MW-09 Area
Pre-Design Investigation Report and Chemical Oxidation/Enhanced Bioremediation Injection Work Plan

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1 Introduction

On behalf of QLT Buffalo LLC, WSP Engineering of New York, P.C. prepared this Pre-Design Investigation Report and Chemical Oxidation/Enhanced Bioremediation Injection Work Plan for the MW-09 Area. The reporting component of this submittal provides information and data recently collected in order to facilitate the development of an in-situ remedy to address benzene concentrations in groundwater in the vicinity of MW-09. This work was conducted in accordance with the Pre-Design Investigation Work Plan – MW-09 Area, dated June 12, 2009. The work plan component of this submittal provides the scope of work for an injection program and performance related groundwater monitoring activities.

QLT Buffalo anticipates following a very aggressive schedule that will require intrusive remediation activities to take place this summer while school is not in session. Significant cooperation from NYSDEC, U.S. EPA (underground injection control permitting), the City of Buffalo, and the Waterfront School officials will be necessary for this schedule to be satisfied.

Based on the investigation conducted in June/July 2009, WSP Engineering proposes moving forward with Klozur® CR for use as the injectate to address the elevated benzene concentrations at the MW-09 area. Klozur® CR is a single, formulated product consisting of base-activated persulfate. Klozur® CR provides three separate chemistries to attenuate petroleum-affected groundwater in a single application:

- Klozur® CR generates the sulfate radical, one of the strongest oxidizing species available. Klozur® CR has the power to destroy many recalcitrant contaminants such as petroleum constituents (including benzene, toluene, ethylbenzene, and xylenes [BTEX] and polycyclic aromatic hydrocarbons [PAH]). The sulfate radical-typically remains active for several weeks within an aquifer.
- Klozur® CR contains an oxygen releasing compound (calcium peroxide) which can stimulate native aerobic petroleum oxidizing microbes to metabolize benzene, toluene, ethylbenzene, xylenes, (BTEX) and other similar compounds. Klozur® CR can release oxygen for up to 6-months following application.
- Sulfate is a byproduct of Klozur® CR. Sulfate has been shown to stimulate native anaerobic petroleum oxidizing microbes to attenuate BTEX. Sulfate longevity in the aquifer is largely site specific, but can persist for a year or more.

Each of these mechanisms requires contact with the contaminant to be successful. Given that site heterogeneities will limit the uniform delivery of the Klozur® CR throughout the affected area, chemical oxidation alone may not achieve remediation goals. To provide additional performance, the longer-lasting dissolved oxygen and sulfate will diffuse beyond the initial delivery zones and be present to stimulate microbes in these “untreated” locations and as the petroleum constituents desorb from the soils (i.e., rebound).

2 Benzene Delineation

In accordance with the pre-design investigation work plan, both passive diffusion bag sampling and direct push sampling was conducted to facilitate the development of an injection footprint both laterally and vertically. The results of this investigation are discussed in the following sections.

2.1 PASSIVE DIFFUSION BAG SAMPLING AND RESULTS

In order to determine if the variable benzene concentrations observed in groundwater samples collected from MW-09 may be attributed to vertical stratification of contaminants in the well screen, four 2-foot long passive diffusion bag (PDB) samplers were installed within the screened interval of MW-09 (7 feet below ground surface (bgs) to 19 feet-bgs) at 1.25-foot intervals (i.e., deployed at 7 feet-bgs, 10.25 feet-bgs, 13.5 feet-bgs, and 16.75 feet-bgs). The PDBs were deployed on June 6, 2009. The PDBs were allowed to equilibrate, and were retrieved on June 26, 2009. WSP collected the groundwater in pre-persevered laboratory provided glassware and placed the samples in an ice-filled cooler. The samples were delivered, under strict chain-of-custody procedures to Test America, Buffalo for BTEX analysis by EPA Method 8260 (Table 1, Appendix A).

Benzene concentrations ranged from 6,800 micrograms per liter (µg/l), in the PDB deployed from 7 feet-bgs to 9 feet-bgs, to 18,000 µg/l, in the PDB deployed from 10.25 feet-bgs to 12.25 feet-bgs. The groundwater samples collected in the PDBs from the lower portion of the well screen (i.e., deployed from 13.5 feet-bgs to 15.5 feet-bgs and 16.75 feet-bgs to 18.75 feet-bgs) both contained benzene at 17,000 µg/l.

Ethylbenzene was not detected above the laboratory reporting limit in the sample collected from PDB deployed from 7 feet-bgs to 9 feet-bgs; concentrations in the groundwater samples collected from PDBs in the lower protion of the well screen ranged from 17 to 18 µg/l.

Toluene and xylenes were not detected above the laboratory reporting limit in any of the groundwater samples collected from the PDBs.

The data indicate that benzene concentrations appear to increase with depth. Similar findings were identified while screening for benzene vapors during direct push activities (Section 2.2). However, the data does not support the presence of an unaffected vertical interval of the saturated zone. Therefore, the injection program will be designed to span the entire saturated zone, approximately 5 ft-bgs to 20 ft-bgs.

2.2 DIRECT PUSH SAMPLING AND RESULTS

Fourteen borings (DP-09-01 thru DP-09-14) were advanced with a direct-push drill rig between June 29 and July 1, 2009. Continuous soil samples were collected from all borings with a Macro-Core® sampler (or similar) equipped with a disposable acetate liner. The soils were screened with a benzene-specific photoionization detector for benzene vapors and logged using the USCS classification system; boring logs are presented in Appendix B. No organic vapors were detected in the vadose zone soils collected from the fourteen boreholes; therefore no vadose zone soils were collected for laboratory analysis in accordance with the work plan. Generally, benzene screening vapors increased with depth along the saturated zone.

Grab groundwater samples were collected from twelve borehole locations (DP-09-01 thru DP-09-03 and DP-09-06 thru DP-09-14) via dedicated, 1-inch Schedule 40 polyvinyl chloride (PVC) temporary wells with a 5-foot, 0.01-inch slot well screen. The temporary wells were installed instead of the screen point sampler described in the workplan to increase sampling efficiency (i.e., the screen point sampler was observed to clog quickly due to fine-grained sediment in the formation). Approximately 1-gallon was

purged from each boring location before sample collection with dedicated tubing equipped with a bottom check valve. The groundwater samples were placed on ice and delivered to Test America, Buffalo, New York and analyzed for BTEX by EPA Method 8260 (Table 2).

Grab groundwater benzene concentrations ranged from 11,000 µg/l (DP-09-01) to 120 µg/l (DP-09-13) (Figure 1). Ethylbenzene was detected above the NYSDEC values in groundwater samples collected from DP-09-01 (29 µg/l), DP-09-02 (34 µg/l), DP-09-03 (20 µg/l), DP-09-06 (84 µg/l), DP-09-07 (48 µg/l), DP-09-08 (30 µg/l), DP-09-10 (35 µg/l), and DP-09-14 (22 µg/l); toluene in samples collected from DP-09-01 (7.7 µg/l), DP-09-06 (10 µg/l), DP-09-08 (6.3 µg/l), DP-09-14 (21 µg/l); and xylenes in samples collected from DP-09-01 (44 µg/l), DP-09-02 (25 µg/l), DP-09-03 (38 µg/l), DP-09-06 (81 µg/l), DP-09-07 (120 µg/l), DP-09-08 (15 µg/l), DP-09-10 (17 µg/l), DP-09-14 (50 µg/l).

The data indicate that benzene concentrations appear to decrease with distance away from MW-09. Delineation for purposes of injection footprint layout is considered complete. The structures located to the north and south (garage, sewer lines and school) of MW-09 provide limitations to injection toward those directions. Relatively low concentrations of benzene are present to the west (DP-08-06), to the east (DP-08-04 and DP-09-11), and to the north (MW-11 and DB-08-05). Consequently, no additional sampling is required to determine a reasonably appropriate injection footprint of the area. In addition, previous remedial excavations have removed contaminated soils to the south, west and east. At the MW-03 location, benzene concentrations appear to be attenuating over time. Review of the last two quarterly sampling events (7^{th} and 8^{th} quarter) show benezene concentrations in groundwater of 420 µg/l and 220 µg/l, respectively. Based on this data, the injection program will not include this location.

Once investigation activities were complete, the temporary wells were pulled and the boreholes were backfilled with bentonite chips and finished to match surrounding grade and materials (i.e., concrete or topsoil). All downhole equipment was decontaminated before commencing site activities and between boreholes with a non-phosphate soap wash, followed by a potable water rinse. Investigation derived waste (IDW) was containerized in labeled drums for disposal off site.

3 Remedial Tracking Parameter Sampling and Results

Groundwater samples were collected from MW-08 and MW-09 on June 26, 2009 using low-flow groundwater sampling techniques. The wells were purged using a peristaltic pump at flow rates less than 250 milliliters per minute. Water quality parameters (temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, and turbidity) were monitored at approximate 5-minute intervals during purging with an in-line water quality meter in accordance with the workplan until stabilization was achieved. Final water quality measurements are presented in Table 1.

3.1 ELECTRON ACCEPTORS

The groundwater samples were analyzed for nitrate (EPA Method 353.2), sulfate (EPA Method 375.4), and sulfide (EPA Method 376.1) (collectively electron acceptors). All samples were filtered with 0.45 micrometer in-line filter and collected in laboratory provided pre-preserved (where appropriate) glassware. The samples were delivered on ice, under strict chain-of-custody procedures to Test America, Buffalo for analysis. In addition, iron and ferrous iron were analyzed in the field using HACH Color Disc Test Kits.

Nitrate, sulfate and sulfide were not detected above the laboratory reporting limit in the samples collected from MW-08. Nitrate and sulfide were not detected above the laboratory reporting limit in the samples collected from MW-09, sulfate was detected at 55 mg/l. Iron was detected at concentrations ranging from 6 milligrams per liter (mg/l) to 3 mg/l in groundwater samples collected from MW-08 and MW-09. Ferrous iron was detected at 2 mg/l in the sample collected from MW-08 and was not detected in the sample collected from MW-09.

The oxidation reduction potential measured in the field indicates reducing conditions (-81 millivolts (mV) at MW-08 and -96 mV at MW-09). The dissolved oxygen concentrations were 1.36 mg/l at MW-08 and 0.28 mg/l at MW-09.

The groundwater data is presented in Table 1.

3.2 MOLECULAR BIOLOGICAL CHARACTERIZATION

Microbial samples were collected from monitoring wells MW-08 and MW-09 by filtering between 150 ml and 600 ml of groundwater through a Bio-Flo inline filter. The filters were then submitted to Microbial Insights of Rockford, Tennessee for polymerase chain reaction (PCR) quantification of microbes containing petroleum degrading oxygenase and synthase genes. Oxygenase genes which code for enzymes that are functional in aerobic conditions were found to be common. While the Benxzyl succiante synthase (bssA) gene, which codes for enzymes that are functional in anaerobic conditions, was not detected. bssA was the only “anaerobic” gene targeted by the PCR procedure.

Of the “aerobic” genes, results showed that microbes containing the gene that codes for napthalene dioxygenases (NAH) were the most prevalent in samples collected from both MW-08 (332,000,000 cells) and MW-09 (137,000,000 cells), followed by toluene dioxygenase (TOD) (619,000 cells and 1,010,000 cells), phenol hydroxylases (PHE) (252 cells and 40,600 cells), and biphenyl dioxygenase (BPH4) (225 cells and 23,400 cells). Toluene monooxygenase (RMO) and xylenes monooxygenase (TOL) were not detected above the laboratory reporting limit. Microbial cell counts were greater in the sample collected from MW-09, with the exception of NAH.

Despite their specific names, the oxygease genes listed above have broad substrate specificity which includes many petroleum hydrocarbons including benzene. The high cell counts containing genes that code for aerobic-functioning oxygenase genes demonstrates that the native microbial population has the potential to attenuate the elevated concentration of benzene present in the MW-09 area. Post treatment

sampling will focus on identifying Ribonucleic acid (RNA) sequences that code for petroleum degrading enzymes. RNA data will quantify production of these enzymes.

3.3 COMPOUND SPECIFIC ISOTOPE ANALYSIS

Compound Specific Isotope Analysis (CSIA) will be used to definitively quantify destruction of benzene via In-situ chemical oxidation (ISCO) and biodegradation. The basis of the CSIA assessment is that bond breaking reactions shift the ratio of naturally occurring isotopes of carbon (^{13}C to ^{12}C) as bonds involving ^{13}C require more energy to break, are kinetically slower reactions, and result in the accumulation of ^{13}C. Carbon isotope ratios are not similarly affected by naturally occurring physical processes such as sorption and dilution. Therefore, measuring changes in the carbon isotope ratios provides definitive evidence of VOC destruction. A CSIA sample was collected from MW-09 on June 26, 2009 and will serve as baseline for comparison with future CSIA samples. Analysis of the baseline sample by Microseeps Inc, Pittsburgh, Pennsylvania is ongoing as of the date of this report. The data will be presented with future CSIA data for comparison purposes.

4 Oxidant Efficiency Testing

Bench-scale treatability studies were performed to assess whether ISCO using sodium persulfate activated with calcium peroxide (brand name Klozur® CR; manufactured by FMC Corporation of Philadelphia, Pennsylvania) is an appropriate remedial technology to treat the benzene in groundwater near MW-09 and, if so, to determine the approximate amount of oxidant that would be necessary. Specifically, the tests were performed to:

- characterize the soil and groundwater, including volatile organic compound (VOC) concentrations, total organic carbon (TOC) content, chemical oxidant demand (COD), and pH levels, all of which are used to estimate appropriate initial oxidant loading rates; and the baseline concentration of chromium which can potentially become mobile during ISCO treatment
- determine the approximate 72-hour oxidant demand of the soil, groundwater, and benzene using several concentrations of oxidant appropriate to the site
- determine the aqueous benzene removal efficiency using several concentrations of oxidant appropriate to the site
- assess the potential for chromium to be mobilized during the ISCO treatment

The bench-scale tests were performed with saturated soil collected from borings installed directly adjacent to monitoring well MW-09 and groundwater samples collected from monitoring well MW-09. Saturated soil samples were collected during the direct push sampling activities (DP-09-04 and DP-09-05). The soil was recovered from below the water table between depths of 6 and 19 feet bgs using a macro core soil sampler in accordance with WSP's SOPs. Soil over the entire interval was mixed, placed in gallon-size Ziploc® bags, and placed on ice. The groundwater sample was collected and placed in the appropriate laboratory-specified containers. All of the samples were packed on ice and shipped to Terra Systems for the bench-scale analysis.

4.1 OXIDANT SELECTION

Many oxidant chemistries have sufficient oxidization potential to treat the benzene; however, persulfate can remain active for several weeks after injection and only Klozur® CR includes materials that stimulate subsequent aerobic and anerobic biodegradation. The in-situ persistence of persulfate combined with the biostimulant attributes of Klozur® CR indicates it as a potentially appropriate oxidant for the site.

Sodium persulfate (NaS_2O_8) dissociates in water to form the persulfate anion ($S_2O_8^{-2}$), a strong oxidizer that, when activated, produces the persulfate radical (SO_4•) which is capable of mineralizing a number of organic compounds including benzene and many other petroleum hydrocarbons. Activation can be achieved through the addition of heat; transition and chelated transition metals; ultraviolet radiation; or hydrogen peroxide, but is most often (for the treatment of petroleum hydrocarbons) activated with alkaline conditions (i.e., pH greater than 10) through the addition of a strong base such as lime, sodium hydroxide, or calcium peroxide. Klozur® CR is a single product consisting of sodium persulfate pre-mixed with PermeOx® Plus, an engineered calcium peroxide base activator.

Klozur® CR provides three separate chemistries to attenuate petroleum-affected groundwater in a single application. In addition to a strong chemical oxidant, Klozur® CR has biostimulant properties that provide a chem-bio treatment train. Klozur® CR is formulated with engineered calcium peroxide for radical activation which also elutes oxygen which can stimulate native aerobic microbes to metabolize amenable contaminants including benzene and many other petroleum compounds. Oxygen elution typically occurs for about 6 months following application. Following the depletion of dissolved oxygen, sulfate formed

during the reduction of the persulfate radical, has been shown to stimulate native anaerobic petroleum-oxidizing microbes.

Sulfate reduction by sulfate reducing microbes is a slow process (when compared to direct oxidation and biologically-mediated aerobic respiration) that results in the slow production of the dianion sulfide (S^{-2}), bisulfide (HS^-), or hydrogen sulfide (H_2S; referred to as hydrosulfuric acid in aqueous solutions). The particular species formed is dependent on establishing equilibrium with the hydrogen ion; at pH values greater than 9.5 the dianion is formed, at pH values between 9.5 and 7 bisulfide is predominant, and at pH values less than 7 hydrogen sulfide is formed. When applied, Klozur® CR amendment will have a pH in excess of 12. With time and natural groundwater flux, the pH will moderate but is not likely to be reduced to below the current pH of 7. Accordingly, sulfide that does not immediately react with metals would accumulate as mostly the dianion or bisulfide. The combination of the slow formation of sulfide, sulfides reactivity with metals, and pH values in the treatment area minimizes concerns about hydrogen sulfide production. FMC Corporation has had its persulfate product (Klozur®) applied at hundreds of remediation sites and has never had reports of hydrogen sulfide production.

Terra Systems of Wilmington Delaware performed ISCO treatability studies. Analysis for VOCs (EPA Method 8260), TOC, and COD were performed by a subcontracted laboratory (American Westech Inc., Harrisburg, Pennsylvania). Results of the studies are summarized below. Terra Systems report is provided in Appendix C.

4.2 CHARACTERIZATION

Initial characterization data was collected to identify the range of Klozur® CR doses that may be appropriate for application at the site or to establish baseline conditions necessary to assess the effect of oxidant application. Key initial characterization data are listed below:

- Groundwater pH = 7.0
- Benzene Concentration (groundwater)= 5,840 µg/l
- TOC = 43 mg/kg
- COD = 54 mg/kg

The full data set is provided in Appendix C.

4.3 72-HOUR OXIDANT DEMAND AND BENZENE DESTRUCTION EFFICIENCY STUDIES

Terra Systems conducted three 72-hour oxidant demand and benzene destruction efficiency studies with each test evaluating the Klozur® CR at three different loading levels. These tests were performed over a 72-hour period to simulate subsurface conditions immediately after injection and provide a rapid assessment of the approximate demand offered by the soil (including the naturally-occurring demand from organic and inorganic materials comprising the soils), the groundwater, and the dissolved VOCs. WSP's experience is that, while the sodium persulfate and the persulfate radical can persist in the subsurface for several weeks, the majority of the chemical oxidation (and, thus, the demand) occurs in the first 72 hours after injection.

Oxidant demand was assessed by monitoring the persulfate concentration during the studies. The destruction efficiency was examined by comparing benzene concentrations before and after the studies. The tests were performed by preparing eight 1,000 ml reactor vessels with samples collected from the MW-09 area. Near field scale soil (1,350 grams per vessel) to groundwater (approximately 300 ml per vessel) ratios were used. Klozur® CR was added to duplicate vessels at loading rates of 2 g-Klozur® CR/kg-soil (4,700 mg-sodium persulfate/l), 4 g-Klozur® CR/kg-soil (8,400 mg-sodium persulfate/l), 6 g-Klozur® CR/kg-soil (12,700 mg-sodium persulfate/l). Two vessels were prepared without the oxidants.

One of the oxidant-amended reactors and one un-amended reactor (as a control) were used to measure the pH, oxidation-reduction potential (ORP), temperature, and oxidant concentrations (amended vessels only) during the studies. Measurements were made at 0, 1, 4, 24, 48, and 72 hours. Groundwater from the remaining vessels was collected at the conclusion of the studies and submitted to the subcontracted laboratory for VOC and hexavalent chromium analysis.

4.4 72-HOUR STUDY RESULTS

The results of the test showed that the calcium peroxide component of the Klozur® CR was sufficient to keep the pH above the activation level of 10.5 for the 4 and 6 g-Klozur® CR/kg-soil loading. The pH in the 2 g-Klozur® CR/kg-soil loading fell to 9.7 at 48 hours and 10.4 at 72 hours. Oxidant concentrations during the studies indicate a residual persulfate level was maintained throughout the 72 hour study duration. The residual persulfate loadings increased with initial Klozur® CR loading from 540 mg/l to 1,000 mg/l to 1,500 mg/l. Subtracting the residual from the initial sodium persulfate concentration provides 72 hour calcium peroxide activated sodium persulfate demands of 4,100 mg-sodium persulfate/l, 7600 mg-sodium persulfate/l and 11,000 mg-sodium persulfate/l, respectively (1.9 g-Klozur® CR/kg-soil, 3.8 g-Klozur® CR/kg-soil, and 5.6 g-Klozur® CR/kg-soil).

The destruction efficiency was examined by comparing the benzene concentrations in groundwater before and after the test. The data shows that benzene destruction varied directly with initial Klozur® CR loading; the 2 g/kg loading had a benzene residual of 2,520 µg/l (57-percent removal efficiency), the 4 g/kg loading had a 1,750 µg/l residual (70-percent removal efficiency), and the 6 g/kg loading had a residual of 386 µg/l (93-percent removal efficiency). The ethylbenzene and toluene were reduced to below detection limits in the two higher Klozur® CR loadings, but not the 2 g/kg loading where ethylbenzene persisted.

The common oxidation intermediates acetone and 2-butanone were generated by the ISCO treatment. Hexavalent chromium was found at similar levels in the control sample (0.15 mg/l) and samples from the three oxidant amended vessels (0.12 mg/l to 0.15 mg/l) demonstrating that treatment with Klozur® CR did not enhance the solubility of hexavalent chromium.

4.5 OXIDANT EFFICIENCY TEST CONCLUSIONS

Based on the sequential chem-bio treatment train, Klozur® CR was selected as the most appropriate remedial technology for the MW-09 area. Treatability studies showed that the 72-hour Klozur® CR demand ranged from 1.9 g/kg to 5.6 g/kg, depending on initial concentration of Klozur® CR. Chromium was not mobilized at any Klozur® CR loading tested. Benzene destruction efficiency was acceptable (70 percent) at a Klozur® CR loading of 4 g/kg, but better at a loading of 6 g/kg (93 percent). However dissolved oxygen loading at the 4 g/kg Klozur dose is stoichiometrically sufficient to stimulate native microbes to attenuate remaining dissolved and sorbed benzene. Using a 6 g/kg dose rather than a 4 g/kg dose would increase the slurry volume and amount of solids requiring injection by 50 percent. This would require approximately 8,000 additional gallons of injection volume. Given the aggressive schedule requirements and additional enhanced bioremediation characteristics of the Klozur® CR product, a loading of 4 g/kg is recommended for the field application.

5 Potable Water Injection Test

Because of the prevalence of fine silt identified during the pre-design investigation, WSP Engineering recommended completing a one day (estimate: 2 to 3 points) potable water injection study in the vicinity of MW-09 to evaluate the viability of injecting liquid into the subsurface. The NYSDEC concurred with this approach via teleconference on July 9, 2009. The injection test was conducted on July 16, 2009.

In order to minimize the potential for the injected water to short-circuit via existing wells MW-09 and MW-11, pneumatic packers (e.g. Solinst Model 800 [single application]) were installed with the mid-point of the packer located at the top of the well screen. The packers were installed before injection activities were initiated.

Direct-push equipment was used to advance temporary delivery points. Bottom up delivery while using expendable drive point tips was determined to provide the highest performance during the test. For bottom up delivery, the direct push rods were advanced until refusal was encountered (approximately 20 ft-bgs). The rods were then pulled up approximately 1 to 2 feet and the injection of potable was initiated. Starting out at low pressures tended to allow the fine silt to clog the interior of the rods and prevent injection. Once flow was initiated at higher pressures (e.g., 35 psi or greater), the achievement of sustained injection flow was maintained at several locations at varying depth intervals spanning from 20 ft-bgs to 8 ft-bgs. Starting at a relatively higher pressure and decreasing pressure once flow was observed prevented clogging via silt entering the rods. Generally, sustained flow rates of 10 gpm or greater were achieved at pressures of 35 psi or greater.

The results indicate that potable water was successfully injected at appropriate flow rates and pressures to support moving forward with a full sale application of Klozur® CR. The information was used to formulate a full scale injection program.

After the injection was completed, the delivery points (borehole) were sealed by filling the voids with bentonite.

6 Injection Program

Based on the results of the oxidant demand test (Section 4.0), the total injection volume proposed is 14,500 gallons of Klozur® CR slurry. The proposed injection area consists of approximately 3,600 square feet over a 15-foot saturated thickness (Figure 2). This injection footprint covers the area of elevated benzene concentrations in groundwater in the vicinity of MW-09.

Klozur® CR is provided as a dry bulk granular material and must be mixed with water and applied to the subsurface as an aqueous slurry. For this application, the Klozur® CR slurry will be mixed at a 20 percent solid to liquid ratio by weight. Delivery points will be spaced approximately 10 feet apart. A total of 35 delivery points are planned and includes delivery of the Klozur® CR slurry over two hundred ten 2-foot intervals (Figure 2). This equates to six 2-foot intervals per delivery point. Approximately 69 gallons of slurry will be injected at each interval. Potable water for the slurry will be obtained from the city's hydrant system or Waterfront school.

Amendment delivery to the subsurface will be made sequentially beginning with the points located closest to the Waterfront school while advancing toward the south. Consecutive delivery to adjacent points will be avoided. The slurry will be delivered to subsurface at the least amount of pressure practical using hollow drive rods equipped with expendable drive point tips or similar delivery device. Deliveries will be made from the bottom up at 2-foot intervals.

Injections will be made at an initial applied pressure of approximately 50 psi to initiate flow. The pressure will be adjusted such that flow is maintained between 2 gpm and 10 gpm. If slurry delivery to any depth interval is not successful, the slurry volume not delivered to that interval will be added to the next delivery interval within the same boring. If delivery in the final interval is not successful, then the volume not delivered to that interval will be added to the same interval at an adjacent location. If a planned delivery point must be eliminated (i.e., because of proximity to protected areas) then the amendment scheduled for that boring will be added to adjacent borings.

After the slurry delivery is completed at the shallowest depth, the delivery point will be abandoned by filling it with grout and the concrete surface patched with Type II Portland cement sand grout to match the existing surface. Soil cuttings, decontamination fluids, and monitoring well purge water will be retained in labeled drums for characterization and proper disposal.

6.1 STORAGE AND MANAGEMENT

The Klozur® CR and PermeOx® Plus will be delivered as a dry powder in pails by common carrier truck and stored within a securable trailer or container. The slurry will be mixed as needed in a mobile feed tank near each injection point.

7 Groundwater Monitoring Program

Performance monitoring of MW-09 and continued monitoring of MW-01 and MW-03 will be conducted. The groundwater monitoring will begin approximately three months after the injection program is complete. Monitoring of MW-09 will be conducted on a quarterly basis and MW-01 and MW-03 will be conducted on a semi-annual basis for one year. As a voluntary option (to be determined after initial performance data is obtained), WSP may collect groundwater samples for parameters that will track remediation progress through each of the three Klozur® CR attenuation mechanisms (direct chemical oxidation, biologically mediated aerobic degradation, and biologically mediated anaerobic oxidation). The remediation and groundwater monitoring program will be considered complete if benzene concentrations decrease below 1,000 µg/l or a decreasing trend is evident.

MW-09 monitoring will include testing for BTEX compounds and optional parameters, geochemical data, molecular biological characterization, and compound specific isotope analysis (CSIA) for benzene. MW-01 and MW-03 will be analyzed for BTEX compounds only. The analytical program and methods are summarized in Table 3.

The abundance or depletion of specific electron acceptors indicates which biologically-mediated attenuation processes are possible. For several months following ISCO application, the calcium peroxide component of the Klozur® CR will elute oxygen and stimulate biologically mediated aerobic degradation of the dissolved benzene. When the supply of calcium peroxide is exhausted anaerobic electron accepting process will stimulate biologically mediated anaerobic oxidation of the dissolved benzene. The anaerobic degradation processes will begin with denitrification (use of nitrate and the production of nitrogen gas) of any available nitrate within site groundwater (no nitrate will be added to groundwater during Klozur® CR application) and then progress to metal reduction and then to sulfate reduction (use of sulfate and the production of sulfide). Klozur® CR application will increase dissolved sulfate concentrations and stimulate microbes that chemically reduce sulfate while oxidizing benzene.

The molecular biological characterization involves a passive sample collection matrix called a Bio-Trap Sampler. The Bio-Trap consists of powdered activated carbon (PAC) beads coated with Nomex which is ideally suited to accommodate growth of in-situ microbes (Appendix D). Sample collection involves suspending the Bio-Trap within the screened interval of a monitoring well over a period of time, typically 30 to 90 days. The microbes that colonize the reactor matrix are then tested employing phospholipids fatty acids (PLFA) and quantitative polymerase chain reaction (qPCR) measurement procedures. The PLFAs are components of microbial membranes. These measurements correlate to total biomass in the system and are specific to groups of organisms. Gene sequences (or analogous RNA segments) specific to known aerobic and anaerobic BTEX and poly-aromatic hydrocarbons (PAH) degrades will be targeted.

WSP proposes to collect CSIA samples to assess the ratio of carbon isotopes (^{13}C and ^{12}C) within the benzene affected groundwater. Temporal changes in the carbon isotope ratio will definitively demonstrate benzene attenuation via the application of Klozur® CR and biodegradation. The basis of the demonstration is that all bond breaking reactions, either chemical or biological, result in predictable changes (an increase or enrichment of ^{13}C within the residual benzene) in the naturally occurring ratio of the stable carbon isotopes while non-destructive attenuation mechanisms such as dilution, dispersion, and sorption do not significantly effect the isotopic ratio. By comparing baseline ^{13}C enrichment to post ISCO application ^{13}C enrichment and with time during aerobic and anaerobic bioremediation phases, destructive attenuation of the benzene can be definitively demonstrated.

Groundwater sampling will be conducted in accordance with WSP Engineering's SOPs and the EPA Region 2 low-flow sampling protocol. Before initiating any sampling activities, the water level at each monitoring well will be measured using a water level indicator. The above identified monitoring wells will then be purged with a peristaltic pump at flow rates less than 500 milliliters per minute. During purging, field measurements of temperature, pH, conductance, dissolved oxygen, oxidation-reduction potential,

and turbidity will be monitored using a water quality meter equipped with a flow-through cell to minimize atmospheric interference; turbidity will be measured separately with a nepholometer. All samples, with the exception of CSIA, will be filtered with 0.45 micrometer in-line filter. In addition, samples for CSIA will not be allowed to pass through the peristaltic pump head, sample containers will be filled using the gravity drain method after electron donor and acceptor samples have been collected.

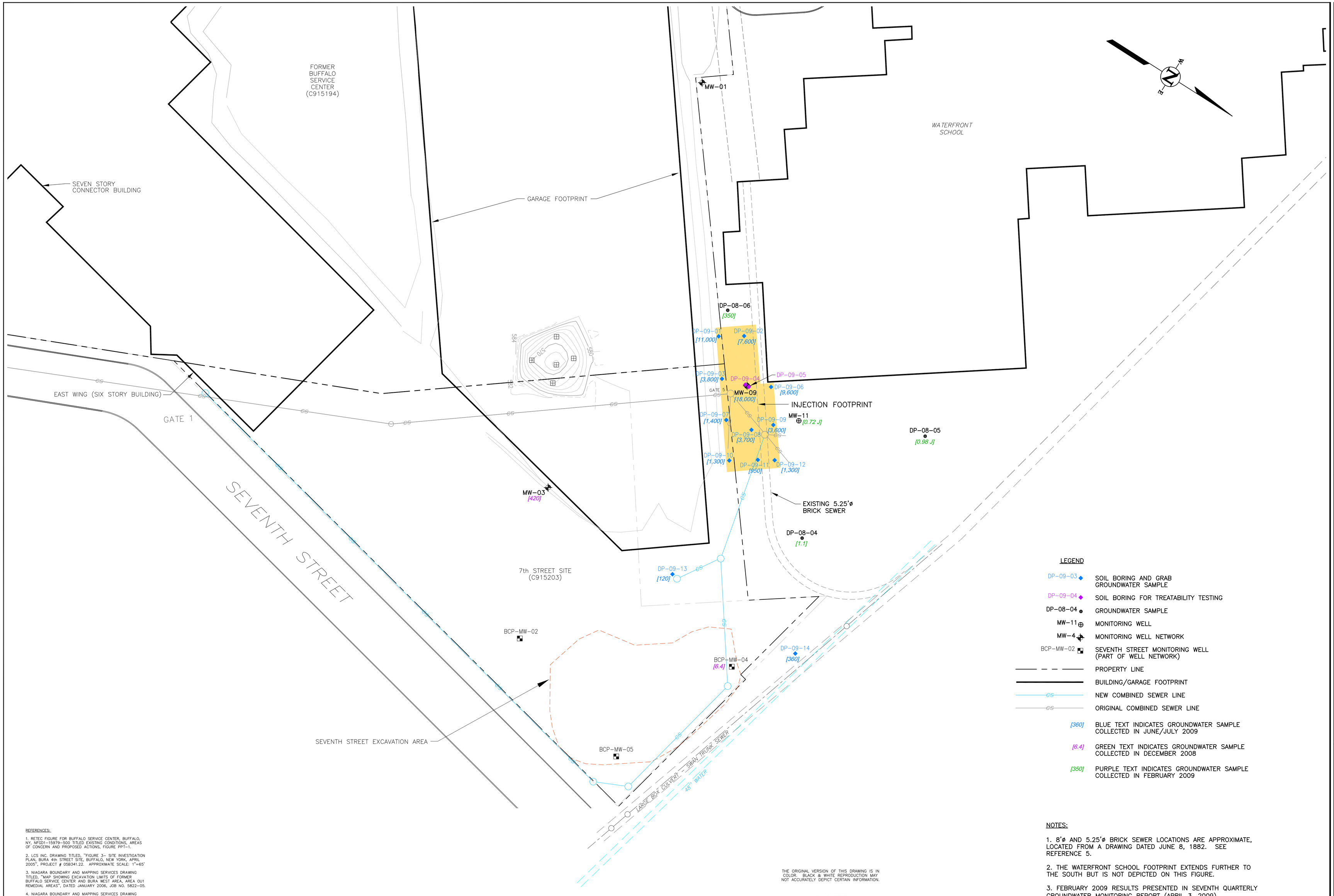
8 Reporting

Following completion of the injection activities, WSP Engineering will provide the NYSDEC with a letter report that documents the field activities with a focus on an “as-built” delivery schedule of Klozur® CR. Any difficulties and corresponding resolutions will also be recorded.

9 Schedule

WSP Engineering expects to begin field work on August 17, 2009, requiring an approximate 2 week field duration.

Figures



THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK & WHITE REPRODUCTION MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

SCALE, FEET

30 0 30 60

LEGEND

- DP-09-03 ◆ SOIL BORING AND GRAB GROUNDWATER SAMPLE
- DP-09-04 ◆ SOIL BORING FOR TREATABILITY TESTING
- DP-08-04 ● GROUNDWATER SAMPLE
- MW-11 ⊕ MONITORING WELL
- MW-4 ✚ MONITORING WELL NETWORK
- BCP-MW-02 ▪ SEVENTH STREET MONITORING WELL (PART OF WELL NETWORK)
- PROPERTY LINE
- BUILDING/GARAGE FOOTPRINT
- GS NEW COMBINED SEWER LINE
- GS ORIGINAL COMBINED SEWER LINE
- [360] BLUE TEXT INDICATES GROUNDWATER SAMPLE COLLECTED IN JUNE/JULY 2009
- [6.4] GREEN TEXT INDICATES GROUNDWATER SAMPLE COLLECTED IN DECEMBER 2008
- [350] PURPLE TEXT INDICATES GROUNDWATER SAMPLE COLLECTED IN FEBRUARY 2009

NOTES:

1. 8'ø AND 5.25'ø BRICK SEWER LOCATIONS ARE APPROXIMATE, LOCATED FROM A DRAWING DATED JUNE 8, 1882. SEE REFERENCE 5.
2. THE WATERFRONT SCHOOL FOOTPRINT EXTENDS FURTHER TO THE SOUTH BUT IS NOT DEPICTED ON THIS FIGURE.
3. FEBRUARY 2009 RESULTS PRESENTED IN SEVENTH QUARTERLY GROUNDWATER MONITORING REPORT (APRIL 3, 2009).
4. HISTORICAL GROUNDWATER SAMPLING RESULTS PRESENTED IN SUPPLEMENTAL GROUNDWATER INVESTIGATION REPORT – MW-09 AREA (MARCH 20, 2009).

REFERENCES:

1. RETEC FIGURE FOR BUFFALO SERVICE CENTER, BUFFALO, NY, NF001-15979-500 TITLED EXISTING CONDITIONS, AREAS OF CONCERN AND PROPOSED ACTIONS, FIGURE PPT-1.
2. LCS INC, DRAWING TITLED, "FIGURE 3– SITE INVESTIGATION PLAN, BURA 4th STREET SITE, BUFFALO, NEW YORK, APRIL 2005", PROJECT # 05B341.22. APPROXIMATE SCALE: 1"=65'
3. NIAGARA BOUNDARY AND MAPPING SERVICES DRAWING TITLED, "MAP SHOWING EXCAVATION LIMITS OF FORMER BUFFALO SERVICE CENTER AND BURA WEST AREA, AREA OU1 REMEDIAL AREAS", DATED JANUARY 2006, JOB NO. 5822–05.
4. NIAGARA BOUNDARY AND MAPPING SERVICES DRAWING TITLED, "MAP SHOWING BACKFILLED EXCAVATION AREA OF FORMER BUFFALO SERVICE CENTER AND BURA WEST AREA, OU1 REMEDIAL AREA", DATED FEBRUARY 2006, JOB NO. 5822–05.
5. CITY OF BUFFALO, DIVISION OF ENGINEERING, BUFFALO, NEW YORK DRAWING TITLED, "PLAN & PROFILE OF THE BUFFALO TRUNK SEWER", DATED JUNE 8, 1882.

REVISIONS

REV	DESCRIPTION		
–	Revised:	Chkd:	Appr.:
(a)	Revised:	Chkd:	Appr.:
(b)	Revised:	Chkd:	Appr.:
(c)	Revised:	Chkd:	Appr.:

SEAL

DATE

DRAWN BY RR 07/10/09
CHECKED GER 07/10/09
APPROVED GER 07/10/09

GROUNDWATER SAMPLING RESULTS FOR BENZENE
MW-09 AREA PRE-DESIGN INVESTIGATION

PREPARED FOR
QLT BUFFALO LLC
BUFFALO, NEW YORK

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

FIGURE 1

Drawing Name
080190–D07

R:\AutoCAD DWGs\080\080190.QLT Buffalo\080190D07.dwg, 7/31/2009 12:40:49 PM

PREPARATION

1. CONTRACTOR SHALL OBTAIN ALL APPLICABLE PERMITS, APPROVALS, AND LICENSES REQUIRED TO COMPLETE THE WORK SPECIFIED HEREIN. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH APPLICABLE ENVIRONMENTAL REGULATIONS.

2. CONTRACTOR IS RESPONSIBLE FOR THE HEALTH AND SAFETY OF ITS EMPLOYEES AND SHALL MAINTAIN A SAFE WORKING ENVIRONMENT DURING PERFORMANCE OF THE WORK SPECIFIED HEREIN. CONTRACTOR SHALL COMPLY, AND SHALL SECURE COMPLIANCE BY ITS EMPLOYEES, AGENTS, AND SUBCONTRACTORS, WITH ALL APPLICABLE HEALTH AND SAFETY LAWS AND REGULATIONS. CONTRACTOR SHALL PREPARE AND IMPLEMENT ITS OWN PROJECT HEALTH AND SAFETY PLAN, BASED ON ITS HEALTH AND SAFETY PROGRAM AND/OR REQUIRED BY FEDERAL, STATE, AND LOCAL REGULATIONS. CONTRACTOR HEALTH AND SAFETY PLAN AND REQUIRED DOCUMENTATION SHALL BE AVAILABLE AT THE SITE FOR REVIEW BY THE OWNER, THE ENGINEER, OTHER ON-SITE CONTRACTORS, AND REGULATORY PERSONNEL. CONTRACTOR SHALL CONSIDER THE REQUIREMENTS OF ANY APPLICABLE SITE SAFETY PLAN PREPARED BY THE OWNER OR ENGINEER WHEN DEVELOPING THEIR HEALTH AND SAFETY PLAN.

3. CONTRACTOR SHALL COORDINATE WITH THE ENGINEER FOR PROVISION AND USE OF EXISTING AND TEMPORARY UTILITIES NEEDED TO COMPLETE THE SPECIFIED WORK. CONTRACTOR SHALL STAGE EQUIPMENT AND MATERIAL IN AREAS DESIGNATED BY ENGINEER.

4. CONTRACTOR SHALL COORDINATE SUBSURFACE DELIVERY ACTIVITIES WITH ENGINEER.

5. KNOWN UNDERGROUND UTILITIES IN REMEDIATION AREAS HAVE BEEN INDICATED ON THESE DRAWINGS. ABOVEGROUND UTILITIES ARE NOT IDENTIFIED. ENGINEER MAKES NO GUARANTEE ABOUT THE ACCURACY OF THE UNDERGROUND UTILITIES SHOWN. ENGINEER MAKES NO GUARANTEE THAT ALL UNDERGROUND UTILITIES ARE SHOWN.

6. CONTRACTOR SHALL CONTACT THE NEW YORK DIG SAFELY AT LEAST 2 BUSINESS DAYS BEFORE BEGINNING INTRUSIVE WORK. CONTRACTOR SHALL COMPLY WITH ALL NEW YORK DIG SAFELY REQUIREMENTS.

7. THE ENGINEER WILL HAVE A PRIVATE UTILITY LOCATOR FIELD IDENTIFY LOCATIONS AND DEPTHS OF UNDERGROUND UTILITIES. CONTRACTOR SHALL PROTECT ALL UTILITIES AT THE SITE. ANY DAMAGE TO IDENTIFIED UTILITIES SHALL BE REPAIRED AT CONTRACTOR EXPENSE.

8. CONTRACTOR SHALL NOT COMPLETE INTRUSIVE WORK WITHIN 2 FEET OF A MARKED SUBSURFACE UTILITY OR WITHIN 3 FEET OF ANY STRUCTURAL MEMBER. CONTRACTOR SHALL NOT INSTALL DELIVERY POINTS WITHIN 3 FEET OF AN EXISTING GROUNDWATER MONITORING WELL.

9. CONTRACTOR SHALL PROTECT AGAINST UNAUTHORIZED ENTRY TO OUTDOOR WORK AND STAGING AREAS BY USING POLYBARRIER OR EQUIVALENT ROLLED FENCING, AS NECESSARY. CONTRACTOR IS RESPONSIBLE FOR THE SECURITY OF THEIR EQUIPMENT. THE ENGINEER AND OWNER WILL NOT REPLACE OR REIMBURSE LOST, STOLEN, OR DAMAGED EQUIPMENT AND MATERIALS.

10. GROUNDWATER REMEDIATION AMENDMENTS SHALL BE APPLIED VIA TEMPORARY WELLS AS SPECIFIED IN THESE DRAWINGS AND WITHIN THE WORK PLAN FOR THIS WORK.

11. ENGINEER SHALL PROVIDE GROUNDWATER REMEDIATION AMENDMENTS FOR THE PROJECT.

12. CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT TOOLS AND MATERIALS NECESSARY TO SECURE, HANDLE, MIX, AND DELIVER THE REMEDIATION AMENDMENTS TO THE SUBSURFACE.

13. PRODUCTS AND EQUIPMENT THAT WILL COME INTO CONTACT WITH THE REMEDIATION AMENDMENTS SHALL BE CONSTRUCTED OF PLASTIC OR STAINLESS STEEL. CONTRACTOR SHALL STORE AND HANDLE ALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH MANUFACTURER INSTRUCTIONS.

14. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO ORIGINAL, PRECONSTRUCTION CONDITIONS.

15. ANY DAMAGE CAUSED BY CONTRACTOR OR ITS SUBCONTRACTORS TO EXISTING FACILITIES, STRUCTURES, UTILITIES AND/OR FINISHED SURFACES LOCATED OFF OR ON THE FACILITY PROPERTY SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE.

16. THE LOCATION OF SUBSURFACE UTILITIES IDENTIFIED IN THESE DRAWINGS MAY NOT BE ACCURATE OR COMPLETE. SEE NOTES 5 THROUGH 8 ON THIS SHEET FOR CONTRACTOR REQUIREMENTS REGARDING SUBSURFACE UTILITIES.

17. PROPOSED LOCATIONS FOR DELIVERY POINTS SHALL BE FIELD VERIFIED BY CONTRACTOR BEFORE STARTING WORK. DELIVERY POINT LOCATIONS MAY BE MODIFIED IN THE FIELD AT THE DISCRETION OF THE ENGINEER TO AVOID PROTECTED. PROPOSED LOCATIONS WILL BE IDENTIFIED BY THE ENGINEER WITH MARKING PAINT BEFORE COMMENCEMENT OF WORK.

DELIVERY PLAN

1. CHEMICAL OXIDATION USING SODIUM PERSULFATE (KLOZUR®) WILL BE IMPLEMENTED WITHIN THE SATURATED ZONE CONTAINING ELEVATED BENZENE CONCENTRATIONS. THE KLOZUR® WILL BE BASE-ACTIVATED USING CALCIUM PEROXIDE (PERMEOX PLUS®). THE MANUFACTURER WILL PREMIX THE KLOZUR® AND PERMEOX PLUS® (LABELED AS KLOZUR® CR).

2. KLOZUR® CR IS PROVIDED AS A DRY BULK MATERIAL AND SHALL BE MIXED WITH WATER AND APPLIED TO THE SUBSURFACE AS AN AQUEOUS SLURRY (20% KLOZUR® CR TO WATER MASS RATIO).

3. CONTRACTOR SHALL PREPARE KLOZUR® CR SLURRY IN ACCORDANCE WITH THE DELIVERY SCHEDULES ON THIS SHEET.

4. THE SLURRY SHALL BE THOROUGHLY MIXED FOR 15 MINUTES (MIN.) BEFORE DELIVERY TO THE SUBSURFACE. ALL SLURRIES SHALL BE APPLIED WITHIN 2 HOURS OF MIXING.

5. CONTRACTOR SHALL TAKE APPROPRIATE PRECAUTIONS (AS NECESSARY) TO MINIMIZE DUST GENERATION DURING THE MIXING PROCESS.

6. SLURRY SHALL BE DELIVERED TO SUBSURFACE AT THE LEAST AMOUNT OF PRESSURE PRACTICAL.

7. AN EXPENDABLE GEOPROBE TIP OR ENGINEER-APPROVED EQUIVALENT DELIVERY DEVICE INSTALLED ON THE END OF A HOLLOW DRIVE ROD SHALL BE ADVANCED TO THE TARGET DELIVERY INTERVAL INDICATED IN THE DELIVERY SCHEDULE ON THIS SHEET. IF INSTRUCTED BY THE ENGINEER THE CONTRACTOR SHALL USE A MEMBRANE INTERFACE PROBE BULB OR OTHER ENGINEER-APPROVED FRICTION REDUCING DEVICE TO MINIMIZE SHORT CIRCUITING ALONG THE DRIVE RODS.

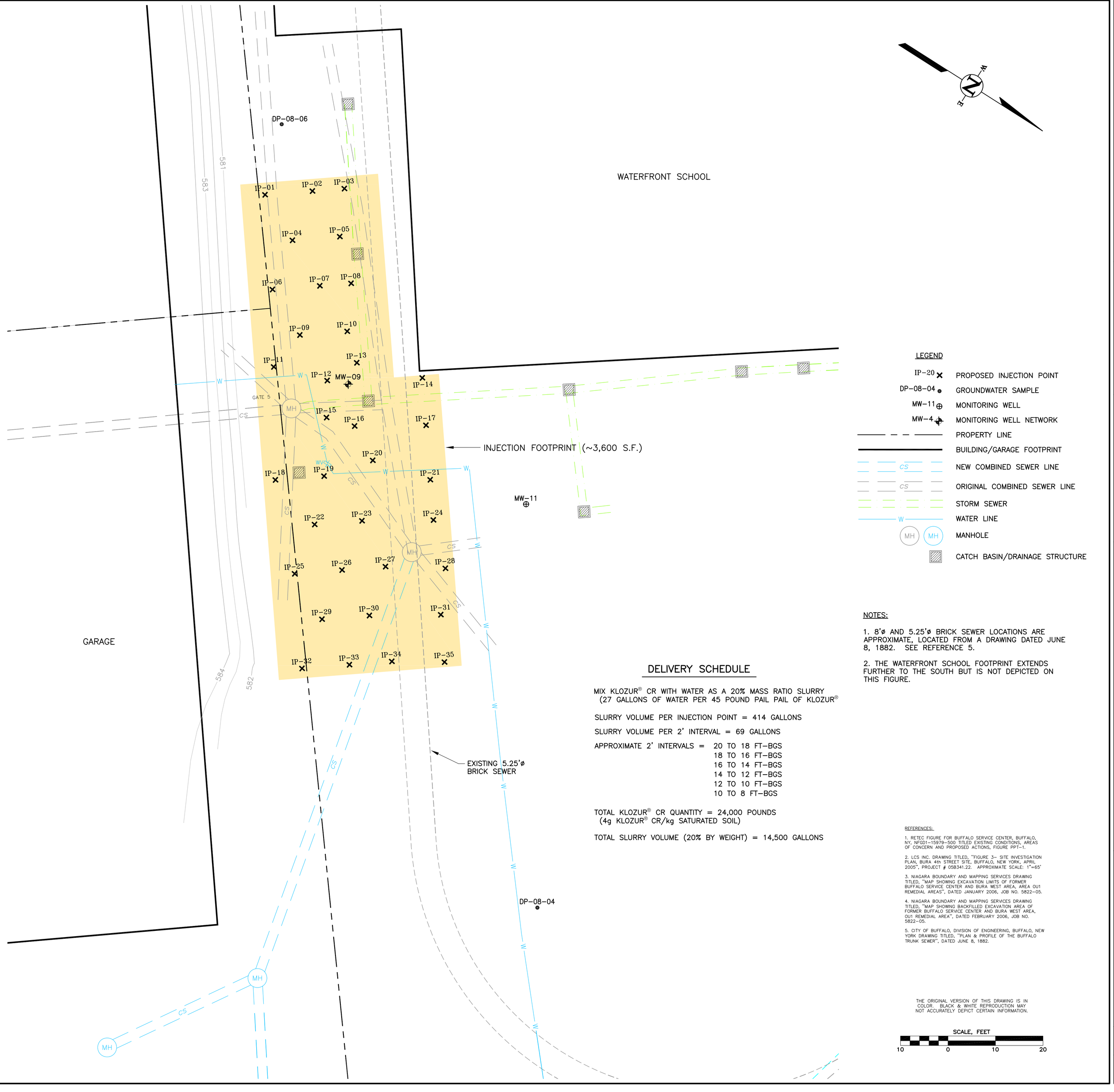
8. EACH TEMPORARY DELIVERY POINT SHALL BE ADVANCED TO THE DEEPEST INTERVAL ON THIS SHEET. THE EXPENDABLE TIP SHALL BE REMOVED AND THE PRESCRIBED VOLUME OF SLURRY DELIVERED TO THE SUBSURFACE. AFTER THE SLURRY IS DELIVERED, THE RODS SHALL BE RETRACTED TO THE NEXT INTERVAL (SEE SCHEDULE ON THIS SHEET) AND THE PRESCRIBED SLURRY FOR THAT INTERVAL SHALL BE DELIVERED.

9. DELIVERY POINTS SHALL BE ADVANCED SEQUENTIALLY BEGINNING WITH THE POINTS LOCATED AT THE NORTH EDGE OF THE EFFECTED AREA AND FINISHING WITH THE POINTS LOCATED TO THE SOUTH. CONSECUTIVE DELIVERY TO ADJACENT POINTS SHALL BE AVOIDED AND ARE ONLY PERMISSIBLE WITH THE APPROVAL OF THE ENGINEER.

10. INJECTIONS SHALL OCCUR AT AN INITIAL APPLIED PRESSURE OF APPROXIMATELY 50 PSI AND DECREASED SLOWLY TO MAINTAIN A FLOW RATE BETWEEN 2 GPM AND 10 GPM.

11. IF SLURRY DELIVERY TO ANY DEPTH INTERVAL IS NOT SUCCESSFUL, THE SLURRY VOLUME NOT DELIVERED TO THAT INTERVAL SHALL BE ADDED TO THE NEXT DELIVERY INTERVAL WITHIN THE SAME BORING. IF DELIVERY IN THE FINAL INTERVAL IS NOT SUCCESSFUL, THEN THE VOLUME NOT DELIVERED TO THAT INTERVAL SHALL BE ADDED TO THE SAME INTERVAL AT AN ADJACENT LOCATION.

12. AFTER SLURRY DELIVERY IS COMPLETED AT THE SHALLOWEST DEPTH THE DELIVERY POINT SHALL BE ABANDONED BY FILLING IT WITH GROUT AND THE CONCRETE SURFACE PATCHED WITH TYPE II PORTLAND CEMENT SAND GROUT TO MATCH THE EXISTING SURFACE. SOIL CUTTINGS, DECONTAMINATION FLUIDS, AND MONITORING WELL PURGE WATER SHALL BE RETAINED IN LABELED DRUMS FOR CHARACTERIZATION AND PROPER DISPOSAL. DISPOSABLE SAMPLING EQUIPMENT AND PERSONAL PROTECTIVE EQUIPMENT SHALL BE COLLECTED IN CONTRACTOR BAGS FOR DISPOSAL BY ENGINEER.



LEGEND

- IP-20 — PROPOSED INJECTION POINT
- DP-08-04 — GROUNDWATER SAMPLE
- MW-11 — MONITORING WELL
- MW-4 — MONITORING WELL NETWORK
- PROPERTY LINE
- BUILDING/GARAGE FOOTPRINT
- NEW COMBINED SEWER LINE
- ORIGINAL COMBINED SEWER LINE
- STORM SEWER
- WATER LINE
- MANHOLE
- CATCH BASIN/DRAINAGE STRUCTURE

DELIVERY SCHEDULE

MIX KLOZUR® CR WITH WATER AS A 20% MASS RATIO SLURRY (27 GALLONS OF WATER PER 45 POUND PAIL PAIL OF KLOZUR®

SLURRY VOLUME PER INJECTION POINT = 414 GALLONS

SLURRY VOLUME PER 2' INTERVAL = 69 GALLONS

APPROXIMATE 2' INTERVALS =
- 20 TO 18 FT-BGS
- 18 TO 16 FT-BGS
- 16 TO 14 FT-BGS
- 14 TO 12 FT-BGS
- 12 TO 10 FT-BGS
- 10 TO 8 FT-BGS

TOTAL KLOZUR® CR QUANTITY = 24,000 POUNDS (4g KLOZUR® CR/kg SATURATED SOIL)

TOTAL SLURRY VOLUME (20% BY WEIGHT) = 14,500 GALLONS

NOTES:

1. 8'ø AND 5.25'ø BRICK SEWER LOCATIONS ARE APPROXIMATE, LOCATED FROM A DRAWING DATED JUNE 8, 1882. SEE REFERENCE 5.

2. THE WATERFRONT SCHOOL FOOTPRINT EXTENDS FURTHER TO THE SOUTH BUT IS NOT DEPICTED ON THIS FIGURE.

REFERENCES:

1. RETEC FIGURE FOR BUFFALO SERVICE CENTER, BUFFALO, NY, NFGD1-15978-500 TITLED EXISTING CONDITIONS, AREAS OF CONCERN AND PROPOSED ACTIONS, FIGURE PPT-1.

2. LCS INC. DRAWING TITLED, "FIGURE 3- SITE INVESTIGATION PLAN, BURA 4th STREET SITE, BUFFALO, NEW YORK, APRIL 2005", PROJECT # 058341.22. APPROXIMATE SCALE: 1"=65'

3. NIAGARA BOUNDARY AND MAPPING SERVICES DRAWING TITLED, "MAP SHOWING EXCAVATION LIMITS OF FORMER BUFFALO SERVICE CENTER AND BURA WEST AREA, AREA OU1 REMEDIAL AREAS", DATED JANUARY 2006, JOB NO. 5822-05.

4. NIAGARA BOUNDARY AND MAPPING SERVICES DRAWING TITLED, "MAP SHOWING BACKFILLED EXCAVATION AREA OF FORMER BUFFALO SERVICE CENTER AND BURA WEST AREA, OU1 REMEDIAL AREA", DATED FEBRUARY 2006, JOB NO. 5822-05.

5. CITY OF BUFFALO, DIVISION OF ENGINEERING, BUFFALO, NEW YORK DRAWING TITLED, "PLAN & PROFILE OF THE BUFFALO TRUNK SEWER", DATED JUNE 8, 1882.

SCALE, FEET
10 0 10 20

REVISIONS

REV	DESCRIPTION		
(a)	Revised	Chkd:	Appr.:
(b)	Revised	Chkd:	Appr.:
(c)	Revised	Chkd:	Appr.:

SEAL

DATE

DRAWN BY: RR 07/31/09
CHECKED: GER 07/31/09
APPROVED: GER 07/31/09

PROPOSED INJECTION PROGRAM

PREPARED FOR
QLT BUFFALO LLC
BUFFALO, NEW YORK

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

FIGURE 2

Drawing Name
080190-D08

Tables

Table 1

Groundwater Sample Results
QLT Buffalo
Buffalo, New York (a)

Parameters	NYSDEC Values	Sample I.D.: MW-09-7	MW-09-10.25	MW-09-13.5	MW-09-16.75	MW-08	MW-09
		Sample Depth (ft-bgs): 7-9	10.25-12.25	13.5-15.5	16.75-18.75	17	13.5
		Sample Date: 06/26/09	06/26/09	06/26/09	06/26/09	06/26/09	06/26/09
Volatile Organic Compounds (µg/l)							
Benzene	1	6,800	18,000	17,000	17,000	-	-
Ethylbenzene	5	40 U	18 J	17 J	18 J	-	-
Toluene	5	40 U	40 U	40 U	40 U	-	-
Total Xylenes	5	80 U	80 U	80 U	80 U	-	-
General Chemistry (mg/l)							
Sulfate	250	-	-	-	-	20 U	55
Sulfide	0.002	-	-	-	-	0.1 U	0.1 U
Nitrate	10	-	-	-	-	0.05 U	0.05 U
Iron	-	-	-	-	-	6	3
Ferrous Iron	-	-	-	-	-	2	ND
Field Parameters							
Temperature (^{o}C)	-	-	-	-	-	19.91	22.04
pH (S.U.)	-	-	-	-	-	6.8	6.89
ORP (mV)	-	-	-	-	-	-81	-96
Conductivity (mS/cm)	-	-	-	-	-	1.4	1.74
Turbidity (NTUs)	-	-	-	-	-	7.3	9.6
D.O. (mg/l)	-	-	-	-	-	1.36	0.28
Functional Genes (cells/beads)							
Benzyl Succinate Synthase (bssA)	-	-	-	-	-	1.30 U	1.00 U
Napthalene Dioxygenase (NAH)	-	-	-	-	-	332,000,000	137,000,000
Phenol Hydroxylase (PHE)	-	-	-	-	-	252	40,600
Toluene Monooxygenase (RMO)	-	-	-	-	-	1.30 U	1.00 U
Toluene Dioxygenase (TOD)	-	-	-	-	-	619,000	1,010,000
Biphenyl Dioxygenase (BPH4)	-	-	-	-	-	225	23,400
Xylene Monooxygenase (TOL)	-	-	-	-	-	1.30 U	0.20 J

Boxed value indicates concentration greater than NYSDEC Ambient Water Quality Values

a/ I.D. = identification; ft-bgs = feet below ground surface; NYSDEC = New York State Department of Environmental Conservation; µg/l = micrograms per liter; mg/l = milligrams per liter; ^{o}C = degrees Celcius; S.U. = Standard Units; ORP = Oxidation Reduction Potential; mV = millivolts; mS/cm = milliSiemens per centimeter; NTU= Nepholmetric Turbidity Units; D.O. = Dissolved Oxygen; '-' indicates no criterion developed or not analyzed; ND = n

b/ NYSDEC Ambient Water Quality Standards and Guidance Values. Technical and Operational Guidance Series (1.1.1). June 1998 and as updated.

c/ Data Qualifiers:
U = constituent not detected at reported detection limit
J = estimated concentration

Table 2

Direct-Push Groundwater Sample Results
QLT Buffalo
Buffalo, New York (a)

Parameters	NYSDEC Values (b)	Sample I.D.: DP-09-01 / Sample Depth (ft-bgs): 14-19 / Sample Date: 06/29/09	DP-09-02 / 14.5-19.5 / 07/01/09	DP-09-03 / 13-18 / 06/29/09	DP-09-06 / 14-19 / 06/30/09	DP-09-07 / 14-19 / 06/29/09	DP-09-08 / 14-19 / 06/30/09	DP-09-09 / 14-19 / 06/30/09	DP-09-10 / 12.5-17.5 / 06/29/09
Volatile Organic Compounds (µg/l)									
Benzene	1	11,000 (c)	7,600	3,800	9,600	1,400	3,700	3,600	1,300
Ethylbenzene	5	29	34	20	84	48	30	2.2	35
Toluene	5	7.7	20 U	4	10	3.8	6.3	1.1	3.4
Total Xylenes	5	44	25 J	38	81	120	15	0.88 J	17

Parameters	NYSDEC Values	Sample I.D.: DP-09-11 / Sample Depth: 15-20 / Sample Date: 06/30/09	DP-09-12 / 15-20 / 06/30/09	DP-09-13 / 14.5-19.5 / 07/01/09	DP-09-14 / 16-20 / 07/01/09
Volatile Organic Compounds (µg/l)					
Benzene	1	950	1,300	120	360
Ethylbenzene	5	1 U	1 U	4 J	22
Toluene	5	0.82 J	1 U	5 U	21
Total Xylenes	5	2 U	2 U	10 U	50

Boxed value indicates concentration greater than NYSDEC Ambient Water Quality Values

a/ I.D. = identification; ft-bgs = feet below ground surface; NYSDEC = New York State Department of Environmental Conservation; µg/l = micrograms per liter; mg/l = milligrams per liter; '-' indicates no criterion developed or not analyzed.
b/ NYSDEC Ambient Water Quality Standards and Guidance Values. Technical and Operational Guidance Series (1.1.1). June 1998 and as updated.
c/ Data Qualifiers:
U = constituent not detected at reported detection limit
J = estimated concentration

Table 3

MW-09 Groundwater Monitoring Program
QLT Buffalo
Buffalo, New York (a)

Media:	**Groundwater**						
Analysis:	**BTEX**	**CSIA-Benzene**	**MBC**	**Sulfate**	**Sulfide**	**Nitrate**	**Ferrous Iron**
Method:	8260	-	-	375.4	376.1	353.2	HACH 8146
Laboratory:	Test America	Microseeps	Microbial Insights	Test America	Test America	Test America	Field Method
Location:	Buffalo, NY	Pittsburgh, PA	Rockford, TN	Buffalo, NY	Buffalo, NY	Buffalo, NY	-
MW-01	**X**						
MW-03	**X**						
MW-09 (b)	**X**	**X**	**X**	**X**	**X**	**X**	**X**

a\ BTEX = benzene, toluene, ethylbenzene, and xylenes; CSIA= Compound Specific Isotope Analysis; MBC= Molecular Biological Characterization.
b\ The red font indicates parameters that are optional (to be determined based on initial performance data)

Appendix A – Analytical Data

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

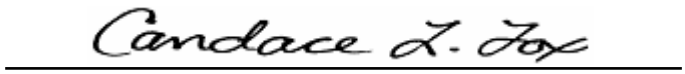
Analytical Report

Work Order: RSF1103

Project Description
Environmental Strategies Corporation

For:

Glen Rieger
WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220



Candace Fox
Project Manager
candace.fox@testamericainc.com

Thursday, July 9, 2009

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1103

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/26/09
Reported: 07/09/09 16:59

TestAmerica Buffalo
Current Certifications

As of 1/27/2009

STATE	Program	Cert # / Lab ID
Arkansas	CWA, RCRA, SOIL	88-0686
California*	NELAP CWA, RCRA	01169CA
Connecticut	SDWA, CWA, RCRA, SOIL	PH-0568
Florida*	NELAP CWA, RCRA	E87672
Georgia*	SDWA,NELAP CWA, RCRA	956
Illinois*	NELAP SDWA, CWA, RCRA	200003
Iowa	SW/CS	374
Kansas*	NELAP SDWA, CWA, RCRA	E-10187
Kentucky	SDWA	90029
Kentucky UST	UST	30
Louisiana*	NELAP CWA, RCRA	2031
Maine	SDWA, CWA	NY0044
Maryland	SDWA	294
Massachusetts	SDWA, CWA	M-NY044
Michigan	SDWA	9937
Minnesota	SDWA,CWA, RCRA	036-999-337
New Hampshire*	NELAP SDWA, CWA	233701
New Jersey*	NELAP,SDWA, CWA, RCRA,	NY455
New York*	NELAP, AIR, SDWA, CWA, RCRA,CLP	10026
Oklahoma	CWA, RCRA	9421
Pennsylvania*	NELAP CWA,RCRA	68-00281
Tennessee	SDWA	02970
Texas*	NELAP CWA, RCRA	T10470441208-TX
USDA	FOREIGN SOIL PERMIT	S-41579
USDOE	Department of Energy	DOECAP-STB
Virginia	SDWA	278
Washington*	NELAP CWA,RCRA	C1677
Wisconsin	CWA, RCRA	998310390
West Virginia	CWA,RCRA	252

*As required under the indicated accreditation, the test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report.

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1103

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/26/09
Reported: 07/09/09 16:59

Case Narrative

According to 40CFR Part 136.3, pH, Chlorine Residual, Dissolved Oxygen, Sulfite, and Temperature analyses are to be performed immediately after aqueous sample collection. When these parameters are not indicated as field (e.g. field-pH), they were not analyzed immediately, but as soon as possible after laboratory receipt.

A pertinent document is appended to this report, 1 page, is included and is an integral part of this report.

TestAmerica Laboratories, Inc. certifies that the analytical results contained herein apply only to the samples tested as received by our Laboratory.

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1103

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/26/09
Reported: 07/09/09 16:59

DATA QUALIFIERS AND DEFINITIONS

D04	Dilution required due to high levels of non-target compounds
D08	Dilution required due to high concentration of target analyte(s)
J	Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). Concentrations within this range are estimated.
M8	The MS and/or MSD were below the acceptance limits. See Blank Spike (LCS).
NR	Any inclusion of NR indicates that the project specific requirements do not require reporting estimated values below the laboratory reporting limit.

ADDITIONAL COMMENTS

Results are reported on a wet weight basis unless otherwise noted.

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1103

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/26/09
Reported: 07/09/09 16:59

Sample Summary

Sample Identification	Lab Number	Client Matrix	Date/Time Sampled	Date/Time Received	Sample Qualifiers
MW-09-7	RSF1103-01	Water	06/26/09 09:35	06/26/09 16:40	
MW-09-10.25	RSF1103-02	Water	06/26/09 09:40	06/26/09 16:40	
MW-09-13.5	RSF1103-03	Water	06/26/09 09:45	06/26/09 16:40	
MW-09-16.75	RSF1103-04	Water	06/26/09 09:50	06/26/09 16:40	
MW-08	RSF1103-05	Water	06/26/09 11:05	06/26/09 16:40	
MW-09	RSF1103-06	Water	06/26/09 13:45	06/26/09 16:40	

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-01 (MW-09-7 - Water)						**Sampled: 06/26/09 09:35**		**Recvd: 06/26/09 16:40**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	ND	D08	40	7.4	ug/L	40.0	07/03/09 20:04	PQ	9G03009	8260B
Toluene	ND	D08	40	20	ug/L	40.0	07/03/09 20:04	PQ	9G03009	8260B
Xylenes, total	ND	D08	80	26	ug/L	40.0	07/03/09 20:04	PQ	9G03009	8260B
1,2-Dichloroethane-d4	*101 %*	*D08*	*Surr Limits: (66-137%)*				*07/03/09 20:04*	*PQ*	*9G03009*	*8260B*
4-Bromofluorobenzene	*97 %*	*D08*	*Surr Limits: (73-120%)*				*07/03/09 20:04*	*PQ*	*9G03009*	*8260B*
Toluene-d8	*95 %*	*D08*	*Surr Limits: (71-126%)*				*07/03/09 20:04*	*PQ*	*9G03009*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-01RE1 (MW-09-7 - Water)							**Sampled: 06/26/09 09:35**		**Recvd: 06/26/09 16:40**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**6800**	D08	100	16	ug/L	100	07/06/09 23:22	CDC	9G06086	8260B
1,2-Dichloroethane-d4	*103 %*	*D08*	*Surr Limits:*	*(66-137%)*			*07/06/09 23:22*	*CDC*	*9G06086*	*8260B*
4-Bromofluorobenzene	*96 %*	*D08*	*Surr Limits:*	*(73-120%)*			*07/06/09 23:22*	*CDC*	*9G06086*	*8260B*
Toluene-d8	*96 %*	*D08*	*Surr Limits:*	*(71-126%)*			*07/06/09 23:22*	*CDC*	*9G06086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-02 (MW-09-10.25 - Water)						**Sampled: 06/26/09 09:40**		**Recvd: 06/26/09 16:40**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**18**	D08,J	40	7.4	ug/L	40.0	07/03/09 20:32	PQ	9G03009	8260B
Toluene	ND	D08	40	20	ug/L	40.0	07/03/09 20:32	PQ	9G03009	8260B
Xylenes, total	ND	D08	80	26	ug/L	40.0	07/03/09 20:32	PQ	9G03009	8260B
1,2-Dichloroethane-d4	*99 %*	*D08*	*Surr Limits: (66-137%)*				*07/03/09 20:32*	*PQ*	*9G03009*	*8260B*
4-Bromofluorobenzene	*95 %*	*D08*	*Surr Limits: (73-120%)*				*07/03/09 20:32*	*PQ*	*9G03009*	*8260B*
Toluene-d8	*94 %*	*D08*	*Surr Limits: (71-126%)*				*07/03/09 20:32*	*PQ*	*9G03009*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-02RE1 (MW-09-10.25 - Water)							**Sampled: 06/26/09 09:40**		**Recvd: 06/26/09 16:40**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**18000**	D08	400	66	ug/L	400	07/06/09 23:50	CDC	9G06086	8260B
1,2-Dichloroethane-d4	*101 %*	*D08*	*Surr Limits:*	*(66-137%)*			*07/06/09 23:50*	*CDC*	*9G06086*	*8260B*
4-Bromofluorobenzene	*94 %*	*D08*	*Surr Limits:*	*(73-120%)*			*07/06/09 23:50*	*CDC*	*9G06086*	*8260B*
Toluene-d8	*94 %*	*D08*	*Surr Limits:*	*(71-126%)*			*07/06/09 23:50*	*CDC*	*9G06086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-03 (MW-09-13.5 - Water)						**Sampled: 06/26/09 09:45**		**Recvd: 06/26/09 16:40**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**17**	D08,J	40	7.4	ug/L	40.0	07/03/09 21:00	PQ	9G03009	8260B
Toluene	ND	D08	40	20	ug/L	40.0	07/03/09 21:00	PQ	9G03009	8260B
Xylenes, total	ND	D08	80	26	ug/L	40.0	07/03/09 21:00	PQ	9G03009	8260B
1,2-Dichloroethane-d4	*99 %*	*D08*	*Surr Limits: (66-137%)*				*07/03/09 21:00*	*PQ*	*9G03009*	*8260B*
4-Bromofluorobenzene	*96 %*	*D08*	*Surr Limits: (73-120%)*				*07/03/09 21:00*	*PQ*	*9G03009*	*8260B*
Toluene-d8	*96 %*	*D08*	*Surr Limits: (71-126%)*				*07/03/09 21:00*	*PQ*	*9G03009*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-03RE1 (MW-09-13.5 - Water)							**Sampled: 06/26/09 09:45**		**Recvd: 06/26/09 16:40**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**17000**	D08	400	66	ug/L	400	07/07/09 00:18	CDC	9G06086	8260B
1,2-Dichloroethane-d4	*101 %*	*D08*	*Surr Limits:*	*(66-137%)*			*07/07/09 00:18*	*CDC*	*9G06086*	*8260B*
4-Bromofluorobenzene	*94 %*	*D08*	*Surr Limits:*	*(73-120%)*			*07/07/09 00:18*	*CDC*	*9G06086*	*8260B*
Toluene-d8	*94 %*	*D08*	*Surr Limits:*	*(71-126%)*			*07/07/09 00:18*	*CDC*	*9G06086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-04 (MW-09-16.75 - Water)						**Sampled: 06/26/09 09:50**		**Recvd: 06/26/09 16:40**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**18**	D08,J	40	7.4	ug/L	40.0	07/03/09 21:29	PQ	9G03009	8260B
Toluene	ND	D08	40	20	ug/L	40.0	07/03/09 21:29	PQ	9G03009	8260B
Xylenes, total	ND	D08	80	26	ug/L	40.0	07/03/09 21:29	PQ	9G03009	8260B
1,2-Dichloroethane-d4	*99 %*	*D08*	*Surr Limits: (66-137%)*				*07/03/09 21:29*	*PQ*	*9G03009*	*8260B*
4-Bromofluorobenzene	*94 %*	*D08*	*Surr Limits: (73-120%)*				*07/03/09 21:29*	*PQ*	*9G03009*	*8260B*
Toluene-d8	*93 %*	*D08*	*Surr Limits: (71-126%)*				*07/03/09 21:29*	*PQ*	*9G03009*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-04RE1 (MW-09-16.75 - Water)							**Sampled: 06/26/09 09:50**		**Recvd: 06/26/09 16:40**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**17000**	D08	400	66	ug/L	400	07/07/09 00:46	CDC	9G06086	8260B
1,2-Dichloroethane-d4	*106 %*	*D08*	*Surr Limits:*	*(66-137%)*			*07/07/09 00:46*	*CDC*	*9G06086*	*8260B*
4-Bromofluorobenzene	*96 %*	*D08*	*Surr Limits:*	*(73-120%)*			*07/07/09 00:46*	*CDC*	*9G06086*	*8260B*
Toluene-d8	*95 %*	*D08*	*Surr Limits:*	*(71-126%)*			*07/07/09 00:46*	*CDC*	*9G06086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-05 (MW-08 - Water)						**Sampled: 06/26/09 11:05**		**Recvd: 06/26/09 16:40**		
Anions by EPA Method 300.0										
Sulfate	ND	D04	20	NR	mg/L	10.0	07/09/09 00:13	BWM	9G09022	300
General Chemistry Parameters										
Nitrate	ND		0.050	NR	mg/L-N	1.00	06/27/09 16:11	JME	9F27024	353.2
Sulfide	ND		0.100	NR	mg/L	1.00	06/29/09 15:00	KLD	9F29075	4500-S D

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1103-06 (MW-09 - Water)							**Sampled: 06/26/09 13:45**		**Recvd: 06/26/09 16:40**	
Anions by EPA Method 300.0										
Sulfate	**55**	D04	20	NR	mg/L	10.0	07/09/09 00:23	BWM	9G09022	300
General Chemistry Parameters										
Nitrate	ND		0.050	NR	mg/L-N	1.00	06/27/09 16:12	JME	9F27024	353.2
Sulfide	ND		0.100	NR	mg/L	1.00	06/29/09 15:00	KLD	9F29075	4500-S D

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SAMPLE EXTRACTION DATA

Parameter	Batch	Lab Number	Wt/Vol Extracte	Units	Extract Volume	Units	Date Prepared	Lab Tech	Extraction Method
Anions by EPA Method 300.0									
300	9G09022	RSF1103-05	5.00	mL	5.00	mL	07/08/09 21:01	BWM	Direct Injection - Anions
300	9G09022	RSF1103-06	5.00	mL	5.00	mL	07/08/09 21:01	BWM	Direct Injection - Anions
General Chemistry Parameters									
353.2	9F27024	RSF1103-05	5.00	mL	5.00	mL	06/27/09 16:05	JME	No prep Nitrate
353.2	9F27024	RSF1103-06	5.00	mL	5.00	mL	06/27/09 16:05	JME	No prep Nitrate
4500-S D	9F29075	RSF1103-05	25.00	mL	25.00	mL	06/29/09 15:00	KLD	No prep Sulfide
4500-S D	9F29075	RSF1103-06	25.00	mL	25.00	mL	06/29/09 15:00	KLD	No prep Sulfide
Volatile Organic Compounds by EPA 8260B									
8260B	9G06086	RSF1103-01RE1	5.00	mL	5.00	mL	07/06/09 18:36	CDC	5030B MS
8260B	9G06086	RSF1103-02RE1	5.00	mL	5.00	mL	07/06/09 18:36	CDC	5030B MS
8260B	9G06086	RSF1103-03RE1	5.00	mL	5.00	mL	07/06/09 18:36	CDC	5030B MS
8260B	9G06086	RSF1103-04RE1	5.00	mL	5.00	mL	07/06/09 18:36	CDC	5030B MS
8260B	9G03009	RSF1103-01	5.00	mL	5.00	mL	07/03/09 10:29	PJQ	5030B MS
8260B	9G03009	RSF1103-02	5.00	mL	5.00	mL	07/03/09 10:29	PJQ	5030B MS
8260B	9G03009	RSF1103-03	5.00	mL	5.00	mL	07/03/09 10:29	PJQ	5030B MS
8260B	9G03009	RSF1103-04	5.00	mL	5.00	mL	07/03/09 10:29	PJQ	5030B MS

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Anions by EPA Method 300.0											
Blank Analyzed: 07/08/09 (Lab Number:9G09022-BLK1, Batch: 9G09022)											
Sulfate			2.0	NR	mg/L	ND					
LCS Analyzed: 07/08/09 (Lab Number:9G09022-BS1, Batch: 9G09022)											
Sulfate		20	2.0	NR	mg/L	21.3	106	90-110			

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
General Chemistry Parameters											
Blank Analyzed: 06/27/09 (Lab Number:9F27024-BLK1, Batch: 9F27024)											
Nitrate			0.050	NR	mg/L-N	ND					
LCS Analyzed: 06/27/09 (Lab Number:9F27024-BS1, Batch: 9F27024)											
Nitrate		1.50	0.050	NR	mg/L-N	1.49	100	90-110			
Duplicate Analyzed: 06/27/09 (Lab Number:9F27024-DUP1, Batch: 9F27024)											
QC Source Sample: RSF1103-06											
Nitrate	ND		0.050	NR	mg/L-N	ND				20	
Matrix Spike Analyzed: 06/27/09 (Lab Number:9F27024-MS1, Batch: 9F27024)											
QC Source Sample: RSF1103-06											
Nitrate	ND	1.00	0.050	NR	mg/L-N	1.03	103	77-123			
General Chemistry Parameters											
Blank Analyzed: 06/29/09 (Lab Number:9F29075-BLK1, Batch: 9F29075)											
Sulfide			0.100	NR	mg/L	ND					
LCS Analyzed: 06/29/09 (Lab Number:9F29075-BS1, Batch: 9F29075)											
Sulfide		0.750	0.100	NR	mg/L	0.712	95	90-110			
Duplicate Analyzed: 06/29/09 (Lab Number:9F29075-DUP1, Batch: 9F29075)											
QC Source Sample: RSF1103-06											
Sulfide	0.0940		0.100	NR	mg/L	0.0920			2	20	
Matrix Spike Analyzed: 06/29/09 (Lab Number:9F29075-MS1, Batch: 9F29075)											
QC Source Sample: RSF1103-06											
Sulfide	0.0940	0.500	0.100	NR	mg/L	0.625	106	40-150			

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/03/09 (Lab Number:9G03009-BLK1, Batch: 9G03009)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*99*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*93*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*94*	*71-126*			
LCS Analyzed: 07/03/09 (Lab Number:9G03009-BS1, Batch: 9G03009)											
Benzene		25	1.0	0.16	ug/L	23.2	93	71-124			
Ethylbenzene			1.0	0.18	ug/L	ND		77-123			
Toluene		25	1.0	0.51	ug/L	22.9	92	70-122			
Xylenes, total			2.0	0.66	ug/L	ND		76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*102*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*95*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*96*	*71-126*			
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/06/09 (Lab Number:9G06086-BLK1, Batch: 9G06086)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*108*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*99*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*99*	*71-126*			
LCS Analyzed: 07/06/09 (Lab Number:9G06086-BS1, Batch: 9G06086)											
Benzene		25	NA		ug/L	22.8	91	71-124			
Ethylbenzene			1.0	0.18	ug/L	ND		77-123			
Toluene		25	NA		ug/L	22.2	89	70-122			
Xylenes, total			2.0	0.66	ug/L	ND		76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*98*	*66-137*			

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
LCS Analyzed: 07/06/09 (Lab Number:9G06086-BS1, Batch: 9G06086)											
Surrogate: 4-Bromofluorobenzene					*ug/L*		*94*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*93*	*71-126*			
Matrix Spike Analyzed: 07/07/09 (Lab Number:9G06086-MS1, Batch: 9G06086)											
QC Source Sample: RSF1103-01RE1											
Benzene	6850	2500	NA		ug/L	8190	54	71-124			D08,M8
Ethylbenzene	ND		100	18	ug/L	ND		77-123			D08
Toluene	ND	2500	NA		ug/L	2190	87	70-122			D08
Xylenes, total	ND		200	66	ug/L	ND		76-122			D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*106*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*94*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*93*	*71-126*			*D08*
Matrix Spike Dup Analyzed: 07/07/09 (Lab Number:9G06086-MSD1, Batch: 9G06086)											
QC Source Sample: RSF1103-01RE1											
Benzene	6850	2500	NA		ug/L	8420	63	71-124	3	13	D08,M8
Ethylbenzene	ND		100	18	ug/L	ND		77-123		15	D08
Toluene	ND	2500	NA		ug/L	2220	89	70-122	1	15	D08
Xylenes, total	ND		200	66	ug/L	ND		76-122		16	D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*106*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*92*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*93*	*71-126*			*D08*

CHAIN OF CUSTODY RECORD

№ 001649

Project Number:	Site and Location:
080190/7	QLT Buffalo, NY

Contact Name:	Contact Email:
Erin Huntley	Erin.Huntley@wspgroup.com

Sampler's Name:	Sampler's Signature:
Erin Huntley Karen Belson	Karen Belson

Matrices:
S = Soil:
Aq = Water
A = Air; Bu = Bulk:
W = Wipe
Bi = Biota;
OW = Oily Waste:
O = Other

Requested Analyses

Sample Identification:	Date	Time	Matrix	Number of Containers	BTEX (8260)	Nitrate, SO4	Sulfide	Remarks
MW-09-7	6/26/09	0935	AQ	3	X			
MW-09-10.25	6/26/09	0940	AQ	3	X			
~~MW-09-16.75~~		~~0945~~	~~AQ~~	~~3~~				
MW-09-13.5	6/26/09	0945	AQ	3	X			
MW-09-16.75	6/26/09	0950	AQ	3	X			
MW-08	6/26/09	1105	AQ	2		X	X	
MW-09	6/26/09	1345	AQ	2		X	X	

Relinquished by (Signature):	Date / Time	Received by (Signature):	Laboratory Name:
Karen Belson	6/26/09 1640	6/26/09 16:40	Test America
Relinquished by (Signature):	Date / Time	Received by (Signature):	Laboratory Location: Buffalo, NY
			Custody Seal Numbers:
Turn-Around Time: Standard		Tracking Number: —	Method of Shipment: Drop off

WSP
ENVIRONMENTAL STRATEGIES

☐ Reston Office: 11911 Freedom Dr, # 900, Reston, VA 20190
Tel: (703) 709-6500, Fax: (703) 709-8505

☒ Pittsburgh Office: 750 Holiday Dr., #410, Pittsburgh, PA 15220
Tel: (412) 604-1040, Fax: (412) 604-1055

☐ Denver Office: 4600 South Ulster, # 930, Denver, CO 80237
Tel: (303) 850-9200, Fax: (303) 850-9214

☐ Minneapolis Office: 123 North 3rd St, #706, Minneapolis, MN 55401
Tel: (612) 343-0510, Fax: (612) 343-0506

20°C

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

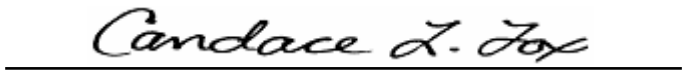
Analytical Report

Work Order: RSF1192

Project Description
Environmental Strategies Corporation

For:

Glen Rieger
WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220



Candace Fox
Project Manager
candace.fox@testamericainc.com

Thursday, July 9, 2009

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1192

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/30/09
Reported: 07/09/09 10:43

TestAmerica Buffalo
Current Certifications

As of 1/27/2009

STATE	Program	Cert # / Lab ID
Arkansas	CWA, RCRA, SOIL	88-0686
California*	NELAP CWA, RCRA	01169CA
Connecticut	SDWA, CWA, RCRA, SOIL	PH-0568
Florida*	NELAP CWA, RCRA	E87672
Georgia*	SDWA,NELAP CWA, RCRA	956
Illinois*	NELAP SDWA, CWA, RCRA	200003
Iowa	SW/CS	374
Kansas*	NELAP SDWA, CWA, RCRA	E-10187
Kentucky	SDWA	90029
Kentucky UST	UST	30
Louisiana*	NELAP CWA, RCRA	2031
Maine	SDWA, CWA	NY0044
Maryland	SDWA	294
Massachusetts	SDWA, CWA	M-NY044
Michigan	SDWA	9937
Minnesota	SDWA,CWA, RCRA	036-999-337
New Hampshire*	NELAP SDWA, CWA	233701
New Jersey*	NELAP,SDWA, CWA, RCRA,	NY455
New York*	NELAP, AIR, SDWA, CWA, RCRA,CLP	10026
Oklahoma	CWA, RCRA	9421
Pennsylvania*	NELAP CWA,RCRA	68-00281
Tennessee	SDWA	02970
Texas*	NELAP CWA, RCRA	T10470441208-TX
USDA	FOREIGN SOIL PERMIT	S-41579
USDOE	Department of Energy	DOECAP-STB
Virginia	SDWA	278
Washington*	NELAP CWA,RCRA	C1677
Wisconsin	CWA, RCRA	998310390
West Virginia	CWA,RCRA	252

*As required under the indicated accreditation, the test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report.

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Case Narrative

According to 40CFR Part 136.3, pH, Chlorine Residual, Dissolved Oxygen, Sulfite, and Temperature analyses are to be performed immediately after aqueous sample collection. When these parameters are not indicated as field (e.g. field-pH), they were not analyzed immediately, but as soon as possible after laboratory receipt.

A pertinent document is appended to this report, 1 page, is included and is an integral part of this report.

TestAmerica Laboratories, Inc. certifies that the analytical results contained herein apply only to the samples tested as received by our Laboratory.

WSP Environmental Strategies - Reston, VA
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DATA QUALIFIERS AND DEFINITIONS

D08	Dilution required due to high concentration of target analyte(s)
J	Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). Concentrations within this range are estimated.
P11	Sample was not sufficiently preserved at time of collection. Sample pH is >2
S13	Due to the amount of sediment present in the sample vials, volumes from two or more separate vials were combined for analysis.
Z	Due to sample matrix effects, the surrogate recovery was below the acceptance limits.
NR	Any inclusion of NR indicates that the project specific requirements do not require reporting estimated values below the laboratory reporting limit.

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Sample Summary

Sample Identification	Lab Number	Client Matrix	Date/Time Sampled	Date/Time Received	Sample Qualifiers
DP-09-01 (14-19)	RSF1192-01	Water	06/29/09 11:15	06/30/09 17:00	
DP-09-03 (13-18)	RSF1192-02	Water	06/29/09 12:20	06/30/09 17:00	
DP-09-07 (14-19)	RSF1192-03	Water	06/29/09 15:20	06/30/09 17:00	
DP-09-10 (12.5-17.5)	RSF1192-04	Water	06/29/09 16:50	06/30/09 17:00	
DP-09-09 (14-19)	RSF1192-05	Water	06/30/09 07:40	06/30/09 17:00	
DP-09-08 (14-19)	RSF1192-06	Water	06/30/09 10:30	06/30/09 17:00	
DP-09-11 (15-20)	RSF1192-07	Water	06/30/09 12:45	06/30/09 17:00	
DP-09-12 (15-20)	RSF1192-08	Water	06/30/09 14:00	06/30/09 17:00	
DP-09-06 (14-19)	RSF1192-09	Water	06/30/09 15:20	06/30/09 17:00	
TB063009	RSF1192-10	Water	06/29/09	06/30/09 17:00	

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-01 (DP-09-01 (14-19) - Water)							**Sampled: 06/29/09 11:15**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**29**		1.0	0.18	ug/L	1.00	07/06/09 22:26	NMD	9G06096	8260B
Toluene	**7.7**		1.0	0.51	ug/L	1.00	07/06/09 22:26	NMD	9G06096	8260B
Xylenes, total	**44**		2.0	0.66	ug/L	1.00	07/06/09 22:26	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*24 %*	*Z*	*Surr Limits: (66-137%)*				*07/06/09 22:26*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*99 %*		*Surr Limits: (73-120%)*				*07/06/09 22:26*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*102 %*		*Surr Limits: (71-126%)*				*07/06/09 22:26*	*NMD*	*9G06096*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-01RE1 (DP-09-01 (14-19) - Water)							**Sampled: 06/29/09 11:15**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**11000**	D08	200	33	ug/L	200	07/08/09 12:38	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*113 %*	*D08*	*Surr Limits:*	*(66-137%)*			*07/08/09 12:38*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*98 %*	*D08*	*Surr Limits:*	*(73-120%)*			*07/08/09 12:38*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*99 %*	*D08*	*Surr Limits:*	*(71-126%)*			*07/08/09 12:38*	*DHC*	*9G07086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-02 (DP-09-03 (13-18) - Water)						**Sampled: 06/29/09 12:20**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**20**	S13, P11	1.0	0.18	ug/L	1.00	07/06/09 22:50	NMD	9G06096	8260B
Toluene	**4.0**	S13, P11	1.0	0.51	ug/L	1.00	07/06/09 22:50	NMD	9G06096	8260B
Xylenes, total	**38**	S13, P11	2.0	0.66	ug/L	1.00	07/06/09 22:50	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*38 %*	*S13, P11,Z*	*Surr Limits: (66-137%)*				*07/06/09 22:50*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*102 %*	*S13, P11*	*Surr Limits: (73-120%)*				*07/06/09 22:50*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*100 %*	*S13, P11*	*Surr Limits: (71-126%)*				*07/06/09 22:50*	*NMD*	*9G06096*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-02RE1 (DP-09-03 (13-18) - Water)							**Sampled: 06/29/09 12:20**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**3800**	D08, P11	40	6.6	ug/L	40.0	07/07/09 12:00	DHC	9G07008	8260B
1,2-Dichloroethane-d4	*113 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/07/09 12:00*	*DHC*	*9G07008*	*8260B*
4-Bromofluorobenzene	*101 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/07/09 12:00*	*DHC*	*9G07008*	*8260B*
Toluene-d8	*102 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/07/09 12:00*	*DHC*	*9G07008*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-03 (DP-09-07 (14-19) - Water)						**Sampled: 06/29/09 15:20**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Toluene	**3.8**	S13, P11	1.0	0.51	ug/L	1.00	07/06/09 23:15	NMD	9G06096	8260B
Xylenes, total	**120**	S13, P11	2.0	0.66	ug/L	1.00	07/06/09 23:15	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*64 %*	*S13, P11,Z*	*Surr Limits:*	*(66-137%)*			*07/06/09 23:15*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*102 %*	*S13, P11*	*Surr Limits:*	*(73-120%)*			*07/06/09 23:15*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*102 %*	*S13, P11*	*Surr Limits:*	*(71-126%)*			*07/06/09 23:15*	*NMD*	*9G06096*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-03RE1 (DP-09-07 (14-19) - Water)						**Sampled: 06/29/09 15:20**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Benzene	**1400**	D08, P11	40	6.6	ug/L	40.0	07/08/09 13:03	DHC	9G07086	8260B
Ethylbenzene	**48**	D08, P11	40	7.4	ug/L	40.0	07/08/09 13:03	DHC	9G07086	8260B
Xylenes, total	**40**	D08, P11,J	80	26	ug/L	40.0	07/08/09 13:03	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*111 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 13:03*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*97 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 13:03*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*100 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 13:03*	*DHC*	*9G07086*	*8260B*

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Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-04 (DP-09-10 (12.5-17.5) - Water)						**Sampled: 06/29/09 16:50**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**35**		1.0	0.18	ug/L	1.00	07/06/09 23:39	NMD	9G06096	8260B
Toluene	**3.4**		1.0	0.51	ug/L	1.00	07/06/09 23:39	NMD	9G06096	8260B
Xylenes, total	**17**		2.0	0.66	ug/L	1.00	07/06/09 23:39	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*75 %*		*Surr Limits: (66-137%)*				*07/06/09 23:39*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*99 %*		*Surr Limits: (73-120%)*				*07/06/09 23:39*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*100 %*		*Surr Limits: (71-126%)*				*07/06/09 23:39*	*NMD*	*9G06096*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-04RE1 (DP-09-10 (12.5-17.5) - Water)							**Sampled: 06/29/09 16:50**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**1300**	D08	20	3.3	ug/L	20.0	07/08/09 13:27	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*115 %*	*D08*	*Surr Limits: (66-137%)*				*07/08/09 13:27*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*98 %*	*D08*	*Surr Limits: (73-120%)*				*07/08/09 13:27*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*101 %*	*D08*	*Surr Limits: (71-126%)*				*07/08/09 13:27*	*DHC*	*9G07086*	*8260B*

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Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-05 (DP-09-09 (14-19) - Water)						**Sampled: 06/30/09 07:40**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**2.2**	P11	1.0	0.18	ug/L	1.00	07/07/09 00:04	NMD	9G06096	8260B
Toluene	**1.1**	P11	1.0	0.51	ug/L	1.00	07/07/09 00:04	NMD	9G06096	8260B
Xylenes, total	**0.88**	P11,J	2.0	0.66	ug/L	1.00	07/07/09 00:04	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*61 %*	*P11,Z*	*Surr Limits: (66-137%)*				*07/07/09 00:04*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*99 %*	*P11*	*Surr Limits: (73-120%)*				*07/07/09 00:04*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*100 %*	*P11*	*Surr Limits: (71-126%)*				*07/07/09 00:04*	*NMD*	*9G06096*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-05RE1 (DP-09-09 (14-19) - Water)							**Sampled: 06/30/09 07:40**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**3600**	D08, P11	40	6.6	ug/L	40.0	07/08/09 13:52	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*112 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 13:52*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*97 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 13:52*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*100 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 13:52*	*DHC*	*9G07086*	*8260B*

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Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-06 (DP-09-08 (14-19) - Water)							**Sampled: 06/30/09 10:30**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**30**	S13, P11	1.0	0.18	ug/L	1.00	07/07/09 00:28	NMD	9G06096	8260B
Toluene	**6.3**	S13, P11	1.0	0.51	ug/L	1.00	07/07/09 00:28	NMD	9G06096	8260B
Xylenes, total	**15**	S13, P11	2.0	0.66	ug/L	1.00	07/07/09 00:28	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*31 %*	*S13, P11,Z*	*Surr Limits: (66-137%)*				*07/07/09 00:28*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*100 %*	*S13, P11*	*Surr Limits: (73-120%)*				*07/07/09 00:28*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*101 %*	*S13, P11*	*Surr Limits: (71-126%)*				*07/07/09 00:28*	*NMD*	*9G06096*	*8260B*

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Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-06RE1 (DP-09-08 (14-19) - Water)							**Sampled: 06/30/09 10:30**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**3700**	D08, P11	80	13	ug/L	80.0	07/08/09 14:17	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*116 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 14:17*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*101 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 14:17*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*103 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 14:17*	*DHC*	*9G07086*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSF1192

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 06/30/09
Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-07 (DP-09-11 (15-20) - Water)						**Sampled: 06/30/09 12:45**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	ND	S13, P11	1.0	0.18	ug/L	1.00	07/07/09 00:53	NMD	9G06096	8260B
Toluene	**0.82**	S13, P11,J	1.0	0.51	ug/L	1.00	07/07/09 00:53	NMD	9G06096	8260B
Xylenes, total	ND	S13, P11	2.0	0.66	ug/L	1.00	07/07/09 00:53	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*71 %*	*S13, P11*	*Surr Limits: (66-137%)*				*07/07/09 00:53*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*97 %*	*S13, P11*	*Surr Limits: (73-120%)*				*07/07/09 00:53*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*99 %*	*S13, P11*	*Surr Limits: (71-126%)*				*07/07/09 00:53*	*NMD*	*9G06096*	*8260B*

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Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-07RE1 (DP-09-11 (15-20) - Water)							**Sampled: 06/30/09 12:45**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**950**	D08, P11	20	3.3	ug/L	20.0	07/08/09 14:41	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*117 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 14:41*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*100 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 14:41*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*103 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 14:41*	*DHC*	*9G07086*	*8260B*

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Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-08 (DP-09-12 (15-20) - Water)						**Sampled: 06/30/09 14:00**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	ND	S13, P11	1.0	0.18	ug/L	1.00	07/07/09 01:17	NMD	9G06096	8260B
Toluene	ND	S13, P11	1.0	0.51	ug/L	1.00	07/07/09 01:17	NMD	9G06096	8260B
Xylenes, total	ND	S13, P11	2.0	0.66	ug/L	1.00	07/07/09 01:17	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*79 %*	*S13, P11*	*Surr Limits: (66-137%)*				*07/07/09 01:17*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*99 %*	*S13, P11*	*Surr Limits: (73-120%)*				*07/07/09 01:17*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*101 %*	*S13, P11*	*Surr Limits: (71-126%)*				*07/07/09 01:17*	*NMD*	*9G06096*	*8260B*

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Project Number: ESC-0001

Received: 06/30/09
Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-08RE1 (DP-09-12 (15-20) - Water)							**Sampled: 06/30/09 14:00**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**1300**	D08, P11	20	3.3	ug/L	20.0	07/07/09 14:28	DHC	9G07008	8260B
1,2-Dichloroethane-d4	*111 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/07/09 14:28*	*DHC*	*9G07008*	*8260B*
4-Bromofluorobenzene	*97 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/07/09 14:28*	*DHC*	*9G07008*	*8260B*
Toluene-d8	*98 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/07/09 14:28*	*DHC*	*9G07008*	*8260B*

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Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-09 (DP-09-06 (14-19) - Water)						**Sampled: 06/30/09 15:20**		**Recvd: 06/30/09 17:00**		
Volatile Organic Compounds by EPA 8260B										
Ethylbenzene	**84**	S13, P11	1.0	0.18	ug/L	1.00	07/07/09 01:42	NMD	9G06096	8260B
Toluene	**10**	S13, P11	1.0	0.51	ug/L	1.00	07/07/09 01:42	NMD	9G06096	8260B
Xylenes, total	**81**	S13, P11	2.0	0.66	ug/L	1.00	07/07/09 01:42	NMD	9G06096	8260B
1,2-Dichloroethane-d4	*6 %*	*S13, P11,Z*	*Surr Limits: (66-137%)*				*07/07/09 01:42*	*NMD*	*9G06096*	*8260B*
4-Bromofluorobenzene	*98 %*	*S13, P11*	*Surr Limits: (73-120%)*				*07/07/09 01:42*	*NMD*	*9G06096*	*8260B*
Toluene-d8	*100 %*	*S13, P11*	*Surr Limits: (71-126%)*				*07/07/09 01:42*	*NMD*	*9G06096*	*8260B*

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Reported: 07/09/09 10:43

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-09RE1 (DP-09-06 (14-19) - Water)							**Sampled: 06/30/09 15:20**		**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**9600**	D08, P11	200	33	ug/L	200	07/08/09 15:06	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*114 %*	*D08, P11*	*Surr Limits:*	*(66-137%)*			*07/08/09 15:06*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*97 %*	*D08, P11*	*Surr Limits:*	*(73-120%)*			*07/08/09 15:06*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*100 %*	*D08, P11*	*Surr Limits:*	*(71-126%)*			*07/08/09 15:06*	*DHC*	*9G07086*	*8260B*

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Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSF1192-10 (TB063009 - Water)						**Sampled: 06/29/09**			**Recvd: 06/30/09 17:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**0.84**	J	1.0	0.16	ug/L	1.00	07/07/09 15:17	DHC	9G07008	8260B
Ethylbenzene	ND		1.0	0.18	ug/L	1.00	07/07/09 15:17	DHC	9G07008	8260B
Toluene	ND		1.0	0.51	ug/L	1.00	07/07/09 15:17	DHC	9G07008	8260B
Xylenes, total	ND		2.0	0.66	ug/L	1.00	07/07/09 15:17	DHC	9G07008	8260B
1,2-Dichloroethane-d4	*123 %*		*Surr Limits: (66-137%)*				*07/07/09 15:17*	*DHC*	*9G07008*	*8260B*
4-Bromofluorobenzene	*99 %*		*Surr Limits: (73-120%)*				*07/07/09 15:17*	*DHC*	*9G07008*	*8260B*
Toluene-d8	*102 %*		*Surr Limits: (71-126%)*				*07/07/09 15:17*	*DHC*	*9G07008*	*8260B*

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Reported: 07/09/09 10:43

SAMPLE EXTRACTION DATA

Parameter	Batch	Lab Number	Wt/Vol Extracte	Units	Extract Volume	Units	Date Prepared	Lab Tech	Extraction Method
Volatile Organic Compounds by EPA 8260B									
8260B	9G07008	RSF1192-10	5.00	mL	5.00	mL	07/07/09 10:24	DHC	5030B MS
8260B	9G06096	RSF1192-01	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-02	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G07008	RSF1192-02RE1	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-03	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-04	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-05	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-06	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-07	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-08	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G07008	RSF1192-08RE1	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G06096	RSF1192-09	5.00	mL	5.00	mL	07/06/09 19:10	NMD	5030B MS
8260B	9G07086	RSF1192-01RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-03RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-04RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-05RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-06RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-07RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSF1192-09RE1	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS

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Work Order: RSF1192

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Reported: 07/09/09 10:43

LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/06/09 (Lab Number:9G06096-BLK1, Batch: 9G06096)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*116*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*98*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*99*	*71-126*			
LCS Analyzed: 07/06/09 (Lab Number:9G06096-BS1, Batch: 9G06096)											
Benzene		25	1.0	0.16	ug/L	25.8	103	71-124			
Ethylbenzene			1.0	0.18	ug/L	ND		77-123			
Toluene		25	1.0	0.51	ug/L	23.9	96	70-122			
Xylenes, total			2.0	0.66	ug/L	ND		76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*117*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*101*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*102*	*71-126*			
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/07/09 (Lab Number:9G07008-BLK1, Batch: 9G07008)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*120*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*100*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*103*	*71-126*			
LCS Analyzed: 07/07/09 (Lab Number:9G07008-BS1, Batch: 9G07008)											
Benzene		25	1.0	0.16	ug/L	25.2	101	71-124			
Ethylbenzene			1.0	0.18	ug/L	ND		77-123			
Toluene		25	1.0	0.51	ug/L	23.3	93	70-122			
Xylenes, total			2.0	0.66	ug/L	ND		76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*114*	*66-137*			

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
LCS Analyzed: 07/07/09 (Lab Number:9G07008-BS1, Batch: 9G07008)											
Surrogate: 4-Bromofluorobenzene					*ug/L*		*99*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*100*	*71-126*			
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/08/09 (Lab Number:9G07086-BLK1, Batch: 9G07086)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*117*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*98*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*100*	*71-126*			
LCS Analyzed: 07/08/09 (Lab Number:9G07086-BS1, Batch: 9G07086)											
Benzene		25	1.0	0.16	ug/L	25.4	101	71-124			
Ethylbenzene		25	1.0	0.18	ug/L	24.0	96	77-123			
Toluene		25	1.0	0.51	ug/L	23.5	94	70-122			
Xylenes, total		75	2.0	0.66	ug/L	71.5	95	76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*108*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*101*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*97*	*71-126*			
Matrix Spike Analyzed: 07/08/09 (Lab Number:9G07086-MS1, Batch: 9G07086)											
QC Source Sample: RSF1192-09RE1											
Benzene	9580	5000	200	33	ug/L	13700	82	71-124			D08
Ethylbenzene	ND		200	37	ug/L	ND		77-123			D08
Toluene	ND	5000	200	100	ug/L	5200	104	70-122			D08
Xylenes, total	ND		400	130	ug/L	ND		76-122			D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*113*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*97*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*99*	*71-126*			*D08*
Matrix Spike Dup Analyzed: 07/08/09 (Lab Number:9G07086-MSD1, Batch: 9G07086)											
QC Source Sample: RSF1192-09RE1											
Benzene	9580	5000	200	33	ug/L	13800	85	71-124	1	13	D08

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LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
Matrix Spike Dup Analyzed: 07/08/09 (Lab Number:9G07086-MSD1, Batch: 9G07086)											
QC Source Sample: RSF1192-09RE1											
Ethylbenzene	ND		200	37	ug/L	ND		77-123		15	D08
Toluene	ND	5000	200	100	ug/L	5140	103	70-122	1	15	D08
Xylenes, total	ND		400	130	ug/L	ND		76-122		16	D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*115*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*101*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*103*	*71-126*			*D08*

Chain of Custody Record

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124 (1007)

Client	Project Manager	Date	Chain of Custody Number
WSP Environment & Energy	Erin Huntley / Glen Bieger	6/30/09	160986
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
750 Holiday Drive, Ste 410	(412) 1004-1040		
City / State / Zip Code	**Site Contact**	**Lab Contact**	
Pittsburg / PA / 15220	Heather Usle	Candace Fox	
Project Name and Location (State)	**Carrier/Waybill Number**		
QLT-Buffalo, Buffalo, NY	SELF		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: BTEX (8260B)	Special Instructions/ Conditions of Receipt
DP-09-01 (14'-19')	6/29/09	11:15		X						X			X	Samples on wet ice
DP-09-03 (13'-18')		12:20		X						X			X	
DP-09-07 (14'-19')		15:20		X						X			X	
DP-09-10 (12.5-17.5')		16:50		X						X			X	
DP-09-09 (14'-19')	6/30/09	7:40		X						X			X	
DP-09-08 (14'-19')	6/30/09	10:30		X						X			X	
DP-09-11 (15'-20')		12:45		X						X			X	
DP-09-12 (15'-20')		14:00		X						X			X	
DP-09-06 (14'-19')		15:20		X						X			X	
~~DB060309~~				X						X			X	
END														

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☒ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	6/30/09	17:00	1. Received By	6/30/09	1700
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

20°

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

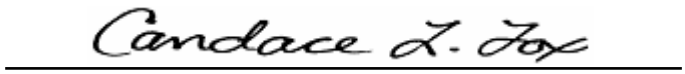
Analytical Report

Work Order: RSG0072

Project Description
Environmental Strategies Corporation

For:

Glen Rieger
WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220



Candace Fox
Project Manager
candace.fox@testamericainc.com

Thursday, July 9, 2009

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

TestAmerica Buffalo
Current Certifications

As of 1/27/2009

STATE	Program	Cert # / Lab ID
Arkansas	CWA, RCRA, SOIL	88-0686
California*	NELAP CWA, RCRA	01169CA
Connecticut	SDWA, CWA, RCRA, SOIL	PH-0568
Florida*	NELAP CWA, RCRA	E87672
Georgia*	SDWA,NELAP CWA, RCRA	956
Illinois*	NELAP SDWA, CWA, RCRA	200003
Iowa	SW/CS	374
Kansas*	NELAP SDWA, CWA, RCRA	E-10187
Kentucky	SDWA	90029
Kentucky UST	UST	30
Louisiana*	NELAP CWA, RCRA	2031
Maine	SDWA, CWA	NY0044
Maryland	SDWA	294
Massachusetts	SDWA, CWA	M-NY044
Michigan	SDWA	9937
Minnesota	SDWA,CWA, RCRA	036-999-337
New Hampshire*	NELAP SDWA, CWA	233701
New Jersey*	NELAP,SDWA, CWA, RCRA,	NY455
New York*	NELAP, AIR, SDWA, CWA, RCRA,CLP	10026
Oklahoma	CWA, RCRA	9421
Pennsylvania*	NELAP CWA,RCRA	68-00281
Tennessee	SDWA	02970
Texas*	NELAP CWA, RCRA	T10470441208-TX
USDA	FOREIGN SOIL PERMIT	S-41579
USDOE	Department of Energy	DOECAP-STB
Virginia	SDWA	278
Washington*	NELAP CWA,RCRA	C1677
Wisconsin	CWA, RCRA	998310390
West Virginia	CWA,RCRA	252

*As required under the indicated accreditation, the test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report.

WSP Environmental Strategies - Reston, VA
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Work Order: RSG0072

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Received: 07/01/09
Reported: 07/09/09 17:02

Case Narrative

According to 40CFR Part 136.3, pH, Chlorine Residual, Dissolved Oxygen, Sulfite, and Temperature analyses are to be performed immediately after aqueous sample collection. When these parameters are not indicated as field (e.g. field-pH), they were not analyzed immediately, but as soon as possible after laboratory receipt.

A pertinent document is appended to this report, 1 page, is included and is an integral part of this report.

TestAmerica Laboratories, Inc. certifies that the analytical results contained herein apply only to the samples tested as received by our Laboratory.

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

DATA QUALIFIERS AND DEFINITIONS

D08	Dilution required due to high concentration of target analyte(s)
D11	insufficient volume for lower dilution
E	Concentration exceeds the calibration range and therefore result is semi-quantitative.
J	Analyte detected at a level less than the Reporting Limit (RL) and greater than or equal to the Method Detection Limit (MDL). Concentrations within this range are estimated.
P11	Sample was not sufficiently preserved at time of collection. Sample pH is >2
P6	Sample received unpreserved, however the sample was analyzed within 7 days per EPA recommendation.
NR	Any inclusion of NR indicates that the project specific requirements do not require reporting estimated values below the laboratory reporting limit.

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Sample Summary

Sample Identification	Lab Number	Client Matrix	Date/Time Sampled	Date/Time Received	Sample Qualifiers
DP-09-02 (14.5-19.5)	RSG0072-01	Water	07/01/09 08:30	07/01/09 18:00	
DP-09-13 (14.5-19.5)	RSG0072-02	Water	07/01/09 10:50	07/01/09 18:00	
DP-09-14 (16-20)	RSG0072-03	Water	07/01/09 09:10	07/01/09 18:00	
TB070109	RSG0072-04	Water	07/01/09	07/01/09 18:00	

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSG0072-01 (DP-09-02 (14.5-19.5) - Water)							**Sampled: 07/01/09 08:30**		**Recvd: 07/01/09 18:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**8800**	D08, P6,E	20	3.3	ug/L	20.0	07/08/09 15:55	DHC	9G07086	8260B
Ethylbenzene	**34**	D08, P6	20	3.7	ug/L	20.0	07/08/09 15:55	DHC	9G07086	8260B
Toluene	ND	D08, P6	20	10	ug/L	20.0	07/08/09 15:55	DHC	9G07086	8260B
Xylenes, total	**25**	D08, P6,J	40	13	ug/L	20.0	07/08/09 15:55	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*102 %*	*D08, P6*	*Surr Limits: (66-137%)*				*07/08/09 15:55*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*100 %*	*D08, P6*	*Surr Limits: (73-120%)*				*07/08/09 15:55*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*101 %*	*D08, P6*	*Surr Limits: (71-126%)*				*07/08/09 15:55*	*DHC*	*9G07086*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSG0072-01RE1 (DP-09-02 (14.5-19.5) - Water)							**Sampled: 07/01/09 08:30**		**Recvd: 07/01/09 18:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**7600**	D08, P11	100	16	ug/L	100	07/08/09 23:00	NMD	9G08102	8260B
Ethylbenzene	ND	D08, P11	100	18	ug/L	100	07/08/09 23:00	NMD	9G08102	8260B
Toluene	ND	D08, P11	100	51	ug/L	100	07/08/09 23:00	NMD	9G08102	8260B
Xylenes, total	ND	D08, P11	200	66	ug/L	100	07/08/09 23:00	NMD	9G08102	8260B
1,2-Dichloroethane-d4	*110 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 23:00*	*NMD*	*9G08102*	*8260B*
4-Bromofluorobenzene	*96 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 23:00*	*NMD*	*9G08102*	*8260B*
Toluene-d8	*101 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 23:00*	*NMD*	*9G08102*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSG0072-02 (DP-09-13 (14.5-19.5) - Water)							**Sampled: 07/01/09 10:50**		**Recvd: 07/01/09 18:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	**120**	D08, D11, P11	5.0	0.82	ug/L	5.00	07/08/09 23:25	NMD	9G08102	8260B
Ethylbenzene	**4.0**	D08, D11, P11,J	5.0	0.92	ug/L	5.00	07/08/09 23:25	NMD	9G08102	8260B
Toluene	ND	D08, D11, P11	5.0	2.6	ug/L	5.00	07/08/09 23:25	NMD	9G08102	8260B
Xylenes, total	ND	D08, D11, P11	10	3.3	ug/L	5.00	07/08/09 23:25	NMD	9G08102	8260B
1,2-Dichloroethane-d4	*117 %*	*D08, D11, P11*	*Surr Limits: (66-137%)*				*07/08/09 23:25*	*NMD*	*9G08102*	*8260B*
4-Bromofluorobenzene	*100 %*	*D08, D11, P11*	*Surr Limits: (73-120%)*				*07/08/09 23:25*	*NMD*	*9G08102*	*8260B*
Toluene-d8	*102 %*	*D08, D11, P11*	*Surr Limits: (71-126%)*				*07/08/09 23:25*	*NMD*	*9G08102*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSG0072-03 (DP-09-14 (16-20) - Water)						**Sampled: 07/01/09 09:10**		**Recvd: 07/01/09 18:00**		
Volatile Organic Compounds by EPA 8260B										
Benzene	**360**	D08, P11	5.0	0.82	ug/L	5.00	07/08/09 23:49	NMD	9G08102	8260B
Ethylbenzene	**22**	D08, P11	5.0	0.92	ug/L	5.00	07/08/09 23:49	NMD	9G08102	8260B
Toluene	**21**	D08, P11	5.0	2.6	ug/L	5.00	07/08/09 23:49	NMD	9G08102	8260B
Xylenes, total	**50**	D08, P11	10	3.3	ug/L	5.00	07/08/09 23:49	NMD	9G08102	8260B
1,2-Dichloroethane-d4	*107 %*	*D08, P11*	*Surr Limits: (66-137%)*				*07/08/09 23:49*	*NMD*	*9G08102*	*8260B*
4-Bromofluorobenzene	*98 %*	*D08, P11*	*Surr Limits: (73-120%)*				*07/08/09 23:49*	*NMD*	*9G08102*	*8260B*
Toluene-d8	*101 %*	*D08, P11*	*Surr Limits: (71-126%)*				*07/08/09 23:49*	*NMD*	*9G08102*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

Analytical Report

Analyte	Sample Result	Data Qualifiers	RL	MDL	Units	Dil Fac	Date Analyzed	Lab Tech	Batch	Method
Sample ID: RSG0072-04 (TB070109 - Water)						**Sampled: 07/01/09**			**Recvd: 07/01/09 18:00**	
Volatile Organic Compounds by EPA 8260B										
Benzene	ND		1.0	0.16	ug/L	1.00	07/08/09 17:09	DHC	9G07086	8260B
Ethylbenzene	ND		1.0	0.18	ug/L	1.00	07/08/09 17:09	DHC	9G07086	8260B
Toluene	ND		1.0	0.51	ug/L	1.00	07/08/09 17:09	DHC	9G07086	8260B
Xylenes, total	ND		2.0	0.66	ug/L	1.00	07/08/09 17:09	DHC	9G07086	8260B
1,2-Dichloroethane-d4	*118 %*		*Surr Limits: (66-137%)*				*07/08/09 17:09*	*DHC*	*9G07086*	*8260B*
4-Bromofluorobenzene	*102 %*		*Surr Limits: (73-120%)*				*07/08/09 17:09*	*DHC*	*9G07086*	*8260B*
Toluene-d8	*103 %*		*Surr Limits: (71-126%)*				*07/08/09 17:09*	*DHC*	*9G07086*	*8260B*

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

SAMPLE EXTRACTION DATA

Parameter	Batch	Lab Number	Wt/Vol Extracte	Units	Extract Volume	Units	Date Prepared	Lab Tech	Extraction Method
Volatile Organic Compounds by EPA 8260B									
8260B	9G07086	RSG0072-01	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G07086	RSG0072-04	5.00	mL	5.00	mL	07/07/09 17:54	NMD	5030B MS
8260B	9G08102	RSG0072-01RE	5.00	mL	5.00	mL	07/08/09 19:41	NMD	5030B MS
8260B	9G08102	RSG0072-02	5.00	mL	5.00	mL	07/08/09 19:41	NMD	5030B MS
8260B	9G08102	RSG0072-03	5.00	mL	5.00	mL	07/08/09 19:41	NMD	5030B MS

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/08/09 (Lab Number:9G07086-BLK1, Batch: 9G07086)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*117*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*98*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*100*	*71-126*			
LCS Analyzed: 07/08/09 (Lab Number:9G07086-BS1, Batch: 9G07086)											
Benzene		25	1.0	0.16	ug/L	25.4	101	71-124			
Ethylbenzene		25	1.0	0.18	ug/L	24.0	96	77-123			
Toluene		25	1.0	0.51	ug/L	23.5	94	70-122			
Xylenes, total		75	2.0	0.66	ug/L	71.5	95	76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*108*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*101*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*97*	*71-126*			
Volatile Organic Compounds by EPA 8260B											
Blank Analyzed: 07/08/09 (Lab Number:9G08102-BLK1, Batch: 9G08102)											
Benzene			1.0	0.16	ug/L	ND					
Ethylbenzene			1.0	0.18	ug/L	ND					
Toluene			1.0	0.51	ug/L	ND					
Xylenes, total			2.0	0.66	ug/L	ND					
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*112*	*66-137*			
Surrogate: 4-Bromofluorobenzene					*ug/L*		*94*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*98*	*71-126*			
LCS Analyzed: 07/08/09 (Lab Number:9G08102-BS1, Batch: 9G08102)											
Benzene		25	1.0	0.16	ug/L	24.7	99	71-124			
Ethylbenzene			1.0	0.18	ug/L	ND		77-123			
Toluene		25	1.0	0.51	ug/L	23.0	92	70-122			
Xylenes, total			2.0	0.66	ug/L	ND		76-122			
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*114*	*66-137*			

WSP Environmental Strategies - Reston, VA
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

Work Order: RSG0072

Project: Environmental Strategies Corporation
Project Number: ESC-0001

Received: 07/01/09
Reported: 07/09/09 17:02

LABORATORY QC DATA

Analyte	Source Result	Spike Level	RL	MDL	Units	Result	% REC	% REC Limits	% RPD	RPD Limit	Data Qualifiers
Volatile Organic Compounds by EPA 8260B											
LCS Analyzed: 07/08/09 (Lab Number:9G08102-BS1, Batch: 9G08102)											
Surrogate: 4-Bromofluorobenzene					*ug/L*		*99*	*73-120*			
Surrogate: Toluene-d8					*ug/L*		*100*	*71-126*			
Matrix Spike Analyzed: 07/09/09 (Lab Number:9G08102-MS1, Batch: 9G08102)											
QC Source Sample: RSG0072-01RE1											
Benzene	7620	2500	100	16	ug/L	10100	97	71-124			D08,E
Ethylbenzene	ND		100	18	ug/L	ND		77-123			D08
Toluene	ND	2500	100	51	ug/L	2420	97	70-122			D08
Xylenes, total	ND		200	66	ug/L	ND		76-122			D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*107*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*97*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*100*	*71-126*			*D08*
Matrix Spike Dup Analyzed: 07/09/09 (Lab Number:9G08102-MSD1, Batch: 9G08102)											
QC Source Sample: RSG0072-01RE1											
Benzene	7620	2500	100	16	ug/L	10200	104	71-124	2	13	D08,E
Ethylbenzene	ND		100	18	ug/L	ND		77-123		15	D08
Toluene	ND	2500	100	51	ug/L	2470	99	70-122	2	15	D08
Xylenes, total	ND		200	66	ug/L	ND		76-122		16	D08
Surrogate: 1,2-Dichloroethane-d4					*ug/L*		*109*	*66-137*			*D08*
Surrogate: 4-Bromofluorobenzene					*ug/L*		*98*	*73-120*			*D08*
Surrogate: Toluene-d8					*ug/L*		*101*	*71-126*			*D08*

Chain of Custody Record

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124 (1007)

Client	Project Manager	Date	Chain of Custody Number
WSP Environment & Energy	Erin Huntley / Glen Rieger	7/1/2009	160985
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** 1 of 1
750 Holiday Drive, Ste 410			
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
Pittsburg / PA / 15220	Heather Use	Candace Fox	
Project Name and Location (State)	**Carrier/Waybill Number**		
QLT-Buffalo, Buffalo, NY	SELF		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis: BTEX (8260B)	Special Instructions/ Conditions of Receipt
DP-09-02 (14.5'-19.5')	7/1/09	8:30		X						X			X	Samples on wet ice
DP-09-13 (14.5'-19.5')	"	10:50		X						X			X	
DP-09-14 (16'-20')	"	9:10		X						X			X	
TB070109	6/5/09			X						X			X	
END														

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☒ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Relinquished By	Date	Time	Received By	Date	Time
1.	Heather Use	7/1/09	1800	[signature] BUFFALO	7/02/09	1800
2.						
3.						

Comments

2.8°C

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Laboratory Results

Total pages in data package: 12

Lab Sample #	Client Sample ID
P0907009-01	MW-09

Microseeps test results meet all the requirements of the NELAC standards or provide reasons and/or justification if they do not.

Approved By: Debbie Hallo ***Date:*** 7-29-09

Project Manager: Debbie Hallo

The analytical results reported here are reliable and usable to the precision expressed in this report. As required by some regulating authorities, a full discussion of the uncertainty in our analytical results can be obtained at our web site or through customer service. Unless otherwise specified, all results are reported on a wet weight basis.

As a valued client we would appreciate your comments on our service.
Please call customer service at (412)826-5245 or email customerservice@microseeps.com.

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Case Narrative: The response for benzene was larger than expected. This sample was analyzed several times and this effect could not readily be explained by a simple co-elution but was more likely the result of some other matrix interference. The best results were obtained through analysis of a very diluted aliquot of the original sample, and that is what is reported here. Regardless, the results of this CSIA measurement should be used carefully. The surrogates, blank, LCS_Lo and LCS_Hi were all close to or within the acceptance range and the results are issued as valid and reflective of the samples as received.

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
MW-09	Water	P0907009-01	26 Jun. 09 13:45	01 Jul. 09 9:49

Analyte(s)	Flag	Result	PQL	Units	Method #	Analysis Date	By
Volatiles							
Benzene		1000.0	200.0	ug/L	8260B	7/10/09	cs
SURROGATE:							
4-Bromofluorobenzene					100.00 %		
Toluene-d8					100.00 %		
CSIA							
Benzene-area		7.11	5.0	Vs	AM24-AR_M	7/10/09	hg
Benzene-carbon		-21.13	-500.0	‰	AM24-DL_M	7/10/09	hg
Benzene-Co-elution		No	0.0	NA	8260B	7/10/09	hg
Surrogate-area		10.9	1.0	Vs	AM24-AR_M	7/10/09	hg
Surrogate-carbon		-36.61	-500.0	‰	AM24-DL_M	7/10/09	hg
Surrogate-Co-elution		No	0.0	NA	8260B	7/10/09	hg

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Prep Method: Purge and trap for aqueous samples
Analysis Method: CSIA-BTEX,TBA,MTBE

M090713009-MB

	Result		TrueSpikeConc.	RDL	%Recovery	Ctl Limits
Benzene	< 5.0	ug/L		5.0		- NA

M090713009-LCS

	Result		TrueSpikeConc.	%Recovery	Ctl Limits
Benzene	50.0	ug/L	50.00	100.00	79 - 118

Outlined Results indicate results outside of Control limits

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

P0907009-01A

	Result		TrueSpikeConc.	%Recovery	Ctl Limits
Toluene-d8	50.0	ug/L	50.00	100.00	70 - 130
4-Bromofluorobenzene	50.0	ug/L	50.00	100.00	70 - 130

M090713009-MB

	Result		TrueSpikeConc.	%Recovery	Ctl Limits
Toluene-d8	50.0	ug/L	50.00	100.00	70 - 130
4-Bromofluorobenzene	50.0	ug/L	50.00	100.00	70 - 130

M090713009-LCS

	Result		TrueSpikeConc.	%Recovery	Ctl Limits
Toluene-d8	50.0	ug/L	50.00	100.00	70 - 130
4-Bromofluorobenzene	50.0	ug/L	50.00	100.00	70 - 130

Outlined Results indicate results outside of Control limits

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Prep Method: 8260m-CoCr_MTBE_TBA
Analysis Method: 8260m-CoCr_MTBE_TBA

M090728014-MB

	Result		TrueSpikeConc.	RDL	%Recovery	Ctl Limits
Surrogate-Co-elution	No	NA		0.0		- NA
Benzene-Co-elution	No	NA		0.0		- NA

Outlined Results indicate results outside of Control limits

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Prep Method: AM24-AR_M
Analysis Method: AM24-AR_M

M090728015-MB

	Result		TrueSpikeConc.	RDL	%Recovery	Ctl Limits
Surrogate-area	13.2	Vs		1.0		- NA
Benzene-area	< 5.0	Vs		5.0		- NA

Outlined Results indicate results outside of Control limits

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

Client Name: WSP Environmental Strategies Corporation
Contact: Erin Huntley
Address: 750 Holiday Drive
#410
Pittsburgh, PA 15220

Lab Proj #: P0907009
Report Date: 07/28/09
Client Proj Name: QLT Buffalo NY
Client Proj #: 080190/7

Prep Method: AM24-DL_M
Analysis Method: AM24-DL_M

M090728016-MB

	Result		TrueSpikeConc.	RDL	%Recovery	Ctl Limits
Surrogate-carbon	-37.04	‰		-500.0		- NA
Benzene-carbon	NR	‰		-500.0		- NA

M090728016-LCS

	Result		TrueSpikeConc.	%Recovery	Ctl Limits
Surrogate-carbon	-36.98	‰	-36.44	0.00	-37 - -36
Benzene-carbon	-23.77	‰	-23.87	0.00	-24 - -23

Outlined Results indicate results outside of Control limits

Data Qualifiers: J - estimated value, U - Non detect, R - Poor surrogate recovery, M - Recovery/RPD poor for MS/MSD, SAMP/DUP, B - detected in blank, S - field sample as received did not meet NELAC sample acceptance criteria, L - Subcontracted Lab used, N - NELAC certified analysis

CHAIN OF CUSTODY RECORD

6/26/2009

Page 1 of 1

Project Number:	Site and Location:
08014017	RLT Buffalo, NY

Contact Name:	Contact Email:
Erin Hunley	Erin.Hunley@wspgroup.com

Sampler's Name:	Sampler's Signature:
Karen Bergan	Karen Bergan

Matrices:
S = Soil:
Aq = Water
A = Air: Bu = Bulk:
W = Wipe
Bi = Biota:
OW = Oily Waste:
O = Other

Requested Analyses

№ 001650

Sample Identification:	Date	Time	Matrix	Number of Containers	CSIA-Benzene	Remarks
MW-09	6/26/09	1345	AQ	9	X	

Relinquished by (Signature):	Date	Time	Received by (Signature):
Karen Bergan	6/26/09	1615	
Relinquished by (Signature):	Date	Time	Received by (Signature):
			7/1/9

Turn-Around Time: Standard

Tracking Number: 8696 7122 9590

Laboratory Name: Microseeps

Laboratory Location: Pittsburgh, PA

Custody Seal Numbers:

Method of Shipment: FEDEX

WSP ENVIRONMENTAL STRATEGIES

☐ Reston Office: 11911 Freedom Dr, # 900, Reston, VA 20190
Tel: (703) 709-6500, Fax: (703) 709-8505

☒ Pittsburgh Office: 750 Holiday Dr., #410, Pittsburgh, PA 15220
Tel: (412) 604-1040, Fax: (412) 604-1055

☐ Denver Office: 4600 South Ulster, # 930, Denver, CO 80237
Tel: (303) 850-9200, Fax: (303) 850-9214

☐ Minneapolis Office: 123 North 3rd St, #706, Minneapolis, MN 55401
Tel: (612) 343-0510, Fax: (612) 343-0506

Debbie Hallo

From: Huntley, Erin [Erin.Huntley@WSPGroup.com]
Sent: Monday, June 29, 2009 8:47 AM
To: Debbie Hallo
Subject: RE: CSIA-BTEX 080190-7
Attachments: Huntley, Erin.vcf

Please send everything to me.

Thanks,
Erin

WSP Environment & Energy - Shaping a sustainable future
We have a brand new website: www.wspenvironmental.com

Erin Huntley, Senior Consultant
WSP Environment & Energy
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

+ 1 412-604-1040 (office)
+ 1 412-920-7455 (fax)
+ 1 412-216-9896 (mobile)
erin.huntley@wspgroup.com
www.wspenvironmental.com/usa

#1 on the Zweig Letter Hot Firm List

Before printing, think about the environment

From: Debbie Hallo [mailto:dhallo@microseeps.com]
Sent: Monday, June 29, 2009 8:46 AM
To: Huntley, Erin
Subject: RE: CSIA-BTEX 080190-7

Hi Erin
We rec'd this sample . Can you tell me who I should send the results and invoice to?
Thanks
Debbie

Debbie Hallo
Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone 412 826 5245
Fax 412 826 3433
www. microseeps.com

From: Huntley, Erin [mailto:Erin.Huntley@WSPGroup.com]
Sent: Monday, June 22, 2009 4:20 PM
To: Debbie Hallo
Cc: Burns, Matt
Subject: RE: CSIA-BTEX 080190-7

We still need the bottles- only for 1 sample, benzene only.

Thanks,
Erin

WSP Environment & Energy - Shaping a sustainable future
We have a brand new website: www.wspenvironmental.com

Erin Huntley, Senior Consultant
WSP Environment & Energy
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

+ 1 412-604-1040 (office)
+ 1 412-920-7455 (fax)
+ 1 412-216-9896 (mobile)
erin.huntley@wspgroup.com
www.wspenvironmental.com/usa

#1 on the Zweig Letter Hot Firm List

From: Debbie Hallo [mailto:dhallo@microseeps.com]
Sent: Monday, June 22, 2009 4:14 PM
To: Huntley, Erin
Subject: RE: CSIA-BTEX 080190-7

Hi Erin
Of the BTEX compounds we can only do the Benzene and Toluene. Please advise if I should still send the bottles.
Debbie

Debbie Hallo

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone 412 826 5245
Fax 412 826 3433
www. microseeps.com

CHECK OUT OUR ON-LINE BOTTLE ORDER FORM AT WWW.MICROSEEPS.COM

From: Huntley, Erin [mailto:Erin.Huntley@WSPGroup.com]
Sent: Monday, June 22, 2009 2:58 PM

To: Debbie Hallo
Subject: CSIA-BTEX 080190-7

Debbie,
Sorry for the short notice. Could you please ship out bottles for 2 CSIA-BTEX samples to:

Karen Beljan
WSP ENVIRONMENT & ENERGY
240 Redtail, Orchard Park, NY 14127
716-675-2527

We need the bottles to arrive Thursday afternoon (6/25). Our FedEx No is: 1287-6913-7.

Thanks,
Erin

WSP Environment & Energy - Shaping a sustainable future
We have a brand new website: www.wspenvironmental.com

Erin Huntley, Senior Consultant
WSP Environment & Energy
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220

+ 1 412-604-1040 (office)
+ 1 412-920-7455 (fax)
+ 1 412-216-9896 (mobile)
erin.huntley@wspgroup.com
www.wspenvironmental.com/usa

#1 on the Zweig Letter Hot Firm List

Before printing, think about the environment

mi microbialinsights

2340 Stock Creek Blvd.
Rockford, TN 37853-3044
phone (865) 573-8188
fax: (865) 573-8133
email: info@microbe.com
www.microbe.com

REPORT TO:

Reports will be provided to the contact(s) listed below. Parties other than the contact(s) listed below will require prior approval.

Name: Matt Burns Quote #09-242
Company: WSP
Address:

email: matt.burns@wspgroup.com
Phone: (781) 933-7340
Fax: ( )

Project Manager: Erin Huntley
Project Name: GLT-Buffalo
Project No.: 080190-7

INVOICE TO:

For Invoices **paid by a third party** it is imperative that contact information & corresponding reference No. be provided.

Name: Erin Huntley
Company: WSP
Address: 750 Holiday Dr, Ste 410
Pgh, PA 15211
email: erin.huntley@wspgroup.com
Phone: (412) 604-1040
Fax: ( )

Purchase Order No.:
Subcontract No.:

Please Check One:

☐ More samples to follow
☒ No Additional Samples

Saturday Delivery
Please see sampling protocol for instructions

Report Type: ☒ Standard (default) ☐ Comprehensive (15% surcharge) ☐ Historical (30% surcharge)

Please contact us prior to submitting samples regarding questions about the analyses you are requesting at (865) 573-8188 (8:00 am to 4:00 pm M-F). After these hours please call (865) 300-8053.

Sample Information

MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	VFA	M/E/E	DGGE+3ID	DGGE+5ID	PCR
086GF 1	MW-08	6/26/09	1105	AQ	X					X
2	MW-09	6/26/09	1345	AQ	X					X

CENSUS: Please select the target organism/gene

MI ID	qDHC (Dehalococcoides)	DHC Functional genes	qDHB (Dehalobacter)	qDSM (Desulfuromonas)	qDSB (Desulfitobacterium)	qEBAC (Total)	qDSR (SRBs only)	qSRB/IRB	qMGN (methanogens)	qMOB (methanotrophs)	qDNF (Denitrifying)	qAOB (ammonia oxidizing)	qPM1 (MTBE aerobic)	qTOD (Initial PAHs aerobic)	qCAT (Intermediate PAHs aerobic)	qBSS (Toluen/Xylene Anaerobic)	qNAH (Napthalene aerobic)	add. qPCR:	add. qPCR:	add. qPCR:	RNA (Expression Option)*	Other:	Other:	Other:	Other:
086GF 1																									
2																									

Relinquished by: [signature] Date: 6/26/09 1615

Received by: [signature] Date 6/27/09

In order for analysis to be completed correctly, it is vital that chain of custody is filled out correctly & that all relative information is provided. Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable. * additional cost and sample preservation are associated with RNA samples.

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone: (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Client: Erin Huntley
WSP Environment & Energy
750 Holiday Drive
Suite 410
Pittsburgh, PA 15220

Phone: 412.604.1040

Fax: 412.920.7455

Identifier: 086GF **Date Rec:** 06/27/2009 **Report Date:** 07/07/2009

Client Project #: 080190-7 **Client Project Name:** QLT

Purchase Order #:

Analysis Requested: CENSUS

Comments:

Reviewed By:

MICROBIAL INSIGHTS, INC.

2340 Stock Creek Blvd. Rockford, TN 37853-3044
Tel. (865) 573-8188 Fax. (865) 573-8133

CENSUS

Client: **WSP Environment & Energy**
Project: QLT

MI Project Number: **086GF**
Date Received: 06/27/2009

Sample Information

Client Sample ID:	**MW-08**	**MW-09**
Sample Date:	06/26/2009	06/26/2009
Units:	cells/mL	cells/mL
Analyst:	ab	ab

Functional Genes

Benzyl Succinate Synthase	bssA	<1.30E+00	<1.00E+00
Napthalene Dioxygenase	NAH	**3.32E+08**	**1.37E+08**
Phenol Hydroxylase	PHE	**2.52E+02**	**4.06E+04**
Toluene Monooxygenase	RMO	<1.30E+00	<1.00E+00
Toluene Dioxygenase	TOD	**6.19E+05**	**1.01E+06**
Biphenyl Dioxygenase	BPH4	**2.25E+02**	**2.34E+04**
Xylene Monooxygenase	TOL	<1.30E+00	**2.00E-01 (J)**

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

Microseeps, Inc.
220 William Pitt Way
Pittsburgh, PA 15238

CSIA Report

28-Jul-09
P0907009
WSP Environmental Strategies Corporation
Client Project Name: QLT Buffalo NY
Client Project #: 080190/7

Benzene		Concentration (ug/l)			CSIA (Carbon) Area		Co-elution	Analysis	Date	Del (‰)
Lab ID	Client ID	Sample	PQL	Date	Sample	PQL				
P0907009-01	MW-09	1000	200	7/10/09	7.11	5	No	7962	7/10/09	-21.13
Blank	0	-	-	-	<5 (U)	5	No	7959	7/23/09	-
LCS_Lo	5	-	-	-	29.7	5	No	7960	7/23/09	-23.77
LCS_Hi	20	-	-	-	155	5	No	7961	7/23/09	-23.99
LCS acceptance range								-23.37	<=>	-24.37

Method	8260B	AM-24-AR_C	AM-24-DL_C
Units	ug/l	Vs	‰
Analyst	CS	HG	HG

1CP (Surrogate)		Sample Collection	CSIA (Carbon) Area	Dilution	PQL	Co-elution	Analysis	Date	Del (‰)
Lab ID	Client ID								
P0907009-01	MW-09	06/26/09	10.9	2500	1	No	7962	07/10/09	-36.61
Blank	-	-	13.2	1	1	No	7959	07/23/09	-37.04
LCS_Lo	-	-	12.6	1	1	No	7960	07/23/09	-36.98
LCS_Hi	-	-	11.3	1	1	No	7961	07/23/09	-36.36
Surrogate acceptance range							-35.94	<=>	-36.94

Method		AM-24-AR_C	AM-24-DL_C
Units		Vs	‰
Analyst		HG	HG

Case Narrative: The response for benzene was larger than expected. This sample was analyzed several times and this effect could not readily be explained by a simple co-elution but was more likely the result of some other matrix inteference. The best results were obtained through analysis of a very diluted aliquot of the original sample, and that is what is reported here. Reguardless, the results of this CSIA measurement should be used carefully.The surrogates, blank, LCS_Lo and LCS_Hi were all close to or within the acceptance range and the results are issued as valid and reflective of the samples as received.

Appendix B – Boring logs

Boring Log: DP-09-01

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 580.19

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		75		***Topsoil*** Brown, clay loam, grass and roots; hard; moist.	
						Poorly-Graded Sand with Gravel (sp) Gray-brown, fine-grained sand with gray, fine, angular metaquartzite gravel; loose; moist; *fill*.	
5		0.0 0.0		100		***Poorly-Graded Sand with Silt (sp-sm)*** Light-brown, very fine-grained sand; dry; *fill*.	
						Poorly-Graded Sand (sp) Black, coarse-grained sand with coal, ash, brick, brick dust, and gravel; medium-dense; wet; no odor; *fill*.	
10		0.0 0.0		100		***Poorly-Graded Sand with Silt (sp-sm)*** Brown with mottled blue, very fine-grained sand with 1 inch brick fragments; moist; *fill*.	
		0.7 0.0		100		***Poorly-Graded Sand with Silt (sp-sm)*** Dark-gray with mottled black, very fine-grained sand, some clay; grading from medium-dense to loose; wet.	
15						***Lean Clay (cl)*** Light reddish-gray, soft, with silt; wet.	
		0.0 11.6		100		***Poorly-Graded Sand with Silt (sp-sm)*** Light-gray, medium-dense, very fine-grained sand; wet.	
20						***Lean Clay (cl)*** Light reddish-gray with silt, very fine-grained sand; soft to hard; saturated.	
						Poorly-Graded Sand with Silt (sp-sm) Light-gray, loose, very fine-grained sand; saturated.	
25						***Lean Clay (cl)*** Light reddish-gray, with silt; soft; saturated.	
						Silt with Sand (ml) Light reddish-gray, fine-grained sand; very dense; wet; slight odor.	
30						Bottom of Boring at 19 feet Refusal at 19 feet	

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-02

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 30, 2009

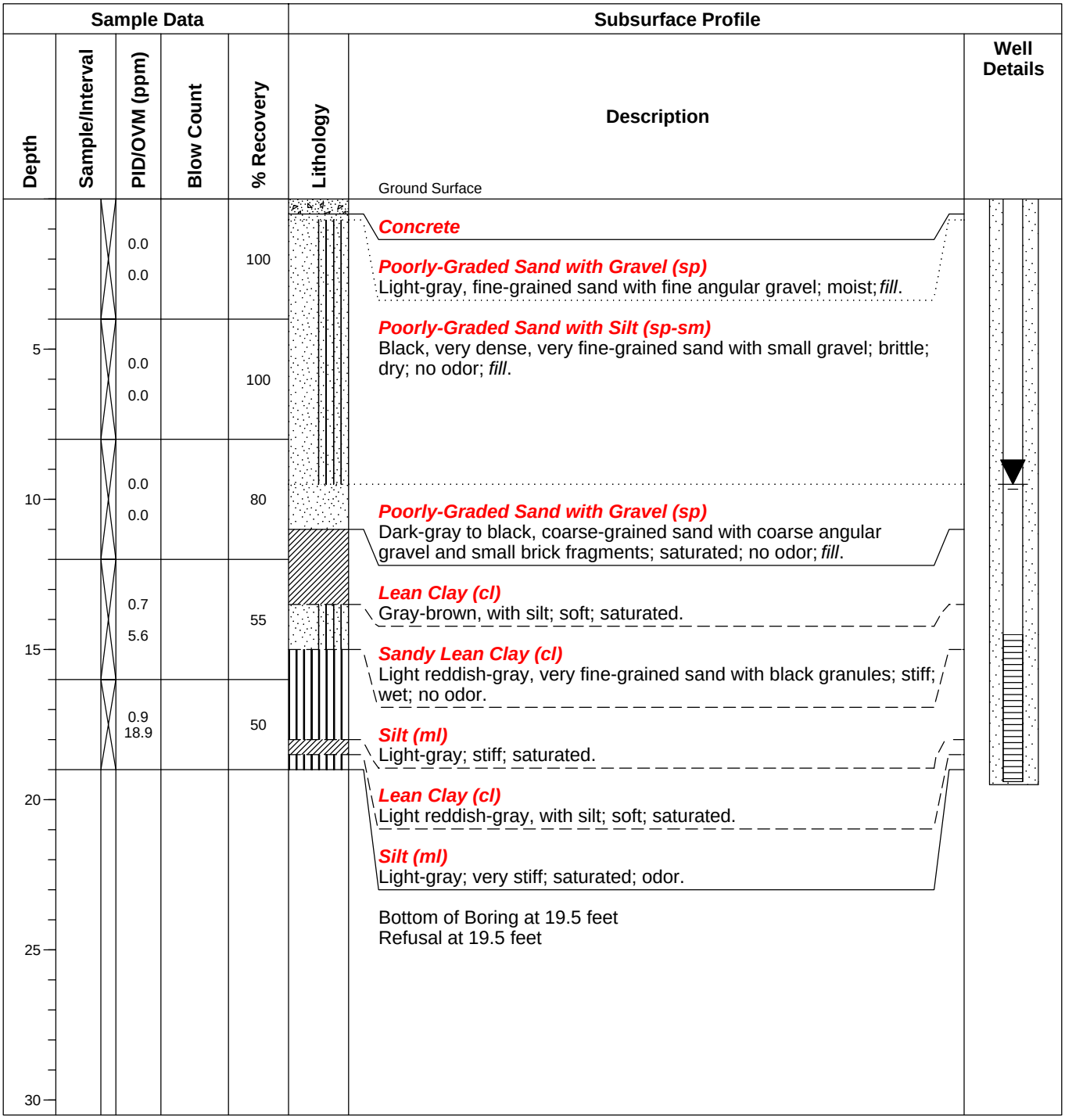
Surface Elevation (feet AMSL*): 580.62

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19.5

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*



Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.

750 Holiday Drive, Suite 410

Pittsburgh, Pennsylvania 15220

(412) 604-1040

Boring Log: DP-09-03

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 580.18

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 18

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		50		***Topsoil*** Brown, clay loam, grass, and roots; hard; moist.	
						Poorly-Graded Sand with Silt (sp-sm) Dark-brown with mottled black, coarse-grained sand with brick, coal, ash, 1 to 2 inch concrete fragments; loose; dry, slight odor; *fill*.	
5		0.0 0.0		25		***Poorly-Graded Sand with Clay and Gravel (sp-sc)*** Dark-brown, fine-grained clayey sand with fine gravel and coarse sand , brick fragments; loose; dry to moist; *fill*.	
		0.0 0.0		100		***Poorly-Graded Sand with Clay and Silt (sp-sc)*** Gray with mottled red-brown, very fine-grained sand; soft; saturated; *fill*.	
10						***Poorly-Graded Sand with Clay (sp-sc)*** Dark-gray to black, with glass, brick, and slag; soft; saturated, slight odor; *fill*.	
				0		***Poorly-Graded Sand with Silt (sp-sm)*** Light-brown, very fine-grained sand with trace clay; medium-dense; wet.	
15		1.2 4.1		100		***Lean Clay (cl)*** Light reddish-gray, with silt; soft; saturated.	
						Silt (ml) Light gray with mottled reddish-gray; very stiff; wet; odor.	
20						Bottom of Boring at 18 feet Refusal at 18 feet	
25							
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-04

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: July 01, 2009

Surface Elevation (feet AMSL*): 580.40

Total Depth (feet): 19

Borehole Diameter (inches): 2

*AMSL = Above mean sea level

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
						Ground Surface
		0.8 0.2		50		***Concrete***
						Poorly-Graded Gravel (gp) Light-gray, angular gravel and concrete fragments; dry; *fill*.
5		0.1 0.0		90		***Poorly-Graded Sand with Silt (sp-sm)*** Black, fine-grained sand with coal, brick, and ash; dense; moist.; no odor; *fill*.
						Poorly-Graded Gravel (gp) Concrete dust and gravel mixture; *fill*.
10		0.0 0.5		60		***Poorly-Graded Sand with Silt (sp-sm)*** Black with mottled orange, fine-grained sand; medium-dense; moist.
						Silt with Sand (ml) Dark-gray to black; soft; saturated, slight odor.
		0.5 2.2		80		***Lean Clay (cl)*** Light reddish-gray, with silt; soft to hard; saturated.
15						***Silt (ml)*** Light reddish-gray with soft clay lenses (25%-50%); very stiff; wet.
		0.0 1.9		97		
20						***Silt (ml)*** Light reddish-gray; very stiff; wet, slight odor.
						Bottom of Boring at 19 feet Refusal at 19 feet
25						
30						

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-05

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: July 01, 2009

Surface Elevation (feet AMSL*): 580.37

Total Depth (feet): 19.2

Borehole Diameter (inches): 2

*AMSL = Above mean sea level

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
						Ground Surface
		0.0 0.0		100		***Concrete***
						Poorly-Graded Gravel (gp) Light-gray, angular gravel and concrete fragments; dry; *fill*.
5		0.0 0.0		50		***Poorly-Graded Sand with Clay and Silt (sp-sc)*** Dark brown with mottled black and orange-brown, fine-grained sand, coal, brick, and slag; medium dense; moist; *fill*.
						Poorly-Graded Sand with Silt (sp-sm) Dark gray to black, very fine-grained sand with fine, angular gravel; brick, wood, ash, and slag; loose; wet to saturated; *fill*.
10		0.0 0.2		100		***Lean Clay (cl)*** Light reddish-brown with silt; soft; moist.
						Silt (ml) Light reddish-gray, with soft clay lenses (40%); stiff; saturated, slight odor.
15		0.7 0.0		75		***Silt (ml)*** Light reddish-gray with soft clay lenses at 17 feet-bgs; soft to stiff; saturated; slight odor.
		0.0 0.0		94		
20						Bottom of Boring at 19.2 feet Refusal at 19.2 feet
25						
30						

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-06

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 30, 2009

Surface Elevation (feet AMSL*): 580.34

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
		0.0 0.0		70		Ground Surface ***Topsoil*** Dark-brown,clay loam, grass, and roots; hard; moist. ***Poorly-Graded Gravel (gp)*** Angular coarse metaquartzite gravel and cobbles; dry; *fill*.	
5		0.0 0.0		100		***Poorly-Graded Sand with Clay and Silt (sp-sc)*** Dark-brown with mottled orange-brown and black, fine-grained sand with cinders, coal, and brick; loose; moist.; no odor; *fill*. ***Lean Clay (cl)*** Light-brown, with silt; soft; wet; *fill*.	
10		0.0 0.0		50		***Poorly-Graded Sand with Silt and Gravel (sp-sm)*** Black, very fine-grained sand with fine-grained gravel and coal fragments; loose; saturated; *fill*. ***Poorly-Graded Sand (sp)*** Light-brown, fine-grained sand; loose; saturated.	
15		0.0 2.2		75		***Silt (ml)*** Light orange-brown with clay; stiff; saturated. ***Silt (ml)*** Dark gray to black with mottled brown; soft; saturated.	
		0.0 5.2		92		***Lean Clay (cl)*** Reddish-brown to reddish-gray, trace silt and black granules; stiff; wet; odor.	
20						***Lean Clay (cl)*** Reddish-brown to reddish-gray, trace silt; soft to stiff; saturated. ***Lean Clay (cl)*** Reddish-brown to reddish-gray, trace silt; soft to stiff; saturated.	
25						***Silt (ml)*** Light reddish-gray; very stiff; wet.	
30						Bottom of Boring at 19 feet Refusal at 19 feet	

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-07

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 580.61

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		100		***Topsoil*** Dark-brown, clay loam, roots; hard; moist.	
						Poorly-Graded Sand with Clay (sp-sc) Dark-brown with mottled black, fine-grained sand with trace clay and coal fragments; loose; moist; *fill*.	
5		0.0 0.0		90		***Lean Clay with Sand (cl)*** Reddish-brown, fine-grained sand with black granules; hard to stiff; wet.	
						Poorly-Graded Sand with Clay and Silt (sp-sc) Gray with mottled orange-brown, fine-grained sand; medium dense; wet.	
10		0.0 0.0		100		***Silt (ml)*** Black with mottled dark-gray, with clay; wet.	
						Poorly-Graded Sand (sp) Yellow-orange, fine-grained sand; saturated.	
15		0.0 0.0		100		***Poorly-Graded Sand with Silt (sp-sm)*** Light-gray with mottled orange-brown, very fine-grained sand; medium dense; wet.	
		0.0 6.1		58		***Poorly-Graded Sand (sp)*** Light-brown, fine-grained sand; saturated.	
20						***Lean Clay with Sand (cl)*** Reddish-brown to light reddish brown with trace sand, fine-grained black gravel fragments and granules; stiff; moist.	
						Lean Clay with Sand (cl) Light reddish-gray with small black gravel fragments and granules; stiff; moist; *till*.	
25						***Poorly-Graded Sand with Silt (sp-sm)*** Light-brown to reddish-brown gray, very fine-grained sand; dense; wet to saturated.	
						Lean Clay with Sand (cl) Light-brown, very fine-grained sand; soft; saturated.	
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-07

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 580.61

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Silt (ml) Light-gray; very stiff; wet; odor.	
						Bottom of Boring at 19 feet Refusal at 19 feet	
35							
40							
45							
50							
55							
60							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-08

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 30, 2009

Surface Elevation (feet AMSL*): 580.31

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		95		***Topsoil*** Dark-brown, clay loam, roots, and grass; hard; moist.	
						Poorly-Graded Sand (sp) Black, loose, coarse-grained sand with coal, ash, brick, slag, and metal; moist; *fill*.	
5		0.0 0.0		100		***Lean Clay (cl)*** Reddish-gray; stiff; moist; *fill*.	
						Lean Clay (cl) Dark-brown with mottled orange-brown with silt, trace brick fragments; soft; wet; *fill*.	
10		0.0 0.0		100		***Silt (ml)*** Light-brown with some coal and slag at 4 feet-bgs; stiff; saturated; *fill*.	
						Silt (ml) Orange-brown with clay; soft; saturated.	
15		2.8 4.0		25		***Silt (ml)*** Light reddish-gray; stiff; wet.	
		2.8 4.0		67		***Lean Clay (cl)*** Reddish-brown to reddish gray with silt, black granules and fine black gravel; stiff; wet.	
20						***Silt (ml)*** Light reddish-gray, trace clay; soft to stiff; saturated; odor.	
						Bottom of Boring at 19 feet Refusal at 19 feet	
25							
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-09

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 580.27

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		75		***Topsoil*** Dark-brown, clay loam, grass, loam, and roots; hard; moist.	
						Poorly-Graded Sand (sp) Black, coarse-grained sand with fine angular gravel, brick, glass, and coal; dry; no odor; *fill*.	
5		0.0 0.0		70		***Poorly-Graded Sand with Silt (sp-sm)*** Brown with mottled light-brown, fine-grained sand with silt, slate, gravel, coal, 2-inch brick fragments, and slag; medium dense; moist. to wet; *fill*.	
		0.0 0.5		100		***Lean Clay (cl)*** Dark-gray to black with silt; soft; saturated; *fill*.	
10						***Poorly-Graded Sand (sp)*** Blue-gray, medium-grained sand with brick, wood, and tile; loose; saturated; odor; *fill*.	
		0.3 3.5		100		***Lean Clay (cl)*** Light gray with silt; soft; saturated; no odor.	
15		1.0 2.8		67		***Silt (ml)*** Light reddish-gray, very fine-grained silt with black granules; very stiff; wet; no odor.	
20						Bottom of Boring at 19 feet Refusal at 19 feet	
25							
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-10

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 29, 2009

Surface Elevation (feet AMSL*): 582.09

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 17.5

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
		0.0 0.0		90		***Topsoil*** Dark-brown, clay loam, grass, and roots; hard; moist.	
						Poorly-Graded Sand with Clay and Gravel (sp-sc) Black, coarse-grained sand with mottled red-brown clay,coal fragments, ash, slag, and small gravel; moist; *fill*.	
5		0.0 0.0		80		***Poorly-Graded Sand (sp)*** Orange, medium-grained sand; loose; moist to wet; *fill*.	
						Poorly-Graded Sand (sp) Light-gray, fine-grained sand; loose; wet; *fill*.	
10		0.0 0.0		95		***Silt (ml)*** Black, with clay; moist to wet; *fill*.	
						Poorly-Graded Sand with Clay (sp-sc) Gray to black with mottled orange, fine-grained sand with trace clay, gravel, brick, and coal; loose; wet; *fill*.	
15		0.0 0.0		25		***Poorly-Graded Sand with Silt (sp-sm)*** Reddish-brown, very fine-grained sand; medium dense; wet.	
		5.2		100		***Silt (ml)*** Black with clay; loose; saturated.	
20						***Poorly-Graded Sand with Silt (sp-sm)*** Light gray-brown, very fine-grained sand; very dense; wet.	
						Poorly-Graded Sand (sp) Light-brown, fine-grained sand; loose; saturated.	
						Lean Clay with Sand (cl) Light gray-brown to reddish-gray, with silt; soft to hard; wet to saturated.	
25						***Silt (ml)*** Light gray, trace clay; very stiff; saturated.	
						Bottom of Boring at 17.5 feet Refusal at 17.5 feet	
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-11

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: June 30, 2009

Surface Elevation (feet AMSL*): 580.93

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 20

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
	1	0.0 0.0		90		***Topsoil*** Dark-brown, clay loam, grass, loam, and roots; hard; moist.	
						Well-Graded Sand (sw) Black coarse-grained sand with brown fine-grained sand, coal, brick, and ash; dry; *fill*.	
5	2	0.0 0.0		75		***Lean Clay (cl)*** Orange-brown to red-gray; stiff; moist; *fill*.	
						Poorly-Graded Sand with Clay (sp-sc) Dark-brown with mottled orange-brown, with silt, trace brick fragments; loose; dry; *fill*.	
10	3	0.0 0.3		50		***Silt (ml)*** Light-brown, with coal, brick, and slag; stiff; moist; *fill*.	
						Poorly-Graded Sand (sp) Dark-brown with mottled orange-brown, fine- to medium-grained sand with coal, slag, brick, and fine-grained gravel, trace silt; dry; *fill*.	
15	4	0.4 0.1		45		***Silt (ml)*** Dark orange-brown with mottled black with clay and fine-grained gravel; stiff; wet to saturated.	
	5	2.4 2.4		75		***Poorly-Graded Gravel (gp)*** Orange, red-brown, green, black, gray, and white, fine-grained, well rounded gravel; saturated.	
20						***Silt (ml)*** Light reddish-gray; stiff; saturated.	
						Lean Clay (cl) Reddish-brown to reddish-gray, trace sand and black granules; stiff; saturated.	
25						***Silt (ml)*** Light reddish-gray; soft to very stiff; saturated.	
						Silt (ml) Light reddish-gray; very stiff; saturated.	
30						Bottom of Boring at 20 feet Refusal at 20 feet	

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-12

Project: QLT Buffalo
Project No.: 080190
Location: Buffalo, New York
Completion Date: June 30, 2009

Surface Elevation (feet AMSL*): 581.22
TOC Elevation (feet AMSL*): Abandoned
Total Depth (feet): 20
Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
	1	0.0 0.0		95		***Topsoil*** Dark-brown, clay loam, grass, loam, and roots; hard; moist.	
						Well-Graded Sand (sw) Black coarse-grained sand with brown fine-grained sand, ash, coal, slag, brick, and gravel; dry; *fill*.	
5	2	0.0 0.0		100		***Poorly-Graded Sand with Silt (sp-sm)*** Black, very fine-grained sand with brick, coal, and wood; loose; moist; *fill*.	
						Lean Clay (cl) Black, soft; moist.	
10	3	0.0 0.0		80		***Silt (ml)*** Light-gray with mottled orange-brown; stiff; saturated.	
						Lean Clay (cl) Reddish-gray; soft; saturated.	
	4	0.0 0.0		45		***Silt (ml)*** Light reddish-gray; stiff; saturated.	
15						***Lean Clay (cl)*** Reddish-gray, trace silt; soft; saturated.	
	5	0.0 1.8		100		***Silt (ml)*** Light reddish-gray; stiff; saturated.	
20						Bottom of Boring at 20 feet Refusal at 20 feet	
25							
30							

Geologist(s): Heather M. Usle
Subcontractor: SJB Services, Inc.
Driller/Operator: Randy Steiner
Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-13

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: July 01, 2009

Surface Elevation (feet AMSL*): 583.72

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 19.5

Borehole Diameter (inches): 2

**AMSL = Above mean sea level*

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
	1	0.0 0.0		100		***Topsoil*** Dark-brown, clay loam, grass, and roots; hard; moist.	
						Lean Clay (cl) Light reddish-brown, hard; moist.	
5	2	0.0 0.0		90		***Poorly-Graded Sand with Gravel (sp)*** Black, coarse-grained sand with fine-grained, angular gravel, brick, coal, and ash; dry; fill.	
						Silt (ml) Light reddish-brown, with clay; stiff; moist; *fill*.	
10	3	0.0 0.0		100		***Silt (ml)*** Gray-brown to black, trace clay, brick, wood, and coal fragments; soft; wet; *fill*.	
						Lean Clay (cl) Light-brown; hard; moist.	
15	4	0.1 0.4		75		***Poorly-Graded Sand with Silt (sp-sm)*** Black, fine-grained sand; loose; saturated.	
	5	0.7 1.2		86		***Poorly-Graded Sand (sp)*** Light-gray to brown, fine-grained sand; loose; saturated.	
						Lean Clay (cl) Dark-gray; soft to hard; saturated.	
20						***Poorly-Graded Sand with Clay and Silt (sp-sc)*** Light to dark-gray with reddish-gray, very fine-grained sand with stiff clay and silt lenses; grading from loose to very dense; saturated.	
25						***Silt (ml)*** Light reddish-gray; stiff; wet; odor.	
						Bottom of Boring at 19.5 feet Refusal at 19.5 feet	
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040

Boring Log: DP-09-14

Project: QLT Buffalo

Project No.: 080190

Location: Buffalo, New York

Completion Date: July 01, 2009

Surface Elevation (feet AMSL*): 586.03

TOC Elevation (feet AMSL*): Abandoned

Total Depth (feet): 21

Borehole Diameter (inches): 2

*AMSL = Above mean sea level

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
	1	0.0 0.0		100		***Asphalt***	
						Poorly-Graded Gravel (gp) Light-gray claystone and broken concrete; dry; *fill*.	
5	2	0.0 0.0		100		***Poorly-Graded Gravel with Sand (gp)*** Light-brown, fine-grained sand with fine- to coarse-grained angular gravel; loose;dry; *fill*.	
						Poorly-Graded Sand with Clay (sp-sc) Dark-brown, fine-grained sand with trace clay and brick fragments; moist; *fill*.	
10	3	0.0 0.0		80		***Poorly-Graded Gravel (gp)*** Light-gray rock dust and small rounded concrete fragments; *fill*.	
						Poorly-Graded Sand with Silt (sp-sm) Reddish-brown to light-brown with gray, fine-grained sand with trace clay; loose to medium dense; moist.	
15	4	0.0 0.0		100		***Silt (ml)*** Light orange-brown; stiff; saturated.	
	5	0.0 0.0		30		***Silt (ml)*** Light-gray with mottled dark-gray, fine-grained angular gravel near 12 feet bgs; stiff; saturated; petroleum odor.	
20	6	0.0		100		***Silt (ml)*** Light reddish-gray, trace clay and gravel; very stiff; saturated; petroleum odor.	
						Silt (ml) Light-gray; very stiff; saturated.	
25						Bottom of Boring at 21 feet Refusal at 21 feet	
30							

Geologist(s): Heather M. Usle

Subcontractor: SJB Services, Inc.

Driller/Operator: Randy Steiner

Method: Direct Push

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Appendix C – Oxidant Efficiency Testing Results

Terra Systems
INCORPORATED

July 22, 2009

Matthew Burns
Senior Project Director
WSP Environment & Energy
300 Trade Center
Suite 4690
Woburn, MA 01801

RE: Final Report on Chemical Oxidation Studies for QLT Site, Buffalo, NY Site

Terra Systems, Inc. (TSI) is pleased to submit this draft report on the chemical oxidation using soil and groundwater from the benzene, ethylbenzene, and toluene contaminated QLT site in Buffalo, NY. *In Situ* Chemical Oxidation (ISCO) is a process which chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidizing agents include ozone, hydrogen peroxide, persulfate, and permanganate. These volatile organic compounds (VOCs) may be amenable to treatment using sodium persulfate. Sodium persulfate ($Na_2S_2O_8$) is typically activated by the addition of heat, ferrous iron, hydrogen peroxide, or alkaline conditions (pH >10). This study used alkaline conditions (calcium peroxide) to activate the FMC Klozur CR ® which contains 50% Klozur ® sodium persulfate and 50% FMC PermeOx Plus ® calcium peroxide. The calcium peroxide raises the pH to activate the persulfate and provides a long-lasting source of oxygen. As the sodium persulfate reacts, sulfuric acid is generated. Oxidative conditions from the application of ISCO may affect the concentrations of oxyanions such as hexavalent chromium in the groundwater.

The laboratory work was done by Erich Hauptmann of TSI in Wilmington, Delaware, under the direction of Michael Lee, Ph.D.

1.0 SUPPLY OF SAMPLES

Samples were shipped on July 1, 2009 on ice and received July 2, 2009. One gallon of groundwater and 11.6 kg of soil were received.

2.0 SCOPE OF WORK

The experimental design for the bench-scale treatability study consisted of three phases of work:

1 Initial characterization

2 Determination of the total oxidant demand and efficiency for removal of the Klozur CR to treat the VOCs and the impact of the oxidant addition on the concentrations of hexavalent chromium;

3 Report

Each phase of work is described in detail in the sections that follow.

2.1 Phase I, Initial Characterization

2.1.1 Initial Characterization Methods

Prior to beginning the actual treatability experiments, the soil and groundwater samples were chemically characterized. All analyses were performed at a subcontracted laboratory (American Westech of Harrisburg, PA). The groundwater samples were analyzed for VOCs plus tentatively identified compounds (TICs) by gas chromatography/mass spectrometry according to EPA Method 8260B, hexavalent chromium, total organic carbon (TOC), and chemical oxygen demand (COD). The soil samples were composited. The pH of the groundwater and soil (20 g soil in 50-mL of distilled water) was analyzed and the quantities of PermeOx Plus needed to bring the groundwater and the soil slurry to pH 10.5 were determined.

2.1.2 Initial Characterization Results

The pH of the groundwater was 7.0 (Table 1). The quantity of PermeOx Plus calcium peroxide needed to bring the groundwater to pH 10.5 was determined to be 8 g/L or 3.4 pounds per cubic yard assuming 25% porosity. The pH of 20 g of the soil in 50 mL distilled water was 8.5. The quantity of PermeOx Plus calcium peroxide to raise the pH of the soil to 10.5 was determined to be 15 g/kg or the equivalent of 41 pounds per cubic yard based upon a density of 100 pounds per cubic yard. A total of 44 pounds of PermeOx Plus would be required to raise the the pH of one cubic yard of aquifer to 10.5. The soil contained 27% moisture, had a density of about 2.13 g/mL, and a field holding capacity of 94 mL/kg.

The groundwater contained 5,840 μg/L benzene, less than 5 μg/L of ethylbenzene and toluene, and no detectable total xylenes, or other VOCs on the Priority Pollutant List (Table 1). Thiopene and 1,2,3-trimethylbenzene were identified by their mass spectra at concentrations of 89.9 and 2.8 μg/L, respectively. There were five unknowns found at 1.66, 2.02, 4.02, 4.20, and 13.33 minutes retention times, but could not identified from a mass spectrum search. Hexavalent chromium was not present at detectable concentrations (<0.02 μg/L) in the groundwater. There were moderate levels of TOC (43 mg/L) and COD (54 mg/L).

Table 1. Initial Characterization Results

Phase	Units		Qualifiers
Groundwater			
Calcium Peroxide Demand to pH 10.5	g/L	8.0	
pH		7.0	
Benzene	µg/L	5840	D
Ethylbenzene	µg/L	3.86	
Toluene	µg/L	3.15	
Total Xylenes	µg/L	<2.0	U
Unknown RT 1.66	µg/L	10.7	E
Unknown RT 2.02	µg/L	9.62	E
Unknown RT 4.02	µg/L	5.54	E
Unknown RT 4.20	µg/L	3.92	E
Thiopene RT 7.76	µg/L	89.9	E
1,2,3-Trimethylbenzene	µg/L	2.8	E
Unknown RT 13.33	µg/L	210	E
Chemical Oxygen Demand	µg/L	54	
Total Organic Carbon	µg/L	43	
Hexavalent Chromium	µg/L	<20	
Soil			
Calcium Peroxide Demand to pH 10.5	g/kg	15	
pH (20 g diluted with 50 mL DI)		8.5	
Soil Moisture	%	27.0	
Field Holding Capacity	mL/kg	94	
Density	g/mL	2.13	

Qualifiers
- D Diluted sample
- E Compound concentration estimated
- U Compound not detected

2.2 Phase II, Determination of Total Oxidant Demand and Destruction Efficiency

2.2.1 Introduction

In addition to reacting with many hazardous chemicals, persulfate will react with many organic and inorganic materials naturally present in site soils. If the concentrations of these non-target oxidizable materials are very high, large amounts of oxidant will be required for field treatment, resulting in high full-scale implementation costs. These tests were designed to determine the total oxidant demand (TOD) for the soil and groundwater and the destruction efficiency for the VOC contaminants.

2.2.2 Methods

Klozur CR ® was tested at low, intermediate, and high concentrations to assess the total oxidant demand and destruction efficiency. Alkaline conditions were the activator as well as the heat from hydration of the calcium peroxide. Establishment of oxidizing conditions (potentially with

elevated pH and sodium levels) may also be advantageous in reducing the potential for transport of some heavy metals and oxyanions while potentially mobilizing others.

Total Oxidant Demand (TOD) Tests were performed by adding 1,350 grams of wet-weight processed soil and 290 to 350 mL of groundwater to each of eight 1,000-mL bottles shown in Table 2. Three loadings of Klozur CR ® were used based upon instructions from WSP. One low (2 g/kg), one moderate (4 g.kg), and one high oxidant (6 g/kg) concentration of Klozur CR ® were tested. Two controls bottle were prepared without the oxidants.

The A bottles were used to measure the pH, ORP, oxidant concentration, and temperature after 0, 1, 4, 24, 48, and 72 hours. The A samples were mixed by hand before sampling. The B Bottles were not opened or mixed until 72 Hours when they were sampled for aqueous VOCs + TICs and hexavalent chromium by American Westech and for pH, ORP, oxidant concentration, and temperature by Terra Systems. The groundwater from the opened A and unopened B bottles were combined for the hexavalent chromium analyses.

The aqueous concentration of Klozur CR ® was determined by the addition of 10 mL of 0.4 N ferrous ammonium sulfate (reductant) to a sample and a blank each containing 10 mL of 25% sulfuric acid. The Klozur CR ® consumes a portion of ferrous ammonium sulfate. A titration with 0.58 M potassium permanganate was then conducted to determine how much of the ferrous ammonium sulfate was consumed versus the blank. The higher the residual Klozur CR ® concentration, the less potassium permanganate titrant was required. A standard curve was prepared with Klozur CR ® to calculate the sodium persulfate concentration. The general equations for the reactions follow:

$Fe(NH_4)_2(SO_4)_2 + Na_2S_2O_8 + 2H_2O \rightarrow 2H_2SO_4 + 2NH_4 + Fe + 5O_2 + 2Na$
$Fe(NH_4)_2(SO_4)_2 + CaO_2 + 2H_2O \rightarrow 2H_2SO_4 + 2NH_4 + Fe + 2O_2 + Ca$
$Fe(NH_4)_2(SO_4)_2 + KMnO_4 + 2H_2O \rightarrow 2H_2SO_4 + 2NH_4 + Fe + MnO_2 + K + 2O_2.$

A standard curve of Klozur CR ® was prepared by adding Klozur CR ® to distilled water and conducting the titration as described above.

Table 2. Number of Bottles and Volumes of Soil and Groundwater

Phase	Soil g	Groundwater mL	Klozur CR g	Klozur CR mg/L
Oxidant Demands and Destruction Efficiency				
Unamended A	1350	330	0	0
Unamended B	1350	330	0	0
2.0 g/kg Klozur CR A	1350	290	2.7	9,310
2.0 g/kg Klozur CR B	1350	290	2.7	9,310
4.0 g/kg Klozur CR A	1350	325	5.4	16,615
4.0 g/kg Klozur CR B	1350	320	5.4	16,875
6.0 g/kg Klozur CR A	1350	330	8.1	24,545
6.0 g/kg Klozur CR B	1350	320	8.1	25,313
Total	**10,800**	**2,535**		

2.3.1 TOD Laboratory Results

Table 3 presents the lab results for the unamended and Klozur CR (2 g/kg, 4 g/kg, and 6 g/kg) treatments through 72 hours. The unamended treatment showed little change in the pH (6.9 to 8.1). The ORP in the Unamended treatment ranged between 120 and 296 mV. The initial temperature was below the room temperature because the groundwater had been refrigerated.

Table 3. TOD Laboratory Results

Treatment	Hours	pH	ORP	Temp (^{O} C)	mg/L Klozur CR	TOD (mg/kg)
Unamended A	0	7.7	167	16		
	1	8.1	214	19		
	4	7.2	212	24		
	24	7.1	206	23		
	48	7.2	120	24		
	72	7.6	296	22		
Unamended B	72	6.9	193	24		
2 g/kg Klozur CR A	0	10.6	180	16	699	1850
	1	10.6	86	16	1185	1745
	4	10.7	127	24	1185	1745
	24	10.7	-10	23	0	2000
	48	9.7	93	24	214	1954
	72	10.4	57	22	537	1885
2 g/kg Klozur CR B	72	9.9	129	24	699	1850
4 g/kg Klozur CR A	0	10.7	87	14	1994	3524
	1	10.7	41	18	4097	3021
	4	10.7	40	24	1994	3524
	24	11.1	-5	23	2641	3369
	48	10.9	170	24	1346	3679
	72	11.1	62	22	861	3795
4 g/kg Klozur CR B	72	11.0	81	22	1022	3756
6 g/kg Klozur CR A	0	11.2	90	16	2964	5288
	1	10.6	40	18	7020	4311
	4	11.1	156	24	2964	5288
	24	11.2	85	23	2641	5366
	48	11.1	170	24	1508	5638
	72	11.4	47	22	1508	5638
6 g/kg Klozur CR B	72	11.5	102	22	1022	5755

There was a rapid reaction of Klozur CR ® with the soil. The Initial (T=0 Hour) data points appear to be low based upon the 1 Hour results. The Klozur CR ® demand over the 72 hours increased from 1,868 mg/kg at the lowest loading (2 g/kg) to 3,776 mg/kg at the intermediate loading (4 g/kg) to 5,696 mg/kg at the highest loading (6 g/kg). The lowest loading of Klozur CR ® did not maintain the pH above the target of 10.5 for activation of the persulfate. The two higher loadings did maintain the pH in the proper range for activation of the persulfate. The ORP

was generally highest in the Unamended treatment followed by the high loading of Klozur CR®. The high pH of the Klozur CR ® treatments may have affected the ORP measurements.

2.4 Destruction Removal Efficiency Test Results

Table 4 shows the VOC, TICs, and hexavalent chromium concentrations in groundwater in the initial characterization samples, the Unamended, and 2 g/kg, 4 g/kg, and 6 g/kg Klozur CR ® Treatments at 72 Hours.

Benzene was reduced to 195 μg/L in the Unamended treatment. It is likely that the unamended treatment became oxygenated during the treatment setup allowing for aerobic biodegradation of the benzene. Benzene reductions were less extensive in the low 2 g/kg Klozur CR treatment (2,520 μg/L) and the 4 g/kg Klozur CR treatment (1,750 μg/L). The treatment with 6 g/kg Klozur CR showed the next best benzene removal to 386 μg/L. The oxygen generated from the calcium peroxide in the Klozur CR ® should support further biodegradation of benzene once the pH levels have dropped to more neutral conditions. The ethylbenzene and toluene were reduced to below detection limits in the Unamended and the two higher Klozur CR treatments, but not the 2 g/kg loading where ethylbenzene persisted. Acetone and 2-butanone were generated in all three Klozur CR ® treatments; production of oxidation byproducts like these ketones is commonly observed with persulfate or Klozur CR ® treatments. Thiopene (retention time 7.76 minutes) was reduced in the Unamended treatment and was not detected in any of the Klozur CR ® amended treatments although an unknown compound with a very similar retention time of 7.74 minutes was found in the 2 g/kg and 6 g/kg Klozur CR ® treatments at estimated concentrations of 10.4 and 2.28 μg/L. Indane, which has a retention time of 13.33 minutes, was found at a concentration of 103 μg/L in the Unamended treatment, 45.1 μg/L in the 2 g/kg Klozur CR ® treatment, and 12.9 μg/L in the 6 g/kg Klozur CR ® treatment. An unknown compound found at a similar retention time of 13.33 minutes was found at 210 μg/L in the Initial Characterization Sample and 4.2 μg/L in the 4 g/kg Klozur CR ® treatment. These results suggest destruction of the thiopene and indane by biodegradation and Klozur CR ®.

Hexavalent chromium was found at similar levels of 110 to 150 μg/L after 72 hours in all four treatments. Treatment with Klozur CR ® did not enhance the solubility of hexavalent chromium.

Table 4. DRE Groundwater VOC, TICs, and Hexavalent Chromium

VOCs Analyte	Units	T=0 Initial Characterization	Q	Unamended T=72 Hours	Q	2 g/kg Klozur CR ® T=72 Hours	Q	4 g/kg Klozur CR ® T=72 Hours	Q	6 g/kg Klozur CR ® T=72 Hours	Q
Benzene	µg/L	5840	D	195	D	2520	D	1750	D	386	D
Ethylbenzene	µg/L	3.86		<2.00		2.11		<2.00		<2.00	
Toluene	µg/L	3.15		<2.00		<2.00		<2.00		<2.00	
Unknown RT 1.66	µg/L	10.7	E	5.02	E						
Unknown RT 2.02	µg/L	9.62	E	4.12	E						
Unknown RT 4.02	µg/L	5.54	E								
Unknown RT 4.20	µg/L	3.92	E								
Unknown RT 7.74	µg/L					10.4	E			2.28	E
Thiopene RT 7.76	µg/L	89.9	E	30.9	E						
1,2,3-Trimethylbenzene	µg/L	2.8	E								
Indane RT 13.32	µg/L			103	E	45.1	E			12.9	E
Unknown RT 13.33	µg/L	210	E					4.2	E		
Acetone	µg/L					<50		81.7		125	
2-Butanone (MEK)	µg/L					6.52		12.9		17	
Hexavalent Chromium	µg/L	<20		150		150		110		120	

E = Compound detected, but at a concentration below the method quantification limit.
D = Sample diluted

Table 5 presents a summary of the total oxidant demand tests, incubation times, and final pHs. The lowest loading of 2 g/kg did not maintain the desired pH of greater than 10.5. The average TOD ranged from 1,868 mg/kg at the lower Klozur CR loading over 72 hours to 3,776 mg/kg at the intermediate 4 g/kg Klozur Cr loading to 5,696 mg/kg at the highest Klozur CR loading over 72 hours.

Table 5. Summary

Klozur CR ® Loading g/L	Time Hours	Final pH	TOD mg/kg
0	72	7.6	
0	72	6.9	
2	72	10.4	1,885
2	72	9.9	1,850
4	72	11.1	3,795
4	72	11.0	3,756
6	72	11.4	5,638
6	72	11.5	5,755

4.0 CONCLUSIONS

- The total oxidant demand for Klozur CR ® to treat the groundwater and soil ranged from 1,868 to 5,696 mg/kg in the 72 hour TOD test. On a cubic yard basis, assuming a soil density of 2,700 pounds per cubic yard and a porosity of 0.25, the Klozur CR ® demand varied between 5.1 and 15.4 pounds. The Klozur CR ® was able to maintain the aqueous pH above the target of 10.5 throughout the 72 hour test except at the lowest 2 g/kg loading.
- Aerobic biodegradation utilizing oxygen introduced during the setup of the control resulted in the highest benzene removals (96.7%). The efficiency test showed that 6 g/kg loading of Klozur CR ® resulted in greater removal of benzene (93.3%) in three days than observed in the lower Klozur CR® loadings. The high pH likely inhibited biodegradation in the Klozur CR ® treatments. In the subsurface, an oxygen source like the calcium peroxide would be required to convert the anaerobic aquifer to oxygenated conditions for aerobic polishing of any benzene remaining after the reaction with the sodium persulfate. The oxygen generated from decomposition of the calcium peroxide would support biodegradation once the pH became more neutral.
- Based upon the persistence of least 4.0 percent of the Klozur CR ® over the 3-day incubation period, more extensive removal of the benzene would likely occur with a longer incubation period or higher Klozur CR ® loadings.
- The Klozur CR ® oxidation process resulted in the increased production of acetone and 2-butanone.

- ISCO treatment with Klozur CR ® did not increase metals such as hexavalent chromium in the subsurface at the Buffalo, NY site over that seen in the treatment exposed to aerobic conditions alone.

Sincerely,
TERRA SYSTEMS, INC.

Michael D Lee, PhD.

Michael D. Lee, PhD.
Vice-President

Appendix D – Microbial Insights Bio-Trap Protocol

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Bio-Trap Sampler Protocol — Q-Potential (DNA) /DGGE (DNA)

Storage:

It is important to minimize the amount of time that Bio-Trap Samplers are stored prior to being installed in the field. The physical properties of the Bio-Trap Samplers that make them an ideal medium for collecting microbes also increase the chances of microbial or chemical contamination. Bio-Trap Samplers need to remain sealed and refrigerated (not frozen) until they can be installed in the field. If the Bio-Trap Samplers are stored for an extended time (more than two weeks), drying could occur, which may then require a longer incubation time in the well.

Note: Clean sterile gloves should be used at all times when handling Bio-Trap Samplers.

Installing Bio-Trap Samplers:

• Prior to installing the Bio-Trap Samplers, the monitoring well may need to be purged if it has not been sampled in a while. If purging is necessary, MI recommends that three well volumes be removed to ensure contact with formation water and reduce well bore effect.

• Remove the Bio-Trap Sampler from the zippered bag and attach the nylon attachment loop (provided) to a nylon line (not provided) and suspend the Bio-Trap Sampler at a depth where significant contaminant concentrations exist. If no data are available on the vertical distribution of contaminants, then suspend the Bio-Trap Sampler in the middle of the saturated screened interval for chlorinated hydrocarbons. For petroleum hydrocarbons, suspend the Bio-Trap Sampler about 1-1.5 ft below the top of the water table. If large fluctuations in the water level are anticipated during the period of incubation, the Bio-Trap Sampler should be suspended from a float (contact MI for further details).

• Once installed, incubation times can vary depending upon the scope of the project (routine monitoring and stable isotope probing (SIP); 30 days and "baited"; 60 days).

Removing Bio-Trap Samplers after incubation:

• Open the monitoring well and pull up the Bio-Trap Samplers. Cut and remove the braided nylon line used to suspend the Bio-Trap Samplers.

• Transfer the recovered Bio-Trap Samplers to labeled (well number and date) zippered bags, seal and then double bag in a larger (one-gallon) zippered bag, immediately place on blue ice in a cooler.

• Repeat the above for all Bio-Trap Samplers from the site. Individual zippered bags containing the Bio-Trap Samplers can be placed in the same one-gallon zippered bag (if there is enough space).

• A chain of custody (C0C) form must be included with each shipment of samples. Access ours at www.microbe.com/Chain_of_Custody.pdf

Shipment:

Bio-Trap Samplers need to be shipped on ice (or blue ice) for next day delivery (please call to confirm Saturday delivery). If regular ice is used, the ice should be double bagged.

Samples should be shipped to:

Sample Custodian
Microbial Insights, Inc.
2340 Stock Creek Blvd.
Rockford, TN 37853-3044
(865) 573-8188

Saturday Delivery:

Microbial Insights, Inc. is **not** open on weekends. Coolers to be delivered on **Saturday** can be collected by a representative of Microbial Insights, Inc. from their FedEx Drop Location. To ensure proper handling if Saturday delivery is required, the FedEx shipping label should be marked under (6) Special Handling, check **Hold Saturday**, and the cooler must be taped with FedEx SATURDAY tape. The cooler should then be addressed to our drop location (address below).

Microbial Insights, Inc.
FedEx Drop Location
1601 Murdock Road
Knoxville, TN 37932
(865) 300-8053 or
(865) 384-4005

Please note, it is essential that **our laboratory name** be on the address label and you **MUST** call Microbial Insights, Inc. on the Friday to arrange for collection of your shipment on Saturday, **with the Tracking # of the package**. **Without proper labeling and the tracking information, there is no guarantee that the samples will be collected.**

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Rockford TN 37853-3044
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Bio-Trap Sampler Protocol PLFA

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• Repeat the above for all Bio-Trap Samplers from the site. Individual zippered bags containing the Bio-Trap Samplers can be placed in the same one-gallon zippered bag (if there is enough space).

• A chain of custody (C0C) form must be included with each shipment of samples. Access ours at www.microbe.com/Chain_of_Custody.pdf

Shipment:

Bio-Trap Samplers need to be shipped on ice (or blue ice) for next day delivery (please call to confirm Saturday delivery). If regular ice is used, the ice should be double bagged.

Samples should be shipped to:

Sample Custodian
Microbial Insights, Inc.
2340 Stock Creek Blvd.
Rockford, TN 37853-3044
(865) 573-8188

Saturday Delivery:

Due to the short hold time associated with RNA it is not recommended to send samples for Q-Expression (RNA) for Saturday delivery.

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Bio-Trap Sampler Protocol Q-Expression (RNA)

Storage:

It is important to minimize the amount of time that Bio-Trap Samplers are stored prior to being installed in the field. The physical properties of the Bio-Trap Samplers that make them an ideal medium for collecting microbes also increase the chances of microbial or chemical contamination. Bio-Trap Samplers need to remain sealed and refrigerated (not frozen) until they can be installed in the field. If the Bio-Trap Samplers are stored for an extended time (more than two weeks), drying could occur, which may then require a longer incubation time in the well.

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• Once installed, incubation times can vary depending upon the scope of the project (routine monitoring and stable isotope probing (SIP); 30 days and “baited”; 60 days).

Removing Bio-Trap Samplers after incubation:

• Open the monitoring well and pull up the Bio-Trap Samplers. Cut and remove the braided nylon line used to suspend the Bio-Trap Samplers.

• In addition to collection of the Bio-Trap, at least 500mL of the groundwater needs to be collected in order to minimize any changes which could occurring during shipment.

• Transfer the recovered Bio-Trap Samplers to a labeled (well number and date) 500mL bottle containing groundwater, secure the lid and immediately place on blue ice in a cooler.

• Repeat the above for all Bio-Trap Samplers from the site.

• A chain of custody (C0C) form must be included with each shipment of samples. Access ours at www.microbe.com/Chain_of_Custody.pdf

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