | $10,427.55 | ☑ | ☑ |
| | | | | **Total Element Cost** | | | **$10,542.13** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 2,580.00 | MI | 0.17 | 0.00 | 0.00 | $427.25 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 12.00 | DAY | 99.00 | 0.00 | 0.00 | $1,188.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |
| 33220105 | Project Engineer | 48.00 | HR | 0.00 | 208.22 | 0.00 | $9,994.74 | ☐ | ☑ |
| 33220109 | Staff Scientist | 120.00 | HR | 0.00 | 178.64 | 0.00 | $21,436.67 | ☐ | ☑ |
| 33220112 | Field Technician | 120.00 | HR | 0.00 | 133.09 | 0.00 | $15,970.27 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$49,875.83** | | |
| | | | | **Total 1st Year Technology Cost** | | | **$79,333.28** | | |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 20.00 | EA | 11.10 | 0.00 | 0.00 | $221.98 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 20.00 | EA | 9.89 | 0.00 | 0.00 | $197.73 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 295.00 | LF | 0.67 | 0.00 | 0.00 | $196.53 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 20.00 | EA | 222.42 | 0.00 | 0.00 | $4,448.44 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 2.00 | DAY | 100.97 | 0.00 | 0.00 | $201.93 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$6,269.26** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 460.00 | MI | 0.17 | 0.00 | 0.00 | $76.18 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 4.00 | DAY | 99.00 | 0.00 | 0.00 | $396.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 16.00 | HR | 0.00 | 208.22 | 0.00 | $3,331.58 | ☐ | ☑ |
| 33220109 | Staff Scientist | 40.00 | HR | 0.00 | 178.64 | 0.00 | $7,145.56 | ☐ | ☑ |
| 33220112 | Field Technician | 40.00 | HR | 0.00 | 133.09 | 0.00 | $5,323.42 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$17,131.64** |
| **Total 1st Year Technology Cost** | **$23,400.89** |

# Phase Technology Cost Detail Report
# (with Markups)

**Technology:** Monitoring

**Element:** Groundwater

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33020401 | Disposable Materials per Sample | 40.00 | EA | 11.10 | 0.00 | 0.00 | $443.95 | ☐ | ☑ |
| 33020402 | Decontamination Materials per Sample | 40.00 | EA | 9.89 | 0.00 | 0.00 | $395.46 | ☐ | ☑ |
| 33020561 | Lysimeter accessories, nylon tubing, 1/4" OD | 565.00 | LF | 0.67 | 0.00 | 0.00 | $376.40 | ☐ | ☑ |
| 33021509 | Monitor well sampling equipment, rental, water quality testing parameter device rental | 1.00 | WK | 310.77 | 0.00 | 0.00 | $310.77 | ☐ | ☑ |
| 33021618 | Testing, purgeable organics (624, 8260) | 40.00 | EA | 222.42 | 0.00 | 0.00 | $8,896.87 | ☐ | ☑ |
| 33230509 | 4" Submersible Pump Rental, Day | 4.00 | DAY | 100.97 | 0.00 | 0.00 | $403.86 | ☐ | ☑ |
| 33231186 | Well Development Equipment Rental (weekly) | 1.00 | WK | 575.53 | 116.35 | 0.00 | $691.88 | ☐ | ☑ |
| | | | | **Total Element Cost** | | | **$11,519.20** | | |

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33010104 | Sample collection, vehicle mileage charge, car or van | 920.00 | MI | 0.17 | 0.00 | 0.00 | $152.35 | ☐ | ☐ |
| 33010202 | Sample collection, sampling personnel travel, per diem | 8.00 | DAY | 99.00 | 0.00 | 0.00 | $792.00 | ☑ | ☐ |
| 33220102 | Project Manager | 4.00 | HR | 0.00 | 214.73 | 0.00 | $858.90 | ☐ | ☑ |

# Phase Technology Cost Detail Report
# (with Markups)

**Element:** General Monitoring

| Assembly | Description | Quantity | Unit of Measure | Material Unit Cost | Labor Unit Cost | Equipment Unit Cost | Extended Cost | Cost Override | Markups Applied |
|---|---|---|---|---|---|---|---|---|---|
| 33220105 | Project Engineer | 32.00 | HR | 0.00 | 208.22 | 0.00 | $6,663.16 | ☐ | ☑ |
| 33220109 | Staff Scientist | 80.00 | HR | 0.00 | 178.64 | 0.00 | $14,291.11 | ☐ | ☑ |
| 33220112 | Field Technician | 80.00 | HR | 0.00 | 133.09 | 0.00 | $10,646.85 | ☐ | ☑ |

| | |
|---|---|
| **Total Element Cost** | **$33,404.37** |
| **Total 1st Year Technology Cost** | **$44,923.57** |
| **Total Phase Cost** | **$683,842.67** |

# Phase Cost Over Time Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Over Time Report
# (with Markups)

## Site:

**Site ID:** Groundwater - AS/SVE
**Site Name:** Groundwater - AS/SVE
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☑
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/22/2007

**Estimator Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Over Time Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** AS/SVE
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Soil Vapor Extraction | Yes | 100 | 0 |
| Air Sparging | Yes | 100 | 0 |
| Carbon Adsorption (Gas) | Yes | 100 | 0 |
| Carbon Adsorption (Liquid) | Yes | 100 | 0 |
| SVE VAPOR MONITORING POINT | Yes | 100 | 0 |
| Residual Waste Management | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Soil Vapor Extraction | $262,918 | $0 | $0 | $0 | $0 | $0 |
| Air Sparging | $53,063 | $0 | $0 | $0 | $0 | $0 |
| Carbon Adsorption (Gas) | $52,097 | $0 | $0 | $0 | $0 | $0 |
| Carbon Adsorption (Liquid) | $21,860 | $0 | $0 | $0 | $0 | $0 |
| SVE VAPOR MONITORING POINT | $11,588 | $0 | $0 | $0 | $0 | $0 |
| Residual Waste Management | $96,551 | $0 | $0 | $0 | $0 | $0 |
| INSTITUTIONAL CONTROL | $6,437 | $0 | $0 | $0 | $0 | $0 |
| Five-Year Review | $0 | $0 | $0 | $0 | $0 | $31,671 |
| Monitoring | $79,333 | $79,333 | $79,333 | $79,333 | $79,333 | $0 |
| Monitoring | $0 | $0 | $0 | $0 | $0 | $23,401 |
| Monitoring | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total Phase Cost** | $583,847 | $79,333 | $79,333 | $79,333 | $79,333 | $55,072 |

# Phase Cost Over Time Report
# (with Markups)

| Technology | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| Soil Vapor Extraction | $0 | $0 | $0 | $0 | $0 | $262,918 |
| Air Sparging | $0 | $0 | $0 | $0 | $0 | $53,063 |
| Carbon Adsorption (Gas) | $0 | $0 | $0 | $0 | $0 | $52,097 |
| Carbon Adsorption (Liquid) | $0 | $0 | $0 | $0 | $0 | $21,860 |
| SVE VAPOR MONITORING POINT | $0 | $0 | $0 | $0 | $0 | $11,588 |
| Residual Waste Management | $0 | $0 | $0 | $0 | $0 | $96,551 |
| INSTITUTIONAL CONTROL | $0 | $0 | $0 | $0 | $0 | $6,437 |
| Five-Year Review | $0 | $0 | $0 | $0 | $31,671 | $63,343 |
| Monitoring | $0 | $0 | $0 | $0 | $0 | $396,666 |
| Monitoring | $23,401 | $23,401 | $0 | $0 | $0 | $70,203 |
| Monitoring | $0 | $0 | $44,924 | $44,924 | $0 | $89,847 |
| **Total Phase Cost** | $23,401 | $23,401 | $44,924 | $44,924 | $31,671 | $1,124,573 |

# Phase Cost Summary Report
# (with Markups)

## System:

**RACER Version:** 8.1.2
**Database Location:** G:\RTiyarattanachai\Racer\LBG RACER.mdb

## Folder:

**Folder Name:** Param Feb 09_Final Draft

## Project:

**Project ID:** Param Petroleum
**Project Name:** Param Petroleum - GW
**Project Category:** None

**Location**
**State / Country:** NEW JERSEY
**City:** NEW JERSEY STATE AVERAGE

| Location Modifiers | Default | User |
|---|---|---|
| **Material:** | ***1.035*** | 1.035 |
| **Labor:** | ***1.558*** | 1.558 |
| **Equipment:** | ***1.054*** | 1.054 |

**Options**
**Database:** Modified System
**Cost Database Date:** 2006
**Report Option:** Calendar

**Description**
GW Remediation
Contaminants - TBA and Benzene
Alternatives: MNA, EMNA (ORC-Adv), ISCO, SVE-AS

# Phase Cost Summary Report
# (with Markups)

## Site:

**Site ID:** Groundwater - AS/SVE
**Site Name:** Groundwater - AS/SVE
**Site Type:** None

**Phase Names**

**Pre-Study:** ☐
**Study:** ☐
**Design:** ☐
**Removal/Interim Action:** ☐
**Remedial Action:** ☑
**Operations & Maintenance:** ☑
**Long Term Monitoring:** ☐
**Site Closeout:** ☐

**Documentation**

**Description:**
**Support Team:**
**References:**

**Estimator Information**

**Estimator Name:** Ronnachai Tiyarattanachai
**Estimator Title:** Engineer
**Agency/Org./Office:** The Louis Berger Group, Inc
**Business Address:** Morristown, NJ
**Telephone Number:** 973-407-1409
**Email Address:** rtiyarattanachai@louisberger.com
**Estimate Prepared Date:** 10/22/2007

**Estimator Signature:** _____ **Date:** _____

**Reviewer Information**

**Reviewer Name:**
**Reviewer Title:**
**Agency/Org./Office:**
**Business Address:**
**Telephone Number:**
**Email Address:**
**Date Reviewed:**

**Reviewer Signature:** _____ **Date:** _____

# Phase Cost Summary Report
# (with Markups)

## Phase:

**Phase Type:** Remedial Action
**Phase Name:** AS/SVE
**Description:**

**Media/Waste Type**
**Primary:** Groundwater
**Secondary:** Soil

**Contaminant**
**Primary:** Volatile Organic Compounds (VOCs)
**Secondary:** None

**Approach:** Ex Situ
**Start Date:** January, 2010

**Rate Groups**
**Labor:** System Labor Rate
**Analysis:** System Analysis Rate

**Phase Markups:** System Defaults

| Technology Markups | Markup | % Prime | % Sub. |
|---|---|---|---|
| Soil Vapor Extraction | Yes | 100 | 0 |
| Air Sparging | Yes | 100 | 0 |
| Carbon Adsorption (Gas) | Yes | 100 | 0 |
| Carbon Adsorption (Liquid) | Yes | 100 | 0 |
| SVE VAPOR MONITORING POINT | Yes | 100 | 0 |
| Residual Waste Management | Yes | 100 | 0 |
| INSTITUTIONAL CONTROL | Yes | 100 | 0 |
| Five-Year Review | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |
| Monitoring | Yes | 100 | 0 |

# Phase Cost Summary Report
# (with Markups)

| Technology | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| Soil Vapor Extraction | $197,853 | $65,065 | $262,918 |
| Air Sparging | $36,258 | $16,805 | $53,063 |
| Carbon Adsorption (Gas) | $38,831 | $13,266 | $52,097 |
| Carbon Adsorption (Liquid) | $16,159 | $5,701 | $21,860 |
| SVE VAPOR MONITORING POINT | $8,020 | $3,568 | $11,588 |
| Residual Waste Management | $75,000 | $21,551 | $96,551 |
| INSTITUTIONAL CONTROL | $5,000 | $1,437 | $6,437 |
| Five-Year Review | $20,981 | $42,362 | $63,343 |
| Monitoring | $201,995 | $194,671 | $396,666 |
| Monitoring | $32,528 | $37,675 | $70,203 |
| Monitoring | $41,254 | $48,593 | $89,847 |
| **Total Capital Cost** | $673,879 | $450,694 | $1,124,573 |

| | Direct Cost | Markups | Total Cost |
|---|---|---|---|
| **Total Phase Cost** | $673,879 | $450,694 | $1,124,573 |

Submitted by: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